# Section J
# Herbicide Damage and Information Guide

Australian Government
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*Cover image:*
**Wide-leaf bladder ketmia**
*Hibiscus trionum* var. *vesicarius*

# HERBICIDE DAMAGE IDENTIFICATION AND INFORMATION GUIDE

## Introduction

Finding herbicide damage in a cotton crop has been an unfortunate experience for far too many cotton growers over the years. Damage may be from residues in the soil from a herbicide applied to a previous crop, from residues in contaminated spraying equipment, from accidental application of an inappropriate herbicide, or from aerial drift from herbicide applied to a different crop. The source of the damage is not a consideration in this guide, as in most cases the damage is the same, regardless of the source.

Damage will always have some impact on the crop, but the nature of the impact is influenced by crop growth stage at the time of exposure, the type of herbicide (damage can be from a wide range of different herbicides), the intensity of exposure (amount of herbicide impacting the crop), the crop potential, and the seasonal conditions at, and following, exposure.

At best, crop damage may delay crop maturity and in favourable conditions may result in no crop yield loss, or even an increase in crop yield. At worst, the crop may never recover from the damage.

The intent of this guide is to give cotton growers information relating the impact of known concentrations of a herbicide on crop growth, exposed at a given crop growth stage, on crop growth and development and final yield. While every crop and every season is different, this information should provide some guidance as to the likely impact of herbicide exposure to a cotton crop.

The Herbicide Damage Guide is a work in progress and covers only a limited range of herbicides and exposure rates. This data base will be expanded over time.

Information can be sourced directly where the nature of the herbicide exposure is known via the Herbicide Damage Information, or indirectly, using the Herbicide Damage Identification Guide to identify the likely herbicide or herbicides that may have caused the damage.

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J2. Herbicide Symptoms Guide

J2.1. Contents Summary

J2.2. Detailed Contents

J3. Herbicide Damage Information

J3.1. Chlorsulfuron (Glean®) Group B

Cotton plants were exposed to chlorsulfuron at 50% and 10% of the recommended dose rate. The chlorsulfuron formulation used was Dupont™ Glean® cereal herbicide (chlorsulfuron 750 g a.i./kg), at 10 g/ha and 2 g/ha. Glean was applied preplanting and at 4, 9, 12 and 16 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

J3.1.1 2 g/ha chlorsulfuron pre-planting

J3.1.2 10 g/ha chlorsulfuron pre-planting

J3.1.3 2 g/ha chlorsulfuron at 4 nodes

J3.1.4 10 g/ha chlorsulfuron at 4 nodes

J3.1.5 2 g/ha chlorsulfuron at 9 nodes

J3.1.6 10 g/ha chlorsulfuron at 9 nodes

J3.1.7 2 g/ha chlorsulfuron at 12 nodes

J3.1.8 10 g/ha chlorsulfuron at 12 nodes

J3.1.9 2 g/ha chlorsulfuron at 16 nodes

J3.1.10 10 g/ha chlorsulfuron at 16 nodes

## J3.2. Iodosulfuron-methyl sodium plus mefenpyr diethyl (Hussar®)

**Group B**

Cotton plants were exposed to iodosulfuron-methyl sodium plus mefenpyr diethyl at 50% and 10% of the recommended dose rate. The formulation of iodosulfuron-methyl sodium plus mefenpyr diethyl used was Bayer CropScience Hussar® selective herbicide (iodosulfuron-methyl sodium 50 g a.i./kg plus mefenpyr diethyl 150 g a.i./kg), at 100 g/ha and 20 g/ha. Hussar was applied preplanting and at 5, 12, 15 and 18 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.2.1 20 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl pre-planting

### J3.2.2 100 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl pre-planting

### J3.2.3 20 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl at 5 nodes

### J3.2.4 100 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl at 5 nodes

### J3.2.5 20 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl at 12 nodes

### J3.2.6 100 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl at 12 nodes

### J3.2.7 20 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl at 15 nodes

### J3.2.8 100 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl at 15 nodes

### J3.2.9 20 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl at 18 nodes

### J3.2.10 100 g/ha Iodosulfuron-methyl sodium plus mefenpyr diethyl at 18 nodes

## J3.3. Imazamox (Raptor®)

**Group B**

## J3.4. Imazapic (Flame®) Group B

Cotton plants were exposed to imazapic at 50% and 10% of the recommended dose rate. The imazapic formulation used was Crop Care Flame® Herbicide (imazapic 240 g a.i./L), at 100 ml/ha and 20 ml/ha. Flame was applied preplanting and at 4, 9, 12 and 16 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.4.1 20 ml/ha imazapic pre-planting

### J3.4.2 100 ml/ha imazapic pre-planting

### J3.4.3 20 ml/ha imazapic at 4 nodes

### J3.4.4 100 ml/ha imazapic at 4 nodes

### J3.4.5 20 ml/ha imazapic at 9 nodes

### J3.4.6 100 ml/ha imazapic at 9 nodes

### J3.4.7 20 ml/ha imazapic at 12 nodes

### J3.4.8 100 ml/ha imazapic at 12 nodes

### J3.4.9 20 ml/ha imazapic at 16 nodes

### J3.4.10 100 ml/ha imazapic at 16 nodes

## J3.5. Imazapyr (Arsenal®) Group B

## J3.6. Imazamox plus imazapyr (Intervix®) Group B

Cotton plants were exposed to imazamox plus imazapyr at 50% and 10% of the recommended dose rate. The imazamox plus imazapyr formulation used was Crop Care Intervix® Herbicide for CLEARFIELD® crops (imazamox 33 g a.i./L plus imazapyr 15 g a.i./L both present as ammonium salts), at 375 ml/ha and 75 ml/ha. Intervix was applied preplanting and at 5, 12, 15 and 18 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.6.1 75 ml/ha imazamox plus imazapyr pre-planting

### J3.6.1 375 ml/ha imazamox plus imazapyr pre-planting

### J3.6.1 75 ml/ha imazamox plus imazapyr at 5 nodes

### J3.6.1 375 ml/ha imazamox plus imazapyr at 5 nodes

### J3.6.1 75 ml/ha imazamox plus imazapyr at 12 nodes

### J3.6.1 375 ml/ha imazamox plus imazapyr at 12 nodes

### J3.6.1 75 ml/ha imazamox plus imazapyr at 15 nodes

### J3.6.1 375 ml/ha imazamox plus imazapyr at 15 nodes

### J3.6.1 75 ml/ha imazamox plus imazapyr at 18 nodes

### J3.6.1 375 ml/ha imazamox plus imazapyr at 18 nodes

## J3.7. Imazapic plus imazapyr (Midas®) Group B

## J3.8. Imazethapyr (Spinnaker®) Group B

Cotton plants were exposed to imazethapyr at 50% and 10% of the recommended dose rate. The formulation of imazethapyr used was Nufarm Spinnaker® 700 WDG Herbicide (imazethapyr 700 g a.i./Kg), at 70 g/ha and 14 g/ha. Spinnaker was applied preplanting and at 5, 12, 15 and 18 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.8.1 14 g/ha imazethapyr pre-planting

### J3.8.2 70 g/ha imazethapyr pre-planting

### J3.8.3 14 g/ha imazethapyr at 5 nodes

### J3.8.4 70 g/ha imazethapyr at 5 nodes

### J3.8.5 14 g/ha imazethapyr at 12 nodes

### J3.8.6 70 g/ha imazethapyr at 12 nodes

### J3.8.7 14 g/ha imazethapyr at 15 nodes

### J3.8.8 70 g/ha imazethapyr at 15 nodes

### J3.8.9 14 g/ha imazethapyr at 18 nodes

### J3.8.10 70 g/ha imazethapyr at 18 nodes

## J3.9. Metsulfuron (Ally®) Group B

Cotton plants were exposed to metsulfuron-methyl at 50% and 10% of the recommended dose rate. The metsulfuron-methyl formulation used was Dupont™ Ally® herbicide (metsulfuron-methyl 600 g a.i./kg), at 3.5 g/ha and 0.7 g/ha. Ally was applied preplanting and at 4, 9, 12 and 16 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.9.1 0.7 g/ha metsulfuron-methyl pre-planting

### J3.9.2 3.5 g/ha metsulfuron-methyl pre-planting

### J3.9.3 0.7 g/ha metsulfuron-methyl at 4 nodes

### J3.9.4 3.5 g/ha metsulfuron-methyl at 4 nodes

### J3.9.5 0.7 g/ha metsulfuron-methyl at 9 nodes

### J3.9.6 3.5 g/ha metsulfuron-methyl at 9 nodes

### J3.9.7 0.7 g/ha metsulfuron-methyl at 12 nodes

### J3.9.8 3.5 g/ha metsulfuron-methyl at 12 nodes

### J3.9.9 0.7 g/ha metsulfuron-methyl at 16 nodes

### J3.9.10 3.5 g/ha metsulfuron-methyl at 16 nodes

## J3.10. Tribenuron-methyl (Express®) Group B

## J3.11. Atrazine Group C

Cotton plants were exposed to atrazine at 50% and 10% of the recommended dose rate. The atrazine formulation used was Gesaprim® Granules 900 WG Herbicide (atrazine 900 g a.i./kg), a Syngenta product, at 1.1 kg/ha and 220 g/ha. Gesaprim 900 WG was applied preplanting and at 5, 10 and 17 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.11.1 200 g/ha atrazine pre-planting

### J3.11.2 1 kg/ha atrazine pre-planting

### J3.11.3 200 g/ha atrazine at 5 nodes

### J3.11.4 1 kg/ha atrazine at 5 nodes

### J3.11.5 200 g/ha atrazine at 10 nodes

### J3.11.6 1 kg/ha atrazine at 10 nodes

### J3.11.7 200 g/ha atrazine at 17 nodes

### J3.11.8 1 kg/ha atrazine at 17 nodes

## J3.12. Bromoxynil Group C

Cotton plants were exposed to Bromoxynil at 50% and 10% of a typical field dose rate. The bromoxynil formulation used was Bromicide® 200 (bromoxynil 200 g a.i./L, present as the n-octanoyl ester), a Nufarm product, at 750 ml/ha and 150 ml/ha. Bromicide 200 was applied at 6, 11 and 15 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.12.1 150 ml/ha dicamba at 6 nodes

### J3.12.2 750 ml/ha dicamba at 6 nodes

### J3.12.3 150 ml/ha dicamba at 11 nodes

### J3.12.4 750 ml/ha dicamba at 11 nodes

### J3.12.5 150 ml/ha dicamba at 15 nodes

### J3.12.6 750 ml/ha dicamba at 15 nodes

## J3.13. Simazine Group C

Cotton plants were exposed to simazine at 50% and 10% of the recommended dose rate. The simazine formulation used was Simazine 900DF herbicide (simazine 900 g a.i./kg), a Nufarm product, at 1.65 kg/ha and 330 g/ha. Simazine 900DF was applied preplanting and at 5, 10 and 17 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.13.1 330 g/ha simazine pre-planting

### J3.13.2 1.65 kg/ha simazine pre-planting

### J3.13.3 330 g/ha simazine at 5 nodes

### J3.13.4 1.65 kg/ha simazine at 5 nodes

### J3.13.5 330 g/ha simazine at 10 nodes

### J3.13.6 1.65 kg/ha simazine at 10 nodes

### J3.13.7 330 g/ha simazine at 17 nodes

### J3.13.8 1.65 kg/ha simazine at 17 nodes

## J3.14. Isoxaflutole (Balance®) Group F

Cotton plants were exposed to isoxaflutole at 50% and 10% of the recommended dose rate. The isoxaflutole formulation used was Balance® 750 WG Herbicide (isoxaflutole 750 g a.i./kg), a Bayer Crop Science product, at 50 g/ha and 10 g/ha. Balance was applied preplanting and at 4, 9, 12 and 16 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.14.1 10 g/ha isoxaflutole pre-planting

### J3.14.2 50 g/ha isoxaflutole pre-planting

### J3.14.3 10 g/ha isoxaflutole at 4 nodes

### J3.14.4 50 g/ha isoxaflutole at 4 nodes

### J3.14.5 10 g/ha isoxaflutole at 9 nodes

### J3.14.6 50 g/ha isoxaflutole at 9 nodes

### J3.14.7 10 g/ha isoxaflutole at 12 nodes

### J3.14.8 50 g/ha isoxaflutole at 12 nodes

### J3.14.9 10 g/ha isoxaflutole at 16 nodes

### J3.14.10 50 g/ha isoxaflutole at 16 nodes

## J3.15. Flumioxazin (Valor®) Group G

## J3.16. 2,4-D Group I

Cotton plants were exposed to 2,4-D amine at 10% and 1% of a typical field dose rate. The 2,4-D formulation used was Baton® (2,4-D amine 800 g a.i./kg, present as the dimethylamine salt), a Nufarm product, at 100 g/ha and 10 g/ha. Baton was applied at 6, 8, 12 and 16 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.16.1 8 g/ha 2,4-D at 6 nodes

### J3.16.2 80 g/ha 2,4-D at 6 nodes

### J3.16.3 8 g/ha 2,4-D at 8 nodes

### J3.16.4 80 g/ha 2,4-D at 8 nodes

### J3.16.5 8 g/ha 2,4-D at 12 nodes

### J3.16.6 80 g/ha 2,4-D at 12 nodes

### J3.16.7 8 g/ha 2,4-D at 16 nodes

### J3.16.8 80 g/ha 2,4-D at 16 nodes

## J3.17. Clopyralid (Lontrel®) Group I

Cotton plants were exposed to clopyralid at 50% and 10% of a typical field dose rate. The clopyralid formulation used was Lontrel® Herbicide (clopyralid 300 g a.i./L, present as the triisopropanolamine salt), a Dow AgroSciences product, at 60 ml/ha and 12 ml/ha. Lontrel was applied pre-planting and at 5, 12, 15 and 18 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.17.1 12 g/ha clopyralid pre-planting

### J3.17.2 60 g/ha clopyralid pre-planting

### J3.17.3 12 g/ha clopyralid at 5 nodes

### J3.17.4 60 g/ha clopyralid at 5 nodes

### J3.17.5 12 g/ha clopyralid at 12 nodes

### J3.17.6 60 g/ha clopyralid at 12 nodes

### J3.17.7 12 g/ha clopyralid at 15 nodes

### J3.17.8 60 g/ha clopyralid at 15 nodes

### J3.17.9 12 g/ha clopyralid at 18 nodes

### J3.17.10 60 g/ha clopyralid at 18 nodes

## J3.18. Dicamba — Group I

Cotton plants were exposed to dicamba at 50% and 10% of a typical field dose rate. The dicamba formulation used was Kamba® 500 (dicamba 500 g a.i./L, present as the dimethylamine salt), a Nufarm product, at 280 ml/ha and 56 ml/ha. Kamba 500 was applied at 6, 11 and 15 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.18.1 28 g/ha dicamba at 6 nodes

### J3.18.2 140 g/ha dicamba at 6 nodes

### J3.18.3 28 g/ha dicamba at 11 nodes

### J3.18.4 140 g/ha dicamba at 11 nodes

### J3.18.5 28 g/ha dicamba at 15 nodes

### J3.18.6 140 g/ha dicamba at 15 nodes

## J3.19. Fluroxypyr (Starane®) — Group I

Cotton plants were exposed to fluroxypyr at 60% and 12% of a typical field dose rate. The fluroxypyr formulation used was Starane® 200 herbicide (fluroxypyr 200 g a.i./L, present as the methylheptyl ester), a Dow AgroSciences product, at 900 ml/ha and 180 ml/ha. Starane® 200 was applied at 6, 11 and 15 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.19.1 36 g/ha fluroxypyr at 6 nodes

### J3.19.2 180 g/ha fluroxypyr at 6 nodes

### J3.19.3 36 g/ha fluroxypyr at 11 nodes

### J3.19.4 180 g/ha fluroxypyr at 11 nodes

### J3.19.5 36 g/ha fluroxypyr at 15 nodes

### J3.19.6 180 g/ha fluroxypyr at 15 nodes

## J3.20. MCPA — Group I

Cotton plants were exposed to MCPA at 50% and 10% of a typical field dose rate. The MCPA formulation used was MCPA 500 (MCPA 500 g a.i./L, present as the dimethylamine salt), a Nufarm product, at 1.05 L/ha and 210 ml/ha. MCPA 500 was applied at 6, 11 and 15 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.20.1 105 g/ha MCPA at 6 nodes

### J3.20.2 525 g/ha MCPA at 6 nodes

### J3.20.3 105 g/ha MCPA at 11 nodes

### J3.20.4 525 g/ha MCPA at 11 nodes

### J3.20.5 105 g/ha MCPA at 15 nodes

### J3.20.6 525 g/ha MCPA at 15 nodes

## J3.21. Triclopyr (Garlon®) — Group I

## J3.22. 2,4-D plus picloram (Tordon® 75D) Group I

Cotton plants were exposed to a combination of 2,4-D and picloram. The combination was applied at 50% and 10% of a typical field dose rate. The formulation used was Tordon® 75D Herbicide (2,4-D 300 g a.i./L, present as the triisopropanolamine salt plus picloram 75 g a.i./L present as the triisopropanolamine salt), a Dow AgroSciences product, at 500 ml/ha and 100 ml/ha. Tordon 75D was applied preplanting and at 5, 10 and 17 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.22.1 30 g + 7.5 g/ha 2,4-D + picloram pre-planting

### J3.22.2 150 g + 37.5 g/ha 2,4-D + picloram pre-planting

### J3.22.3 30 g + 7.5 g/ha 2,4-D + picloram at 5 nodes

### J3.22.4 150 g + 37.5 g/ha 2,4-D + picloram at 5 nodes

### J3.22.5 30 g + 7.5 g/ha 2,4-D + picloram at 10 nodes

### J3.22.6 150 g + 37.5 g/ha 2,4-D + picloram at 10 nodes

### J3.22.7 30 g + 7.5 g/ha 2,4-D + picloram at 17 nodes

### J3.22.8 150 g + 37.5 g/ha 2,4-D + picloram at 17 nodes

## J3.23. Aminopyralid plus fluroxypyr (Hotshot®) Group I

## J3.24. MCPA plus picloram (Tordon® 242) Group I

Cotton plants were exposed to a combination of MCPA and picloram. The combination was applied at 50% and 10% of a typical field dose rate. The formulation used was Tordon® 242 Cereal Herbicide (MCPA 420 g a.i./L, present as the potassium salt plus picloram 26 g a.i./L present as the potassium salt), a Dow AgroSciences product, at 500 ml/ha and 100 ml/ha. Tordon 242 was applied preplanting and at 5, 10 and 17 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.24.1 42 g + 2.6 g/ha MCPA + picloram pre-planting

### J3.24.2 210 g + 13 g/ha MCPA + picloram pre-planting

### J3.24.3 42 g + 2.6 g/ha MCPA + picloram at 5 nodes

### J3.24.4 210 g + 13 g/ha MCPA + picloram at 5 nodes

### J3.24.5 42 g + 2.6 g/ha MCPA + picloram at 10 nodes

### J3.24.6 210 g + 13 g/ha MCPA + picloram at 10 nodes

### J3.24.7 42 g + 2.6 g/ha MCPA + picloram at 17 nodes

### J3.24.8 210 g + 13 g/ha MCPA + picloram at 17 nodes

## J3.25. Picloram Group I

## J3.26. Triclopyr plus picloram (Grazon® DS) Group I

Cotton plants were exposed to a combination of triclopyr and picloram. The combination was applied at 50% and 10% of a typical field dose rate. The formulation used was Grazon® DS Herbicide (triclopyr 300 g a.i./L plus picloram 100 g a.i./L), a Dow AgroSciences product, at 250 ml/ha and 50 ml/ha. Grazon DS was applied preplanting and at 5, 10 and 17 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

**J3.26.1 15 g + 5 g/ha triclopyr + picloram pre-planting**

**J3.26.2 75 g + 25 g/ha triclopyr + picloram pre-planting**

**J3.26.3 15 g + 5 g/ha triclopyr + picloram at 5 nodes**

**J3.26.4 75 g + 25 g/ha triclopyr + picloram at 5 nodes**

**J3.26.5 15 g + 5 g/ha triclopyr + picloram at 10 nodes**

**J3.26.6 75 g + 25 g/ha triclopyr + picloram at 10 nodes**

**J3.26.7 15 g + 5 g/ha triclopyr + picloram at 17 nodes**

**J3.26.8 75 g + 25 g/ha triclopyr + picloram at 17 nodes**

## J3.27. 2,4-D plus glyphosate Groups I & M

Cotton plants were exposed to a combination of glyphosate and 2,4-D amine. The glyphosate was applied at 17% and 3% of the field dose rate commonly used in Roundup Ready Flex® cotton, and the 2,4-D was applied at 10% and 1% of a typical field dose rate. The glyphosate formulation used was Roundup Ready Herbicide® (glyphosate 690 g a.i./kg, present as the mono-ammonium salt), a Monsanto product, at 250 g/ha and 50 g/ha. The 2,4-D formulation used was Baton® (2,4-D amine 800 g a.i./L, present as the dimethylamine salt), a Nufarm product, at 100 ml/ha and 10 ml/ha. The combinations were applied at 6, 8, 12 and 16 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

**J3.27.1 35 g + 8 g 2,4-D/ha + glyphosate at 6 nodes**

**J3.27.2 173 g + 80 g/ha 2,4-D + glyphosate at 6 nodes**

**J3.27.3 35 g + 8 g/ha 2,4-D + glyphosate at 8 nodes**

**J3.27.4 173 g + 80 g/ha 2,4-D + glyphosate at 8 nodes**

**J3.27.5 35 g + 8 g/ha 2,4-D + glyphosate at 12 nodes**

**J3.27.6 173 g + 80 g/ha 2,4-D + glyphosate at 12 nodes**

**J3.27.7 35 g + 8 g/ha 2,4-D + glyphosate at 16 nodes**

**J3.27.8 173 g + 80 g/ha 2,4-D + glyphosate at 16 nodes**

## J3.28. Pyroxasulfone (Sakura®) Group K

## J3.29. Paraquat plus diquat (Spray.Seed®) Group L

Cotton plants were exposed to the combination of paraquat plus diquat at 50% and 10% of a typical field dose rate. The paraquat plus diquat formulation used was Spray.Seed® 250 (paraquat 135 g a.i./L, present as paraquat dichloride, plus diquat 115 g a.i./L, present as diquat dibromide), a Syngenta product, at 1.6 L/ha and 320 ml/ha. Spray.Seed was applied at 6, 11 and 15 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.29.1 43 g + 37 g/ha paraquat + diquat at 6 nodes

### J3.29.2 216 g + 184 g/ha paraquat + diquat at 6 nodes

### J3.29.3 43 g + 37 g/ha paraquat + diquat at 11 nodes

### J3.29.4 216 g + 184 g/ha paraquat + diquat at 11 nodes

### J3.29.5 43 g + 37 g/ha paraquat + diquat at 15 nodes

### J3.29.6 216 g + 184 g/ha paraquat + diquat at 15 nodes

## J3.30. Amitrole plus paraquat (Alliance®) Groups L & Q

## J3.31. Glyphosate Group M

Cotton plants were exposed to glyphosate at 17% and 3% of the field dose commonly used in cotton. The glyphosate formulation used was Roundup Ready Herbicide® (glyphosate 690 g a.i./kg, present as the mono-ammonium salt), a Monsanto product, at 250 g/ha and 50 g/ha. Roundup Ready Herbicide was applied at 6, 8, 12 and 16 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.31.1 35 g/ha glyphosate at 6 nodes

### J3.31.2 173 g/ha glyphosate at 6 nodes

### J3.31.3 35 g/ha glyphosate at 8 nodes

### J3.31.4 173 g/ha glyphosate at 8 nodes

### J3.31.5 35 g/ha glyphosate at 12 nodes

### J3.31.6 173 g/ha glyphosate at 12 nodes

### J3.31.7 35 g/ha glyphosate at 16 nodes

### J3.31.8 173 g/ha glyphosate at 16 nodes

## J3.32. Glufosinate (Liberty®) Group N

Cotton plants were exposed to glufosinate at 50% and 10% of the recommended dose rate for use in Liberty Link® cotton. The glufosinate formulation used was Liberty® 200 (glufosinate-ammonium 200 g a.i./L), a Bayer CropScience product, at 1.875 L/ha and 375 ml/ha. Liberty 200 was applied at 6, 11 and 15 nodes of cotton growth, broadcast over the crop in 100 L water/ha. All data were compared to an untreated control.

### J3.32.1 75 g/ha glufosinate at 6 nodes

### J3.32.2 375 g/ha glufosinate at 6 nodes

### J3.32.3 75 g/ha glufosinate at 11 nodes

### J3.32.4 375 g/ha glufosinate at 11 nodes

### J3.32.5 75 g/ha glufosinate at 15 nodes

### J3.32.6 375 g/ha glufosinate at 15 nodes

## J3.33. Amitrole plus ammonium thiocynate (Amitrole T®) Group Q

# HERBICIDE DAMAGE SYMPTOMS GUIDE

**Graham Charles**
**(NSW Dept of Primary Industries)**

## Introduction

This guide shows some of the more typical damage symptoms seen in Australian cotton from exposure to a range of herbicides. Images were obtained from experiments where known rates of herbicide were applied to irrigated cotton at specific growth stages. The symptoms of herbicide damage displayed by cotton plants are affected by the type of herbicide, the herbicide rate, the crop growth stage, and environmental factors such as soil moisture, temperature and humidity. Under different conditions, crops may not display the symptoms of damage indicated in these photos.

## Herbicide Damage Symptoms

## Phenoxy Herbicides

A range of herbicides, collectively known as the phenoxy herbicides and synthetic auxins, affect the plant in a manner similar to endogenous auxin (IAA), a natural plant growth hormone. At low rates they can distort plant growth. At higher concentrations they affect cell walls and nucleic acid metabolism and inhibit cell division and growth, leading to plant death. They are effective in controlling a wide range of broad-leaf weeds, but can be very damaging to cotton, even at very low rates.

### 2,4-D – (symptoms from plants exposed to 8 g a.i./ha at 12 nodes)

Group I – Synthetic Auxin

15 days after exposure

28 days after exposure

### Clopyralid – (symptoms from plants exposed to 45 g a.i./ha at 12 nodes)

Group I – Synthetic Auxin

14 days after exposure

20 days after exposure

**Dicamba** – (symptoms from plants exposed to 28 g a.i./ha at 11 nodes) Group I – Synthetic Auxin

6 days after exposure

28 days after exposure

**Fluroxypyr** – (symptoms from plants exposed to 36 g a.i./ha at 11 nodes) Group I – Synthetic Auxin

6 days after exposure

28 days after exposure

**MCPA** – (symptoms from plants exposed to 105 g a.i./ha at 11 nodes) Group I – Synthetic Auxin

6 days after exposure

28 days after exposure

**2,4-D plus picloram** – (plants exposed to 30 + 7.5 g a.i./ha at 8 nodes) Group I – Synthetic Auxin

7 days after exposure

28 days after exposure

## Glyphosate & 2,4-D – (plants exposed to 35 + 8 g a.i./ha at 12 nodes) Groups M & I – Syn Auxin

15 days after exposure

28 days after exposure

## MCPA plus picloram – (plants exposed to 42 + 2.6 g a.i./ha at 8 nodes) Group I – Synthetic Auxin

9 days after exposure

28 days after exposure

## Triclopyr plus picloram – (plants exposed to 15 + 0.5 g a.i./ha at 8 nodes) Group Is – Syn Auxin

7 days after exposure

37 days after exposure

## Other Herbicides - Bleachers

A wide range of herbicides other than the phenoxys are commonly used in agriculture and can cause mild to severe damage to cotton. Damaged plants can display a wide range of symptoms, but as with the phenoxys, some symptoms may be fairly general, over a number of herbicides. An example is the Group C herbicides, which disrupt photosynthesis and at lower rates cause leaf bleaching. At higher rates, they can cause necrosis and leaf death.

**Atrazine** – (symptoms from plants exposed to 200 g a.i./ha at 8 nodes) Group C - Bleacher

15 days after exposure

28 days after exposure

**Bromoxynil** – (symptoms from plants exposed to 30 g a.i./ha at 11 nodes) Group C - Bleacher

6 days after exposure

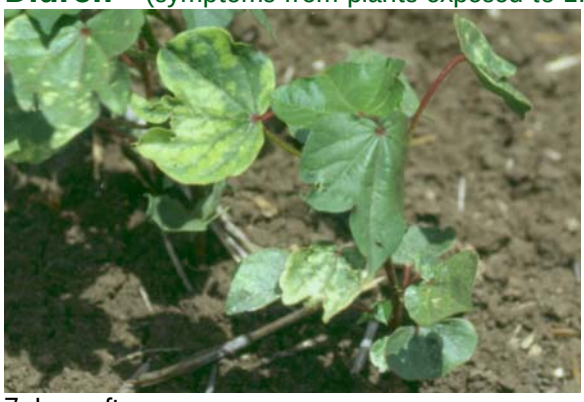
16 days after exposure

**Cyanazine** – (symptoms from plants exposed to 1.3 kg a.i./ha at 5 nodes) Group C - Bleacher

7 days after exposure

7 days after exposure

**Diuron** – (symptoms from plants exposed to 1.8 kg a.i./ha at 5 nodes) Group C - Bleacher



7 days after exposure

7 days after exposure

**Fluometuron** – (symptoms from plants exposed to 1 kg a.i./ha pre-planting) Group C - Bleacher

**Prometryn** – (plants exposed to 2.3 kg a.i./ha at 5 nodes and 15 nodes) Group C - Bleacher

7 days after exposure

**Simazine** – (symptoms from plants exposed to 1.5 kg a.i./ha at 8 nodes) Group C - Bleacher

15 days after exposure

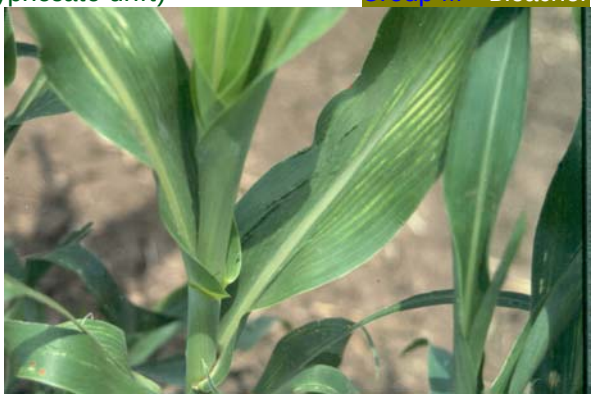
28 days after exposure

**Isoxaflutole** – (symptoms from plants exposed to 37.5 g a.i./ha at 9 nodes) Group F - Bleacher

7 days after exposure

23 days after exposure

**Glyphosate** – (symptoms from plants exposed to glyphosate drift) Group M - Bleacher



**Glyphosate** – (plants exposed to 35 g a.i./ha at 12 nodes) Group M - Minimal symptoms

6 days after exposure

28 days after exposure

## Other Herbicides - yellowers

The Group B herbicides disrupt amino acid synthesis, affecting protein biosynthesis. Many of the Group B herbicides are effective at very low rates for the control of broadleaf and some grass weeds and are often used post-emergence in cereal crops. They can have a long plant-back to cotton, especially on alkaline soils. The symptoms of Group B damage can include bright yellowing of the growing tips.

### **Chlorsulfuron** – (symptoms from plants exposed to 7.5 g a.i./ha at 4 nodes) Group B - Yellower

19 days after exposure

25 days after exposure

### **Iodosulfuron-methyl sodium plus mefenpyr diethyl**

(symptoms from plants exposed to 5 + 15 g a.i./ha at 12 nodes) Group B - Yellower

14 days after exposure

28 days after exposure

### **Imazapic** – (symptoms from plants exposed to 24 g a.i./ha at 4 nodes) Group B - Yellower

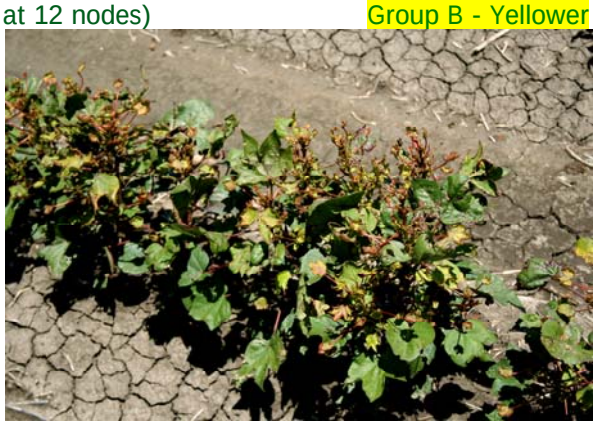
14 days after exposure

27 days after exposure

## Imazamox plus imazapyr

(symptoms from plants exposed to 12.4 + 5.6 g a.i./ha at 12 nodes) Group B - Yellower

14 days after exposure

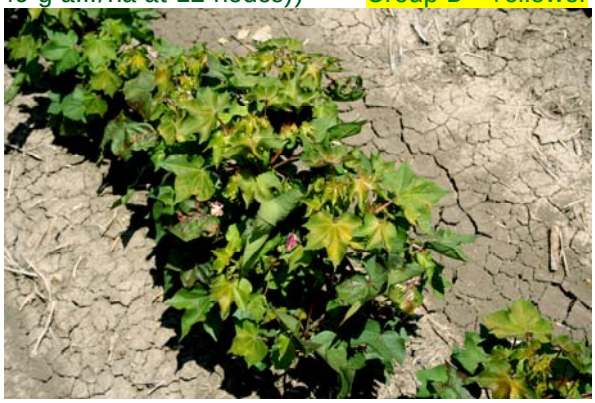


33 days after exposure

## Imazapyr – (symptoms from seedlings exposed to soil residues) Group B - Yellower

## Imazethapyr – (symptoms from plants exposed to 49 g a.i./ha at 12 nodes)) Group B - Yellower

14 days after exposure



20 days after exposure

## Metsulfuron – (symptoms from plants exposed to 2.1 g a.i./ha at 4 nodes) Group B - Yellower

14 days after exposure

27 days after exposure

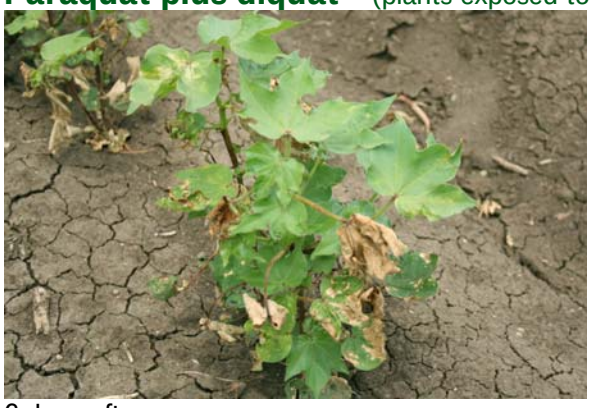
## Other Herbicides that may Damage Cotton

**Glufosinate** – (symptoms from plants exposed to 75 g a.i./ha at 11 nodes) Group N - Desiccant

6 days after exposure

16 days after exposure

**Paraquat plus diquat** – (plants exposed to 43 + 37 g a.i./ha at 11 nodes) Group L - Desiccants



6 days after exposure

16 days after exposure

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **1.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years, depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 9 days after crop emergence.

Initial symptoms of chlorsulfuron damage were apparent soon after seedlings emerged with slight yellowing and leaching of the outer edges of the cotyledons.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha and incorporated prior to planting cotton. Photo taken on 12th Nov, 17 days after crop emergence.

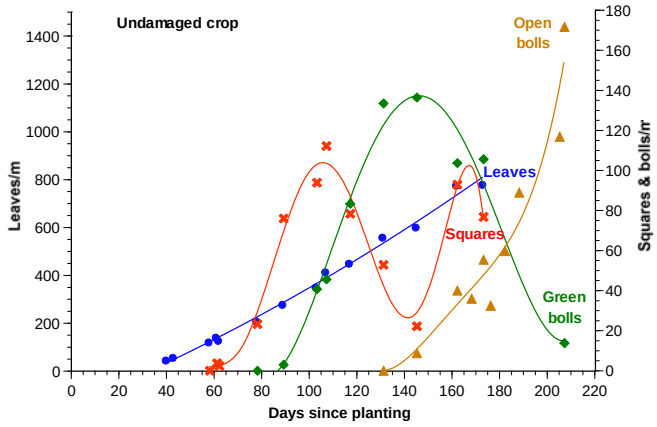
Symptoms of chlorsulfuron damage were clearly visible on some cotyledons 17 days after emergence with inter-vienal yellowing and bleaching and some necrosis. Some seedlings had few or no symptoms. However, all seedlings appeared to develop normally following this initial damage, with no signs of damage on the newly emerged true leaves.

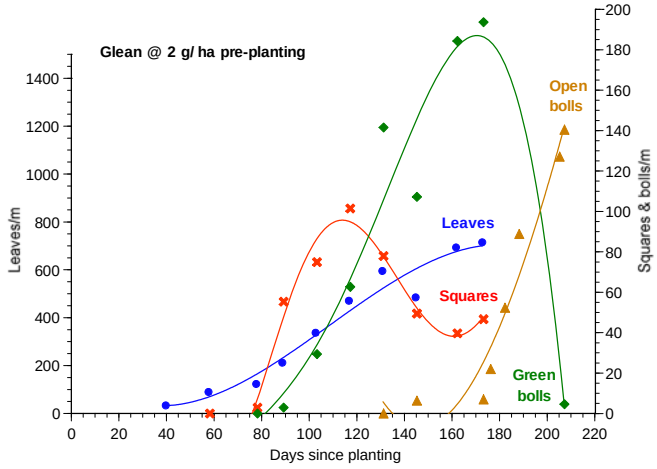
Glean® (chlorsulfuron) applied broadcast at 2 g/ha and incorporated prior to planting cotton. Photo taken on 23rd Nov, 28 days after crop emergence.

Few symptoms of chlorsulfuron damage remain 28 days after emergence, except for the initial damage on the cotyledons. Seedlings appear to be growing normally.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha and incorporated prior to planting cotton. Photo taken on 9th Dec, 44 days after crop emergence.

No symptoms of chlorsulfuron damage remained 44 days after emergence.




## Impact on plant growth

**Plants:** exposure to the lighter rate of residual chlorsulfuron caused some damage to the cotyledons, but had few other apparent affects on the plant's subsequent growth or development, although there was a 13% reduction in the plant stand.

**Leaves:** the herbicide caused some damage to the cotyledon leaves of many emerging seedlings. Plants had 8% fewer leaves at the final observation, but there was no reduction in leaf area.

**Squares**: there was a 15 day delay in the start of square production.

**Bolls:** initial boll development and retention appeared to be unaffected by the herbicide damage, but there was a 30 days delay in the start of boll opening compared to undamaged plants. Some bolls appeared to be lost later in the season, with 18% fewer open bolls retained at picking. There was no delay in average crop maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **chlorsulfuron 10% pre-plant** |
| **Nodes/plant** | 26.9 | 26.4 |
| **Leaves/m*** | 775 | 712 |
| **Leaf area (cm²/m)*** | 30138 | 29533 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 145 |
| **Boll weight (g/open boll)** | 4.2 | 4.3 |
| **Retention posit's 1-3^** | 91% | 96% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 – 20 |
| **Days to 50% open** | 193 | 186 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 97% |
| **Lint yield (kg/ha)** | 2099 | 2101 |


## Summary

Exposure to 10% of a typical field rate of residual chlorsulfuron caused some cotyledon damage but appeared to have few other affects on the plants. There was a reduction in the plant stand, a delay in squaring, a delay in the start of boll opening and a reduction in the number of bolls open at picking.

However, there was no delay in average crop maturity, or reduction in fibre quality or lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years, depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 9 days after crop emergence.

Initial symptoms of chlorsulfuron damage were apparent soon after seedlings emerged with noticeable yellowing and bleaching of the cotyledons.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha and incorporated prior to planting cotton. Photo taken on 12th Nov, 17 days after crop emergence.

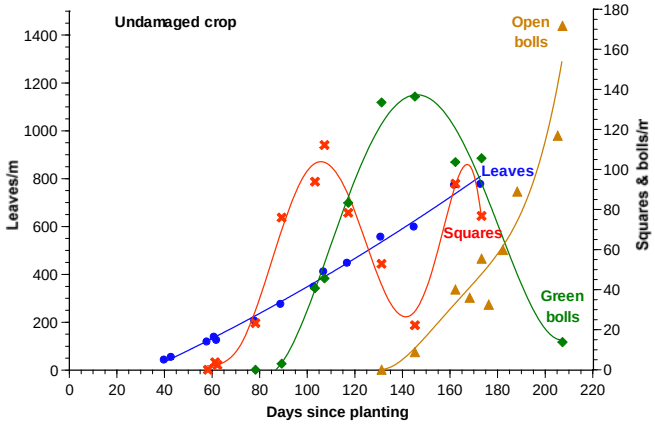
Symptoms of chlorsulfuron damage were clearly visible on the cotyledons 17 days after emergence with inter-vienal bleaching and some necrosis. However, the seedlings appeared to develop normally, with no signs of damage on the newly emerged true leaves.

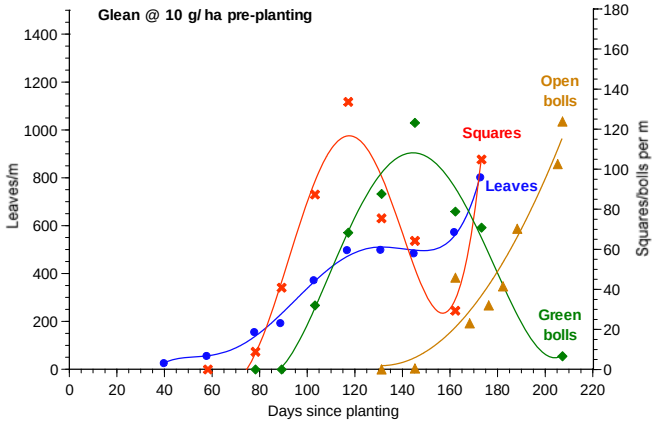
Glean® (chlorsulfuron) applied broadcast at 10 g/ha and incorporated prior to planting cotton. Photo taken on 23rd Nov, 28 days after crop emergence.

Few symptoms of chlorsulfuron damage remain 28 days after emergence, except for the initial damage on the cotyledons. Seedlings appear to be growing normally.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha and incorporated prior to planting cotton. Photo taken on 9th Dec, 44 days after crop emergence.

No symptoms of chlorsulfuron damage were apparent 44 days after emergence.




## Impact on plant growth

**Plants**: exposure to residual chlorsulfuron damaged the cotyledons but didn't reduce plant height, nodes or weight. The plant stand was reduced by 14%, with 25% more plants tipped-out.

**Leaves:** the herbicide caused extensive damage to the cotyledon leaves of most emerging seedlings, but had no other apparent affect on the plant's subsequent growth or development. There was no reduction in the final leaf number or area.

**Squares**: there was 15 day delay in the start of square production but no reduction in peak squaring or the duration of squaring.

**Bolls:** the herbicide exposure appeared to have minimal effect on boll production and retention, although some bolls were lost later in the season, with 28% fewer open bolls retained at picking. There was no impact on boll weight or boll maturity.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but the cotton fell below base grade with 10.5% short fibres and lint yield was reduced by 26%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **chlorsulfuron 50% pre-plant** |
| **Nodes/plant** | 26.9 | 26.6 |
| **Leaves/m*** | 775 | 799 |
| **Leaf area (cm²/m)*** | 30138 | 32011 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 130 |
| **Boll weight (g/open boll)** | 4.2 | 4.1 |
| **Retention posit's 1-3^** | 91% | 89% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 - 21 |
| **Days to 50% open** | 193 | 193 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 95% |
| **Lint yield (kg/ha)** | 2099 | 1549 |


### Summary

Exposure to 50% of a typical field rate of residual chlorsulfuron caused extensive cotyledon damage, tipping-out and some seedling mortality but most plants appeared to recover quickly from the damage.

Square and boll production and retention were largely unaffected, although plants retained fewer open bolls at picking. There was no affect on average crop maturity, but fibre quality was reduced and lint yield was down by 26%.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **1.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **25th Nov** (4 weeks post-emergence) |
| **Growth stage at exposure:** | **4 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years, depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 4 node cotton. Photo taken on 9th Dec, 14 days after exposure.

Symptoms of chlorsulfuron damage were apparent soon after exposure with inter-vienal yellowing and leaching of the exposed leaves and reddening of the petioles. Some had necrotic spots and patches. Some newly emerged leaves were yellow, cupped and with bright red petioles, veins and leaf margins.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 4 node cotton. Photo taken on 14th Dec, 19 days after exposure.

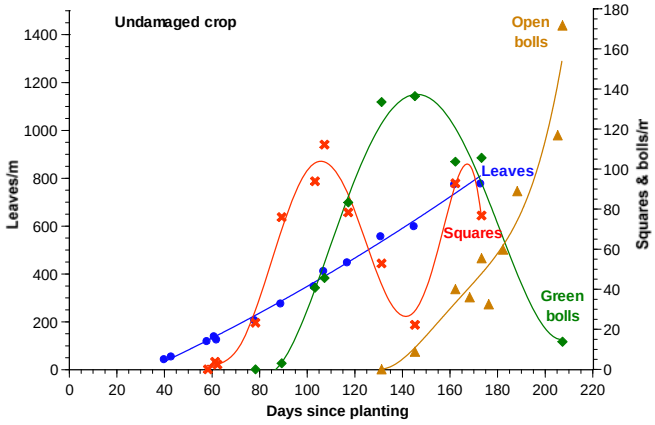
Plants showed a marked contrast 19 days after exposure, with bright green (normal) cotyledons and lower leaves, and bright yellow, cupped and stunted new leaves with areas of reddening.

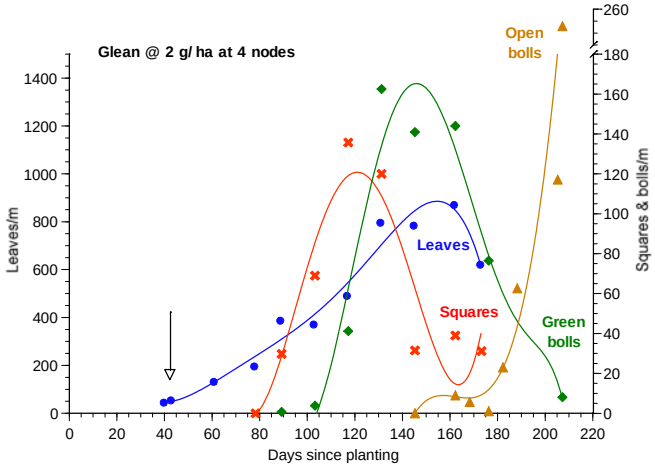
Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 4 node cotton. Photo taken on 22nd Dec, 27 days after exposure.

Plants grew rapidly in the warm conditions of early summer, but many plants continued to show strong symptoms of chlorsulfuron damage. Damage symptoms included leaf yellowing and some reddening, vienal yellowing with some red streaks radiating from the centre, shortened internodes and leaf distortion, tending towards an okra type leaf shape.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 4 node cotton. Photo taken on 7th Jan, 43 days after exposure.

No symptoms of chlorsulfuron damage remained 43 days after exposure except some shortening of the internodes.




## Impact on plant growth

**Plants**: exposed to the lighter rate of chlorsulfuron at 4 nodes showed strong damage symptoms for 35 days after exposure. Plants compensated for this damage later in the season and developed normally, but many were tipped-out, plants were 6 cm shorter and 25% smaller by weight at the final observation.

**Leaves:** the herbicide caused extensive crop damage, with leaf discolouration, cupping and stunting and reduced internode lengths. Plants had 20% fewer leaves and 16% less leaf area at the final observation.

**Squares**: there was a 20 day delay in the start of square production but no reduction in peak squaring.

**Bolls:** boll retention was delayed by around 15 days, although peak boll retention appeared to be unaffected. Plants shed some early bolls, with 18% fewer bolls retained in positions 1 – 3, but set a heavy late crop, with 47% more open bolls at picking. Boll weight was down 9% and there was a 7 day delay in crop maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide.

**Final plant count data**

| | undamaged comparison | chlorsulfuron 10% @ 4 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 26.8 |
| **Leaves/m*** | 775 | 618 |
| **Leaf area (cm²/m)*** | 30138 | 25313 |
| **Reduction in leaf area*** | | 16% |
| **Bolls/m** | 186 | 261 |
| **Boll weight (g/open boll)** | 4.2 | 3.8 |
| **Retention posit's 1-3^** | 91% | 73% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 6 - 19 |
| **Days to 50% open** | 193 | 200 |
| **Maturity delay (days)** | | 7 |
| **% Open bolls at picking** | 92% | 97% |
| **Lint yield (kg/ha)** | 2099 | 2193 |


## Summary

Exposure to 10% of a typical field rate of chlorsulfuron at 4 nodes caused extensive leaf damage, increasing tipping-out and reduced internode lengths.

Square and boll production was delayed and some early bolls were shed, with fewer bolls retained in positions 1 - 3. Plants compensated by setting a heavy late crop of smaller bolls. Average boll weight was reduced and crop maturity was delayed by 7 days, but there was no reduction in fibre quality or yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **25th Nov (4 weeks post-emergence)** |
| **Growth stage at exposure:** | **4 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years, depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 4 node cotton. Photo taken on 9th Dec, 14 days after exposure.

Plants virtually shut down following exposure to this high rate of chlorsulfuron, displaying few damage symptoms other than some yellowing of the youngest (5th) leaf. A sprinkling of necrotic stops were evident on the older leaves.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 4 node cotton. Photo taken on 20th Dec, 25 days after exposure.

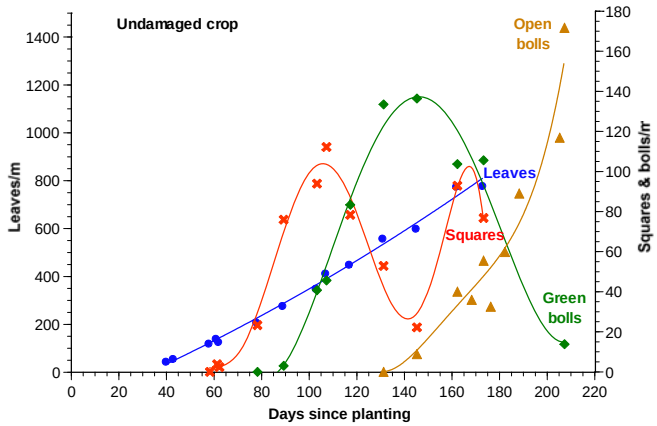
Some plants had resume growth 25 days after exposure, but strong symptoms of chlorsulfuron damage were obvious, with yellow, cupped and stunted new leaves with areas of reddening and inter vienal reddening and shortened internodes, giving the new growth a bunched appearance. The older leaves were peppered with necrotic spots and patches.

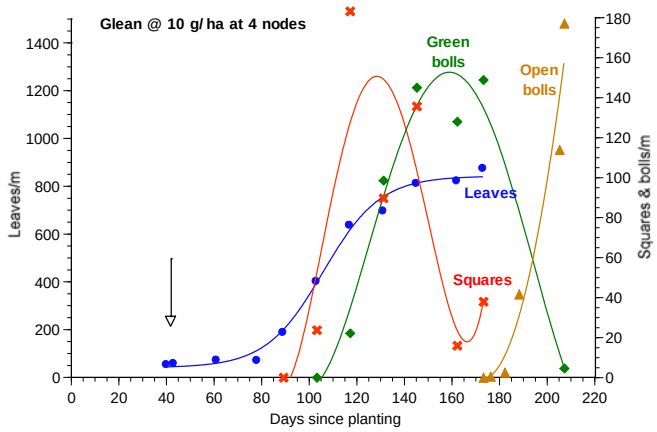
Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 4 node cotton. Photo taken on 4th Jan, 40 days after exposure.

New growth continued to be stunted, with short internodes giving a bunched appearance 40 days after exposure. Leaves were small, yellowish, cupped and distorted, with bright red petioles.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 4 node cotton. Photo taken on 17th Jan, 53 days after exposure.

Plants had resumed more normal growth 53 days after exposure, but leaf stunting and bunching, due to shortening of the internodes was still obvious. Some yellowing and reddening of the upper leaves was also still apparent.
Plants had resumed normal growth by 74 days after exposure, with no obvious damage symptoms remaining.




## Impact on plant growth

**Plants**: showed strong damage symptoms for 70 days following the herbicide exposure. Damaged plants only put on an additional 2.3 nodes and 2.3 cm height in the first 35 days after exposure, compared to 6.5 nodes and 12.9 cm for undamaged plants. By the final observation, plants were still 7 cm shorter, with 5 fewer nodes.

**Leaves:** the herbicide caused extensive crop damage, with leaf discolouration, cupping and stunting and reduced internodes.

**Squares**: squaring was delayed by 30 days but with no reduction in peak squaring.

**Bolls:** boll retention was delayed by 20 days, although the final boll number was unaffected. However, 41% fewer bolls were retained on positions 1 – 3 and many bolls were retained on the lateral branches, the bolls were 20% lighter and there was a 6 day delay in boll maturity.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but the cotton was immature, with low micronaire (3.37) and 10.05% short fibres. Lint yield was reduced by 20%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **chlorsulfuron 50% @ 4 nodes** |
| **Nodes/plant** | 26.9 | 21.7 |
| **Leaves/m*** | 775 | 874 |
| **Leaf area (cm²/m)*** | 30138 | 35400 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 182 |
| **Boll weight (g/open boll)** | 4.2 | 3.4 |
| **Retention posit's 1-3^** | 91% | 49% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 1 - 15 |
| **Days to 50% open** | 193 | 199 |
| **Maturity delay (days)** | | 6 |
| **% Open bolls at picking** | 92% | 97% |
| **Lint yield (kg/ha)** | 2099 | 1671 |

## Summary

Exposure to 50% of a typical field rate of chlorsulfuron at 4 nodes caused extensive leaf damage, stunting and reduced internode lengths. Almost all plants were tipped-out.

Square and boll production were delayed, with many bolls shed from the primary fruiting positions. There was a reduction in boll weight, but no reduction in final boll retention. Fibre quality was reduced and lint yield was down by 20%.

**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **1.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **15th Dec (7 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years, depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 9 node cotton. Photo taken on 22nd Dec, 7 days after exposure.

Mild symptoms of chlorsulfuron damage were apparent soon after exposure with patches of inter-vienal yellowing, with some reddish areas, yellowing of the main veins and reddening of the petioles.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 9 node cotton. Photo taken on 29th Dec, 14 days after exposure.

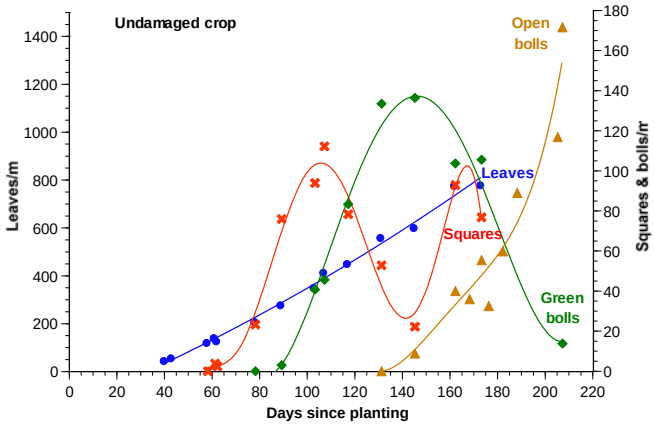
The only symptoms of chlorsulfuron damage remaining after 14 days was yellowing of the main veins and some small yellowish patches and spots on the leaves.

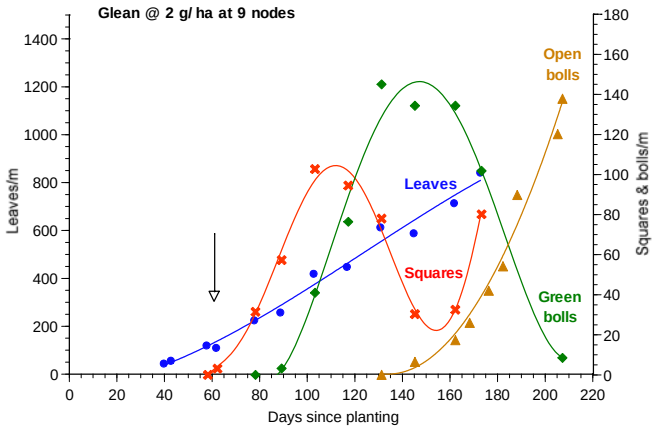
Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 9 node cotton. Photo taken on 7th Jan, 23 days after exposure.

Most symptoms of chlorsulfuron damage had faded by 23 days, although there were still a few yellowish patches and slight yellowing of the main veins.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 9 node cotton. Photo taken on 17th Jan, 33 days after exposure.

No obvious symptoms of chlorsulfuron damage remained 33 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of chlorsulfuron at 9 nodes caused minor damage to the plants, with few long-term affects. Plants compensated for the minor damage and developed normally with no reduction in plant height or size.

**Leaves:** the herbicide exposure caused transitory leaf discolouration (yellowing). Plants had compensated for any damage by the final observation, with no reduction in leaf number or leaf area at this time.

**Squares**: there was no apparent impact on square initiation or retention.

**Bolls:** the herbicide had little impact on boll initiation, production or retention, although some early bolls were shed, with few bolls retained on nodes 8 and 9. There was a 10 day delay in the start of boll opening and plants retained 20% fewer open bolls at picking. There was no delay in average crop maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **chlorsulfuron 10% @ 9 nodes** |
| **Nodes/plant** | 26.9 | 27.4 |
| **Leaves/m*** | 775 | 839 |
| **Leaf area (cm²/m)*** | 30138 | 30086 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 146 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention posit's 1-3^** | 91% | 94% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 10 – 21 |
| **Days to 50% open** | 193 | 186 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 94% |
| **Lint yield (kg/ha)** | 2099 | 2113 |


## Summary

Exposure to 10% of a typical field rate of chlorsulfuron at 9 nodes caused only minor leaf damage, which was no longer apparent 33 days after exposure.

The herbicide had no affect on squaring, but some early bolls were shed, with few bolls retained on nodes 8 and 9, causing a short delay in boll opening and a reduction in the number of bolls open at picking. There was no affect on average crop maturity, fibre quality or lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **15th Dec (7 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years, depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 9 node cotton. Photo taken on 22nd Dec, 7 days after exposure.

Symptoms of chlorsulfuron damage were apparent soon after exposure. Many of the younger leaves had a yellowish appearance, with patches of inter-vienal yellowing, with some reddish areas, yellowing of the main veins and reddening of the petioles. Some of the deeper yellow patches had areas of reddish discolouration.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 9 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Damage symptoms were obvious 14 days after exposure. Most of the younger leaves had a yellowish appearance, with patches of strong yellow (sometimes covering the whole leaf), reddish areas, necrotic spots and reddening of the petioles. Red streaks radiated along the main veins from the petioles of many leaves. The internodes of the new leaves were short, giving a bunched appearance.

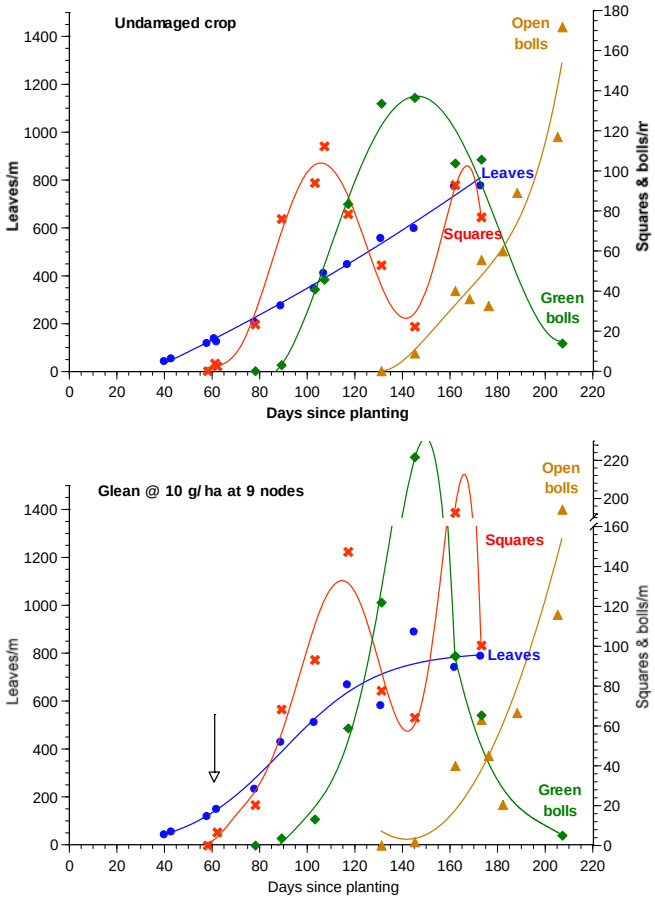
Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 9 node cotton. Photo taken on 7th Jan, 23 days after exposure.

Symptoms of chlorsulfuron damage were still obvious at 23 days. Most of the younger leaves had a yellowish appearance, with patches of strong yellow (sometimes covering the whole leaf), reddish areas, necrotic spots and reddening of the petioles. Red streaks radiated along the main veins from the petioles of many leaves. The internodes of the new leaves were short, giving a bunched appearance to the new growth.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 9 node cotton. Photo taken on 17th Jan, 33 days after exposure.

The yellowish colouration of the upper leaves was fading 33 days after exposure, although reddish areas were still common radiating out from the petiole on many of the upper leaves, sometime including red streaks on the main veins, and sometimes inter-vienal.

No obvious symptoms of damage remained 44 days after exposure.




## Impact on plant growth

**Plants**: exposure to chlorsulfuron at 9 nodes caused extensive damage to the plants, with increased tipping-out, and reducing final plant weight by 18%.

**Leaves:** the herbicide exposure caused extensive discolouration of young leaves. Plants had compensated for this damage by the final observation, with no reduction in leaf number, but 21% less leaf area.

**Squares**: there was a short delay in square initiation, but no impact on peak squaring. Plants produced a flush of late squares.

**Bolls:** the herbicide caused a 15 day delay in the boll retention, and some early bolls were lost. Later in the season, plants set a large number of late bolls (39% more than the undamaged plants), but then shed 43% of that boll load, ending up with a comparable boll load to the undamaged plants. Average boll weight was down 7%.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but lint yield was reduced by 12%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **chlorsulfuron 50% @ 9 nodes** |
| **Nodes/plant** | 26.9 | 27.0 |
| **Leaves/m*** | 775 | 786 |
| **Leaf area (cm²/m)*** | 30138 | 23849 |
| **Reduction in leaf area*** | | 21% |
| **Bolls/m** | 186 | 199 |
| **Boll weight (g/open boll)** | 4.2 | 3.9 |
| **Retention posit's 1-3^** | 91% | 80% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 6 - 22 |
| **Days to 50% open** | 193 | 197 |
| **Maturity delay (days)** | | 4 |
| **% Open bolls at picking** | 92% | 97% |
| **Lint yield (kg/ha)** | 2099 | 1852 |

## Summary

Exposure to 50% of a typical field rate of chlorsulfuron at 9 nodes caused extensive damage to the plants, reducing plant size and tipping-out some plants.

There was a short delay in square and boll production, but plants retained a heavy lead of bolls mid-season, only to shed many of these later in the season. There was a small reduction in boll size and no impact on fibre quality, but there was a 12% reduction in lint yield.

**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **1.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years, depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 12 node cotton. Photo taken on 28th Jan, 15 days after exposure.

Symptoms of chlorsulfuron damage were apparent soon after exposure, with patches of yellowing on most of the upper leaves, often covering the leaf. The colour was generally brightest on expanding leaves. Some of these leaves had reddish areas, as did the exposed squares and petioles. The main veins of some leaves had red streaks which radiate from the petioles.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 12 node cotton. Photo taken on 7th Feb, 25 days after exposure.

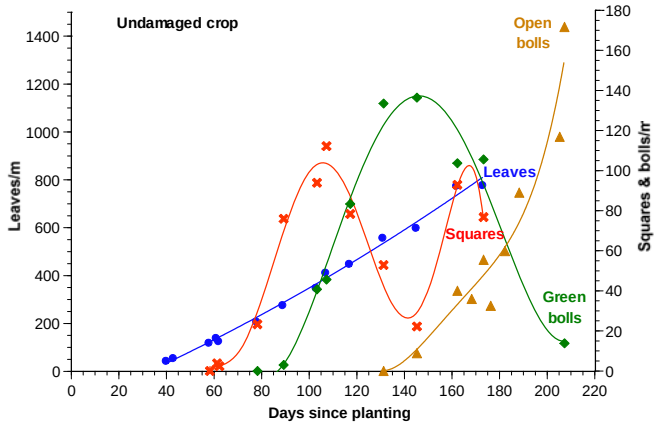
Much of the yellowish discolouration had faded 25 days after exposure, but damage was very evident at the stem terminals, where new growth was emerging. This growth was bunched, and distorted, with leaves supported on short petioles emerging from short inter-nodes.

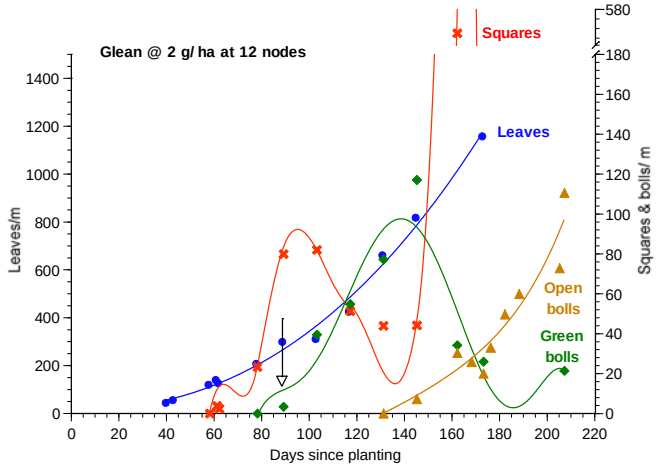
Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 12 node cotton. Photo taken on 18th Feb, 36 days after exposure.

The yellowish discolouration had mostly faded 36 days after exposure, but the damaged growth at the stem terminals were very obvious. This growth was bunched, stunted, cupped and distorted, with many small, round leaves supported on very short petioles and short inter-nodes.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 12 node cotton. Photo taken on 14th Mar, 60 days after exposure.

The bunched, stunted growth was still evident at the stem terminals, but was being overgrown by normal growth from undamaged lateral branches 60 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of chlorsulfuron at 12 nodes caused major, season-long damage. Plants were 5 cm shorter and 43% smaller by weight.

**Leaves:** the herbicide exposure caused leaf discolouration which lasted for around 5 weeks, and terminal damage, leading to the production of a large number of small, bunched leaves. Plants had 49% more leaves but 17% less leaf area at the last observation.

**Squares**: many early and mid-season squares were shed, and the plants produced a huge number of late-season squares which did not contribute to yield.

**Bolls:** plants retained an early boll load but bolls were shed later in the season, resulting in 36% fewer open bolls at picking, and a 12% reduction in boll weight. There was no delay in maturity.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but the cotton was below base grade with 11.18% short fibres and lint yield was reduced by 54%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **chlorsulfuron 10% @ 12 nodes** |
| **Nodes/plant** | 26.9 | 26.3 |
| **Leaves/m*** | 775 | 1154 |
| **Leaf area (cm²/m)*** | 30138 | 25136 |
| **Reduction in leaf area*** | | 17% |
| **Bolls/m** | 186 | 132 |
| **Boll weight (g/open boll)** | 4.2 | 3.7 |
| **Retention posit's 1-3^** | 91% | 91% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 8 – 19 |
| **Days to 50% open** | 193 | 195 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 84% |
| **Lint yield (kg/ha)** | 2099 | 940 |


## Summary

Exposure to 10% of a typical field rate of chlorsulfuron at 12 nodes caused severe crop damage, with leaf discolouration and terminal damage. Plants were stunted, producing a flush of small, bunched leaves

The damage resulted in the loss of squares and bolls, although plants compensated with a massive set of late squares. There was a reduction in boll size, boll maturity, final boll number and fibre quality. Lint yield was reduced by 54%.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years, depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 28th Jan, 15 days after exposure.

Symptoms of chlorsulfuron damage were apparent soon after exposure, with patches of yellowing and bleaching on many of the upper leaves, the yellowing often covering the leaf. The colour was generally brightest on expanding leaves. Some of these leaves had pinkish areas. The main veins of most exposed leaves were pale.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 7th Feb, 25 days after exposure.

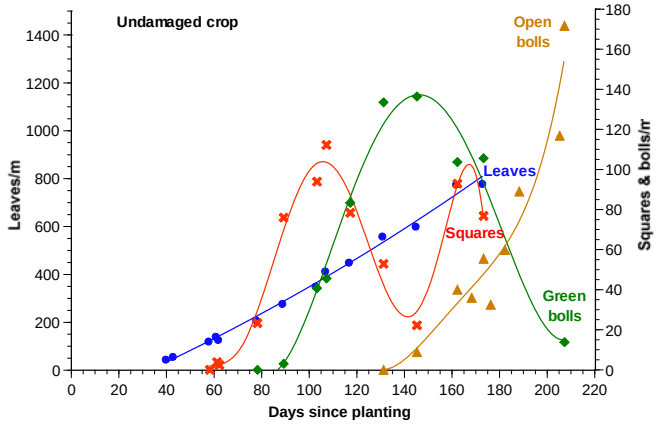
The more intense yellowish areas had faded 25 days after exposure, but damage was very evident at the stem terminals, where new growth was emerging. This growth was yellowish, with pinkish patches and red leaf margins, bunched, and distorted, with leaves supported on short petioles emerging from short inter-nodes. Some necrotic spots were evident.

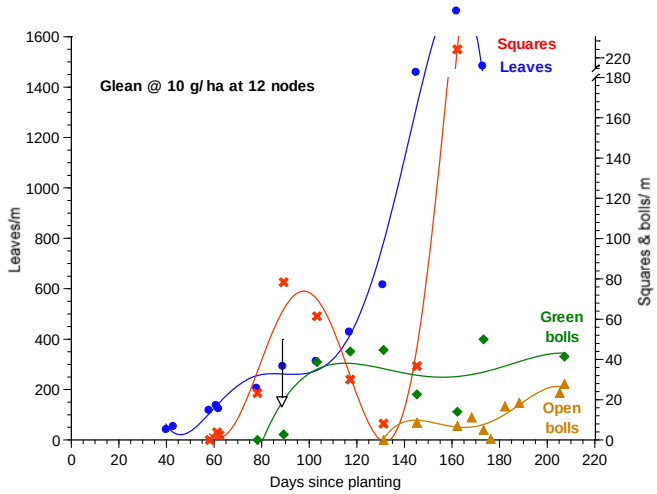
Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 18th Feb, 36 days after exposure.

The yellowish discolouration had mostly faded 36 days after exposure, many of the terminal leaves were dead and the damaged growth at the stem terminals was very obvious. This growth was bunched, stunted, cupped and distorted, with many small, round leaves supported on short petioles and short inter-nodes. The petioles were bright red.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 14th Mar, 60 days after exposure.

The dead leaves and bunched, stunted growth was still evident at the stem terminals, but was being overgrown by normal growth from undamaged lateral branches 60 days after exposure.




## Impact on plant growth

**Plants**: exposure to chlorsulfuron at 12 nodes caused season-long damage to the plants. Plants were 4 nodes and18 cm shorter and 35% smaller by weight.

**Leaves:** the herbicide exposure caused leaf discolouration, necrosis and terminal damage on the main stems, causing the production of a large number of small, bunched leaves. Plants had 91% more leaves but only 4% more leaf area than the undamaged crop at the last removal.

**Squares**: many early and mid-season squares were shed, and the plants produced a mass of late-season squares.

**Bolls:** damaged plants shed bolls throughout the season, with few bolls retained on the first 3 positions and few bolls above 13 nodes. Plants had 63% fewer bolls at picking, with only 40% of these open, and a 20 day delay in crop maturity.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but the cotton was below base grade with reduced fibre length and strength, 12.1% short fibres and lint yield was reduced by 82%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **chlorsulfuron 50% @ 12 nodes** |
| **Nodes/plant** | 26.9 | 22.8 |
| **Leaves/m*** | 775 | 1483 |
| **Leaf area (cm²/m)*** | 30138 | 31465 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 69 |
| **Boll weight (g/open boll)** | 4.2 | 4.1 |
| **Retention posit's 1-3^** | 91% | 51% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 6 - 13 |
| **Days to 50% open** | 193 | 213 |
| **Maturity delay (days)** | | 20 |
| **% Open bolls at picking** | 92% | 40% |
| **Lint yield (kg/ha)** | 2099 | 370 |


## Summary

Exposure to 50% of a typical field rate of chlorsulfuron at 12 nodes caused severe crop damage, with leaf discolouration, necrosis and terminal damage on the main stems. Plants were stunted but produced a mass of small leaves.

The damage caused shedding of squares and bolls, with a flush of late-season squares. There was a large reduction in boll maturity, boll number at picking, and fibre quality. Lint yield was down 82%.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **1.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **31st Jan (14 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 16 node cotton. Photo taken on 7th Feb, 7 days after exposure.

Symptoms of chlorsulfuron damage were apparent soon after exposure, with patches of inter-vienal yellowing on the terminal leaves, often covering the leaf, and reddening of the upper petioles.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 16 node cotton. Photo taken on 18th Feb, 18 days after exposure.

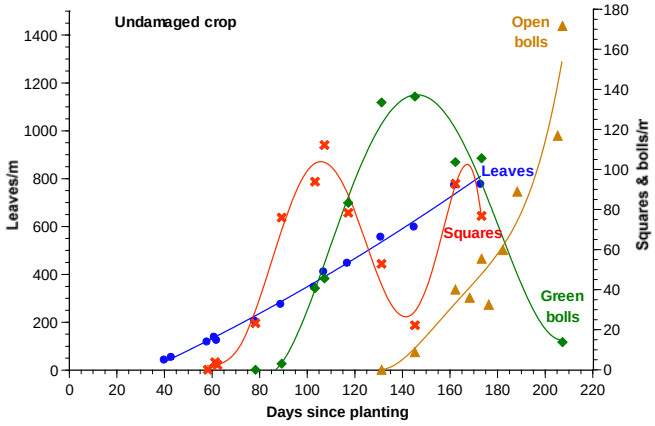
The yellow colouration was much stronger on the terminal leaves18 days after exposure. Some of the expanding leaves had reddish spots, patches and leaf margins. The new growth at the stem terminals was bunched, and distorted, with leaves supported on short petioles emerging from short inter-nodes.

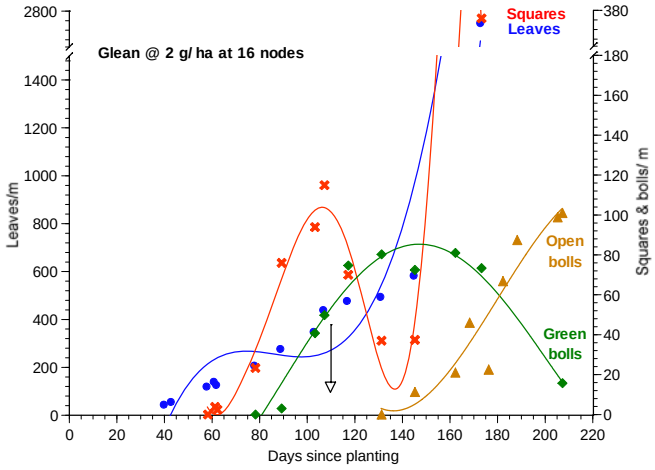
Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 16 node cotton. Photo taken on 3rd Mar, 31 days after exposure.

The yellowish discolouration had mostly faded 31 days after exposure, but the damaged growth at the stem terminals were very obvious. This growth was bunched, stunted, cupped and distorted, with many small leaves supported on short petioles and short inter-nodes.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 12 node cotton. Photo taken on 14th Mar, 42 days after exposure.

The bunched, stunted growth was still very evident at the stem terminals 42 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of chlorsulfuron at 16 nodes caused stunting and leaf bunching. Plants were 13 cm shorter at picking.

**Leaves:** the herbicide exposure caused severe crop damage, with leaf discolouration and terminal damage, causing the production of a large number of small, bunched leaves late in the season. Plants had 254% more leaves and 42% more leaf area than the undamaged crop at the last observation.

**Squares**: the herbicide damage appeared to have little impact on square production until late in the season when plants produced a huge number of new squares.

**Bolls:** damaged plants shed bolls throughout the later part of the season, resulting in 37% fewer bolls, with few bolls retained above node 16, and 41% fewer bolls open at picking.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but lint yield was reduced by 27%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **chlorsulfuron 10% @ 16 nodes** |
| **Nodes/plant** | 26.9 | 25.6 |
| **Leaves/m*** | 775 | 2747 |
| **Leaf area (cm²/m)*** | 30138 | 42820 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 117 |
| **Boll weight (g/open boll)** | 4.2 | 4.1 |
| **Retention posit's 1-3^** | 91% | 95% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 - 16 |
| **Days to 50% open** | 193 | 184 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 86% |
| **Lint yield (kg/ha)** | 2099 | 1527 |


### Summary

Exposure to 10% of a typical field rate of chlorsulfuron at 16 nodes caused severe crop damage late in the season, with leaf discolouration and terminal damage. Plants responded by producing late vegetative growth and a flush of late squares.

Plants shed bolls following the damage, with few bolls retained above node 16. There was a reduction in the number of bolls open at picking and boll maturity, and a 27% reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **chlorsulfuron** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **31st Jan (14 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 28 - 42 days. Breakdown is slower in alkaline soils.

Glean® (chlorsulfuron) applied broadcast at 10 g/ha to 16 node cotton. Photo taken on 7th Feb, 7 days after exposure.

Symptoms of chlorsulfuron damage were apparent soon after exposure, with patches of yellowing on the terminal leaves, often covering the leaf, and reddening of the upper petioles.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 16 node cotton. Photo taken on 18th Feb, 18 days after exposure.

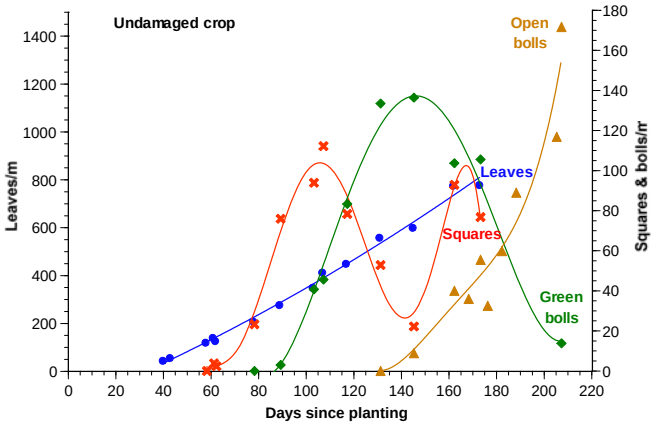
The yellow colouration was much stronger on the terminal leaves18 days after exposure. Some of the expanding leaves had reddish spots, patches and leaf margins. The new growth at the stem terminals was bunched, and distorted, with leaves supported on short petioles emerging from short inter-nodes.

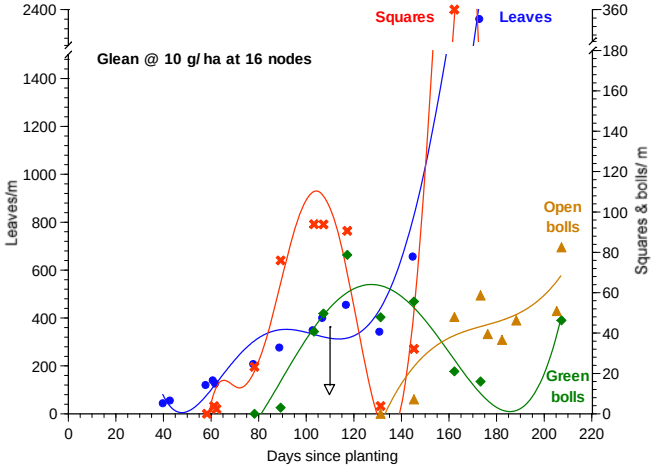
Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 16 node cotton. Photo taken on 3rd Mar, 31 days after exposure.

The yellowish discolouration had mostly faded 31 days after exposure, but the damaged growth at the stem terminals were very obvious. This growth was bunched, stunted, cupped and distorted, with many small leaves supported on short petioles and short inter-nodes. Many of these terminal leaves had necrotic patches.

Glean® (chlorsulfuron) applied broadcast at 2 g/ha to 12 node cotton. Photo taken on 14th Mar, 42 days after exposure.

The bunched, stunted growth was still very evident at the stem terminals 42 days after exposure.




## Impact on plant growth

**Plants**: exposure to chlorsulfuron at 16 nodes caused major damage to the plants, resulting in stunting and a mass of late-season vegetative growth. Plants were 5 cm and 27% smaller by weight compared to undamaged plants.

**Leaves:** the herbicide exposure caused leaf discolouration and terminal damage, resulting in the production of a large number of small, bunched leaves late in the season. Plants had 204% more leaves and 76% more leaf area than undamaged plants at the final observation.

**Squares**: plants produced a flush of new squares 50 days after the exposure.

**Bolls:** damaged plants shed bolls throughout the middle and later parts of the season, retaining few bolls above node 13. Plants had 31% fewer bolls, with 52% fewer open bolls at picking, bolls were 6% lighter, and crop maturity was delayed by 11 days.

**Lint**: ginning turnout was unaffected by the herbicide exposure but the cotton had 10.35% short fibres and lint yield was reduced by 62%.

**Final plant count data**

| | undamaged comparison | chlorsulfuron 50% @ 16 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 27.6 |
| **Leaves/m*** | 775 | 2357 |
| **Leaf area (cm²/m)*** | 30138 | 52944 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 129 |
| **Boll weight (g/open boll)** | 4.2 | 3.9 |
| **Retention posit's 1-3^** | 91% | 90% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 - 13 |
| **Days to 50% open** | 193 | 204 |
| **Maturity delay (days)** | | 11 |
| **% Open bolls at picking** | 92% | |
| **Lint yield (kg/ha)** | 2099 | 760 |


**Summary**

Exposure to 50% of a typical field rate of chlorsulfuron at 16 nodes caused severe crop damage, with leaf discolouration and terminal damage. Plants were stunted and responded by producing vegetative growth and a flush of late squares.

Bolls were shed following the exposure. There was a reduction in boll weight and number, with fewer bolls open at picking. There was a delay in crop maturity and fibre quality was reduced. Lint yield was down by 62%.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **1 + 3 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **10th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 18 days after crop emergence.

Symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent on some seedlings at emergence, with sagging of the cotyledons and reddening of the petioles.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha and incorporated prior to planting cotton. Photo taken on 21st Nov, 35 days after crop emergence.

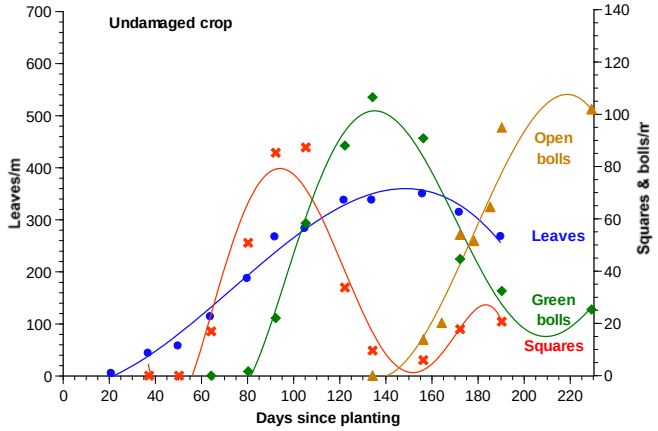
Most plants were growing normally 35 days after emergence, but a few very stunted plants remained, with cupped and stunted new leaves with areas of reddening.

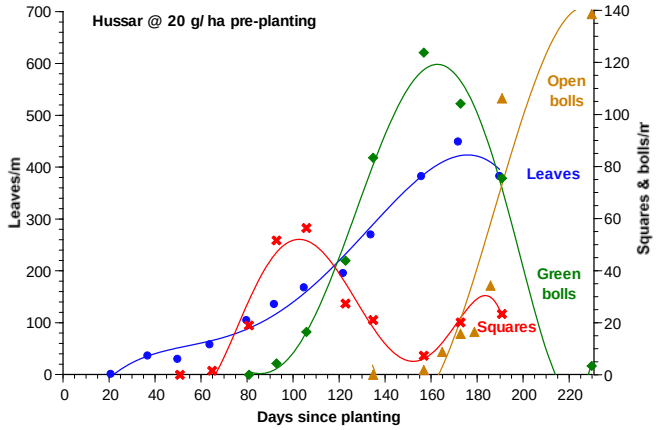
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha and incorporated prior to planting cotton. Photo taken on 16th Dec, 60 days after crop emergence.

Most damage symptoms had disappeared 60 days after emergence, but most plants were still noticeably shorter than the undamaged plants.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha and incorporated prior to planting cotton. Photo taken on 17th Jan, 92 days after crop emergence.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained 92 days after emergence except a delay in plant growth.




## Impact on plant growth

**Plants**: exposure to the lighter rate of residual iodosulfuron-methyl sodium + mefenpyr diethyl damaged and stunted many of the seedlings, although some seedlings developed normally. Plants compensated for the early-season damage with a flush of late growth and a delayed crop.

**Leaves:** the herbicide caused extensive cotyledon damage, with leaf discolouration, cupping and stunting. Plants compensated with late growth and had 43% more leaves, 67% more leaf area and were 73% larger at defoliation.

**Squares**: there was a 10 day delay in the start of square production and a 35% reduction in peak squaring.

**Bolls:** there was a small delay in initial boll retention, with peak boll retention delayed by 20 days and the first open bolls by 20 days. Plants shed some early bolls, with 10% fewer bolls retained in positions 1 – 3 and a 9 day delay in crop maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 10% reduction in lint yield.

**Final plant data**

| | undamaged comparison | iodosulfuron + mefenpyr 10% pre-plant |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.1 |
| **Leaves/m*** | 268 | 382 |
| **Leaf area (cm²/m)*** | 6144 | 10247 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 142 |
| **Boll weight (g/open boll)** | 5.6 | 5.9 |
| **Retention posit's 1-3^** | 91% | 81% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 - 17 |
| **Days to 50% open bolls** | 179 | 188 |
| **Maturity delay (days)** | | 9 |
| **% Open bolls at picking** | 80% | 98% |
| **Lint yield (kg/ha)** | 2079 | 1875 |


## Summary

Exposure to 10% of a typical field rate of residual iodosulfuron-methyl sodium + mefenpyr diethyl caused extensive cotyledon damage, severely stunting many seedlings, although some were unaffected.

Plant growth and development, squaring and boll production were delayed and some early bolls were shed, with fewer bolls retained in positions 1 - 3. Plants compensated, but average crop maturity was delayed by 9 days. There was no reduction in fibre quality. Lint yield was down by 10%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **5 + 15 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **10th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 18 days after crop emergence.

Symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent on some seedlings at emergence, with many seedlings dying soon after emergence and surviving seedlings damaged with sagging cotyledons and reddening of the petioles.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha and incorporated prior to planting cotton. Photo taken on 21st Nov, 35 days after crop emergence.

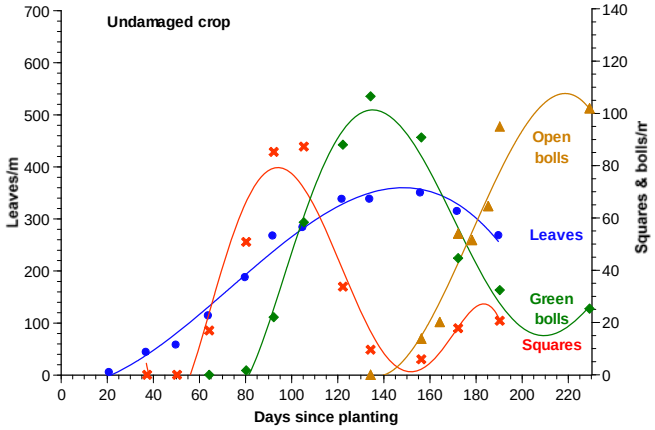
The surviving seedlings were growing normally 35 days after emergence, but were very stunted, some with cupped and stunted new leaves with areas of reddening.

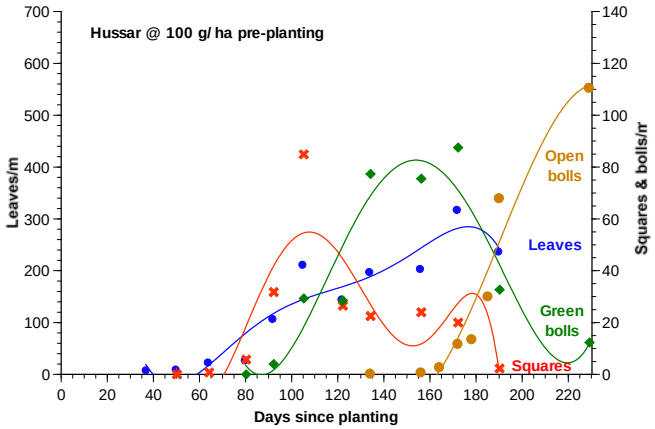
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha and incorporated prior to planting cotton. Photo taken on 16th Dec, 60 days after crop emergence.

Most plants were growing normally 60 days after emergence, but plants were still noticeably shorter than the undamaged plants, with a long delay in development.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha and incorporated prior to planting cotton. Photo taken on 17th Jan, 92 days after crop emergence.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained 92 days after emergence except a reduction in the plant stand and a delay in plant growth and development.




## Impact on plant growth

**Plants**: exposure to the heavier rate of residual iodosulfuron-methyl sodium + mefenpyr diethyl killed many seedlings, reducing the plant stand by 55%. Most surviving seedlings were damaged and stunted, with an increase in tipping-out. Plants compensated for the early-season damage and produced a delayed crop.

**Leaves:** the herbicide caused extensive cotyledon damage, with leaf stunting, discolouration and cupping. Plant growth was delayed. Plants had 12% fewer leaves at defoliation but retained more 23% leaf area with average leaf size up 39%.

**Squares**: there was a 10 day delay in the start of square production.

**Bolls:** there was a 10 day delay in initial boll retention, with peak boll retention delayed by 10 days and the first open bolls by 20 days. Plants shed many early bolls, with 40% fewer bolls retained in positions 1 – 3 and there was an 8 day delay in maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 27% reduction in lint yield.

**Final plant data**

| | undamaged comparison | iodosulfuron + mefenpyr 50% pre-plant |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.4 |
| **Leaves/m*** | 268 | 236 |
| **Leaf area (cm²/m)*** | 6144 | 7543 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 123 |
| **Boll weight (g/open boll)** | 5.6 | 6.3 |
| **Retention posit's 1-3^** | 91% | 55% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 5 - 18 |
| **Days to 50% open bolls** | 179 | 187 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 80% | 90% |
| **Lint yield (kg/ha)** | 2079 | 1516 |

## Summary

Exposure to 50% of a typical field rate of residual iodosulfuron-methyl sodium + mefenpyr diethyl killed many seedlings and caused extensive cotyledon damage on survivors, delaying crop growth and development.

Square and boll production were delayed and many early bolls were shed, with fewer bolls retained in positions 1 - 3. Plants compensated for this damage, although average crop maturity was delayed by 8 days. There was no reduction in fibre quality, but lint yield was reduced by 27%.

**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **1 + 3 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **20th Nov (5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 5 node cotton. Photo taken on 5th Dec, 15 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent after exposure, although there was a small reduction in the plant stand.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 5 node cotton. Photo taken on 16th Dec, 26 days after exposure.

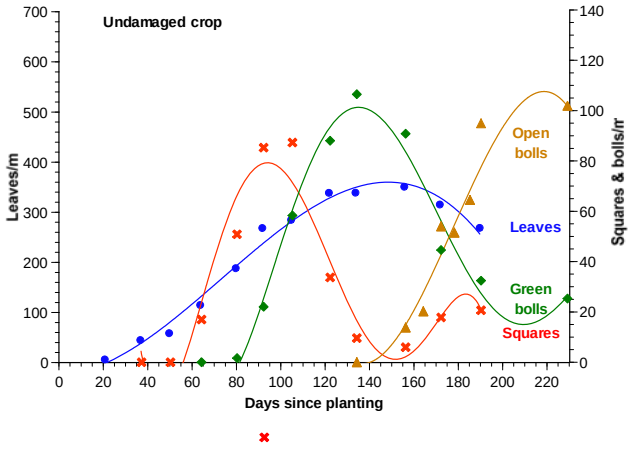
No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent at any stage.

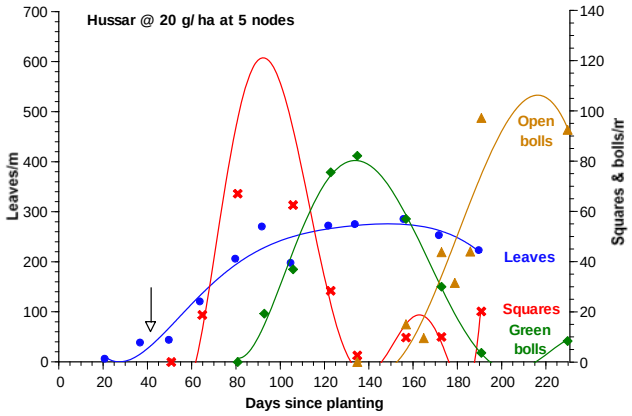
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 5 node cotton. Photo taken on 29th Dec, 39 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent at any stage. The leaf damage apparent on some leaves in this photo was inadvertently caused by a 2nd herbicide.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 5 node cotton. Photo taken on 17th Jan, 58 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent at any stage.




## Impact on plant growth

**Plants**: exposure to the lighter rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 5 nodes caused no obvious damage to the seedlings, but there was an 8% reduction in the plant stand and growth was delayed. Plants remained 10 cm shorter and 20% smaller by weight at defoliation.

**Leaves:** the herbicide caused no obvious leaf damage, although leaf production was reduced. Plants had 17% fewer leaves and 11% less leaf area at defoliation.

**Squares**: there was no delay in the start of square production and plants had 91% more squares at peak squaring.

**Bolls:** there was no delay in initial boll retention, but peak boll retention was down by 23%. Plants retained 21% fewer bolls and 9% fewer open bolls at picking.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 14% reduction in lint yield.

**Final plant data**

| | undamaged comparison | iodosulfuron + mefenpyr 10% @ 5 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 24.5 |
| **Leaves/m*** | 268 | 222 |
| **Leaf area (cm²/m)*** | 6144 | 5447 |
| **Reduction in leaf area*** | | 11% |
| **Bolls/m** | 127 | 101 |
| **Boll weight (g/open boll)** | 5.6 | 5.2 |
| **Retention posit's 1-3^** | 91% | 95% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 17 |
| **Days to 50% open bolls** | 179 | 181 |
| **Maturity delay (days)** | | 2 |
| **% Open bolls at picking** | 80% | 92% |
| **Lint yield (kg/ha)** | 2079 | 1784 |


## Summary

Exposure to 10% of a typical field rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 5 nodes caused no obvious damage to the seedlings, but there was a small reduction in the plant stand and plants remained shorter and smaller at defoliation, with fewer leaves and less leaf area.

Plants produced a mass of squares but retained fewer green bolls and had fewer bolls at picking. There was no reduction in ginning turnout or fibre quality. Lint yield was reduced by 14%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **5 + 15 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **20th Nov (5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 5 node cotton. Photo taken on 5th Dec, 15 days after exposure.

No obvious symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent after exposure, although leaf yellowing was apparent on some seedlings.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 5 node cotton. Photo taken on 16th Dec, 26 days after exposure.

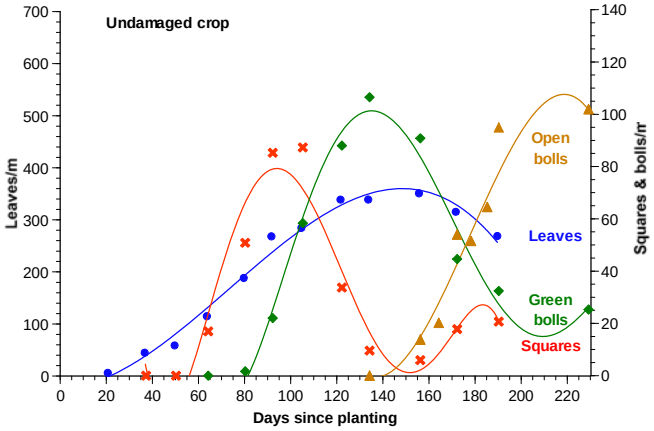
No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 26 days after exposure.

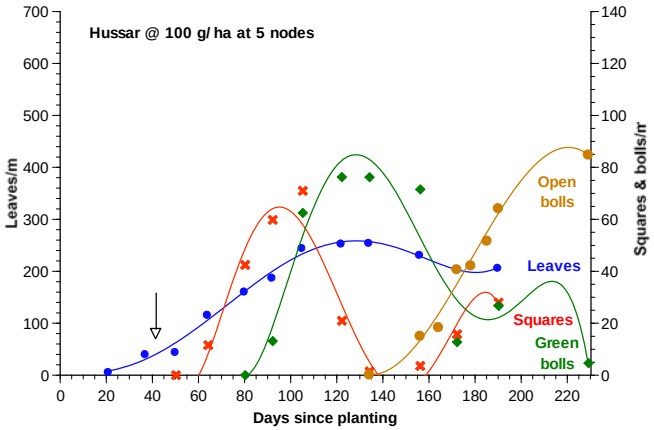
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 5 node cotton. Photo taken on 29th Dec, 39 days after exposure.

No symptoms of the herbicide damage were apparent 39 days after exposure. The leaf damage apparent on some leaves in this photo was inadvertently caused by a 2nd herbicide.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 5 node cotton. Photo taken on 17th Jan, 58 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained 58 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 5 nodes appeared to cause only minor damage to the plants, with some leaf yellowing. However, there was a 16% reduction in the plant stand and a reduction in crop growth, with plants remaining 9 cm shorter and 8% smaller by weight at defoliation.

**Leaves:** the herbicide caused no obvious leaf damage other than yellowing but peak leaf area was reduced by 33%. Plants had 23% fewer leaves at defoliation but the leaves were larger on average and there was no reduction in total leaf area.

**Squares**: there was no delay in the start of square production but plants had 19% fewer squares at peak squaring.

**Bolls:** there was no delay in initial boll retention, but peak boll retention was down by 28%. Plants retained 30% fewer bolls and 17% fewer open bolls at picking.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 34% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | iodosulfuron + mefenpyr 50% @ 5 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 24.3 |
| **Leaves/m*** | 268 | 205 |
| **Leaf area (cm²/m)*** | 6144 | 6039 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 89 |
| **Boll weight (g/open boll)** | 5.6 | 5.2 |
| **Retention posit's 1-3^** | 91% | 98% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 17 |
| **Days to 50% open bolls** | 179 | 175 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 80% | 95% |
| **Lint yield (kg/ha)** | 2079 | 1373 |


## Summary

Exposure to 50% of a typical field rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 5 nodes caused some leaf yellowing but no other obvious damage to the seedlings. However, there was a small reduction in the plant stand and plants remained shorter and smaller at picking, with fewer leaves.

Plants produced fewer squares, retained fewer green bolls and had fewer open bolls at picking. There was no reduction in ginning turnout or fibre quality, but lint yield was reduced by 34%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **1 + 3 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **15th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 12 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 14 days after exposure with yellowing and cupping of the newly expanded leaves. The leaf burn apparent on some leaves in this photo was inadvertently caused by a 2nd herbicide.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 12 node cotton. Photo taken on 4th Jan, 20 days after exposure.

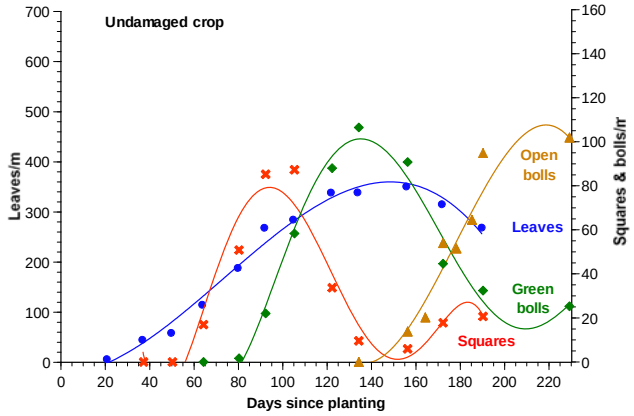
The yellowing of the upper leaves was less apparent 20 days after exposure but could still be seen on some leaves.

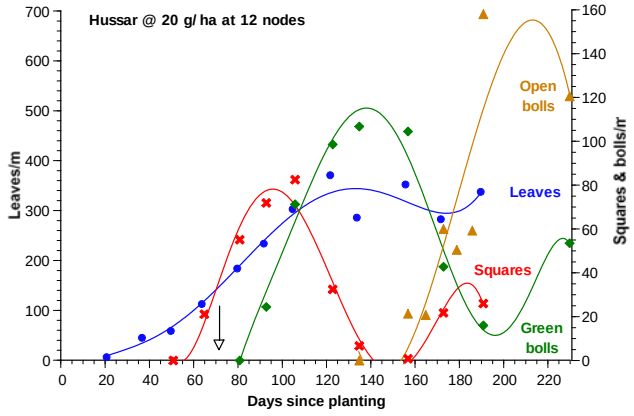
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 12 node cotton. Photo taken on 17th Jan, 33 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained obvious 33 days after exposure.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 12 node cotton. Photo taken on 9th Feb, 56 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 56 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 12 nodes caused cupping and yellowing on the newly expanded leaves. Plants compensated for this damage and were 20% larger by weight at defoliation.

**Leaves:** the herbicide initially caused leaf yellowing and cupping, but there was an increase in leaf number later in the season. Plants had 26% more leaves and 15% more leaf area at defoliation.

**Squares**: there were no major changes in the pattern of square production.

**Bolls:** there was no delay in initial boll retention or change in peak boll retention, but plants shed some early bolls from nodes 6 and 7 and produced a flush of late bolls, retaining 37% more bolls at picking. These late bolls reduced the average boll size by 46% and didn't contribute to yield, with 14% fewer bolls open at picking.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide.

**Final plant data**

| | undamaged comparison | iodosulfuron + mefenpyr 10% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.0 |
| **Leaves/m*** | 268 | 336 |
| **Leaf area (cm²/m)*** | 6144 | 7096 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 174 |
| **Boll weight (g/open boll)** | 5.6 | 3.0 |
| **Retention posit's 1-3^** | 91% | 94% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 17 |
| **Days to 50% open bolls** | 179 | 183 |
| **Maturity delay (days)** | | 4 |
| **% Open bolls at picking** | 80% | 69% |
| **Lint yield (kg/ha)** | 2079 | 2002 |


## Summary

Exposure to 10% of a typical field rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 12 nodes caused leaf cupping and yellowing at the top of the plant.

The pattern of square production was unchanged by the herbicide exposure. Early bolls were shed from nodes 6 and 7 and plants produced a mass of late bolls. Average boll size was reduced and fewer mature bolls were open at picking, but there was no reduction in ginning turnout, fibre quality or lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **5 + 15 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **15th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 12 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Strong symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 14 days after exposure, with strong yellowing of the upper leaves and reddening of the veins of these leaves.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 12 node cotton. Photo taken on 12th Jan, 28 days after exposure.

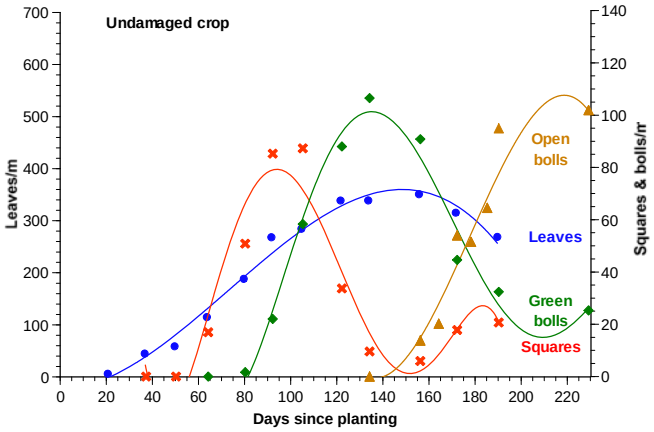
The symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were even more apparent 28 days after exposure with strong yellowing of the upper leaves. These leaves appear to be clumped, indicating a shortening of the internodes in the damaged areas.

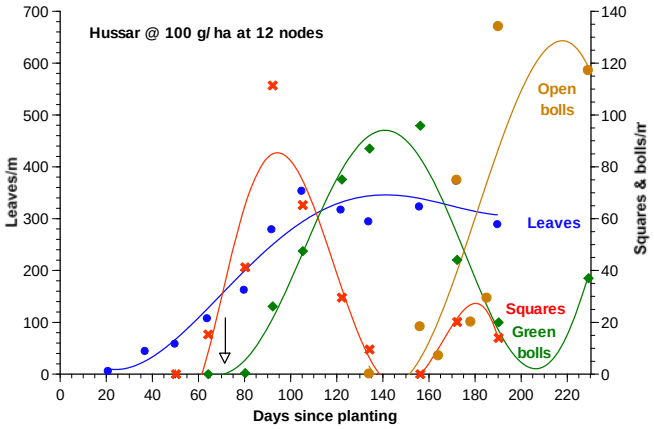
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 12 node cotton. Photo taken on 17th Jan, 33 days after exposure.

The symptoms of the herbicide damage were still strongly apparent 33 days after exposure.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 12 node cotton. Photo taken on 9th Feb, 56 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained 56 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 12 nodes caused strong yellowing and cupping of the upper leaves and appeared to shorten the internodes but had no other obvious impact on plant growth or development.

**Leaves:** the herbicide caused strong yellowing and cupping of the upper leaves. There was no reduction in leaf number or leaf area at defoliation, although the leaves were 9% smaller on average.

**Squares**: there was no change in the pattern of square production other than a 28% increase in squares at peak squaring.

**Bolls:** there was no delay in initial boll retention or reduction in peak boll retention. Plants shed bolls from nodes 6 and 7 and put on additional late bolls, retaining 21% more bolls at picking.

**Lint**: fibre quality fell below base grade, with reduced fibre length and strength and a 17% increase in short fibres. Lint yield was reduced by 12%.

**Final plant count data**

| | undamaged comparison | iodosulfuron + mefenpyr 50% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.0 |
| **Leaves/m*** | 268 | 288 |
| **Leaf area (cm²/m)*** | 6144 | 6040 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 154 |
| **Boll weight (g/open boll)** | 5.6 | 5.6 |
| **Retention posit's 1-3^** | 91% | 90% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 19 |
| **Days to 50% open bolls** | 179 | 187 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 80% | 76% |
| **Lint yield (kg/ha)** | 2079 | 1824 |


## Summary

Exposure to 50% of a typical field rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 12 nodes caused strong leaf yellowing and cupping.

Square production was not reduced with an increase in peak squaring but early bolls were shed. There was a flush of late season bolls, with an increase in final boll retention, additional bolls retained at the top of the plant and a delay in average crop maturity. There was reduction in ginning turnout and fibre quality, and a 12% reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **1 + 3 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **3rd Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

**Damage key:**

**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 15 node cotton. Photo taken on 12th Jan, 9 days after exposure.

Mild symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 9 days after exposure with mild yellowing and cupping of the newly expanded leaves.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 15 node cotton. Photo taken on 17th Jan, 14 days after exposure.

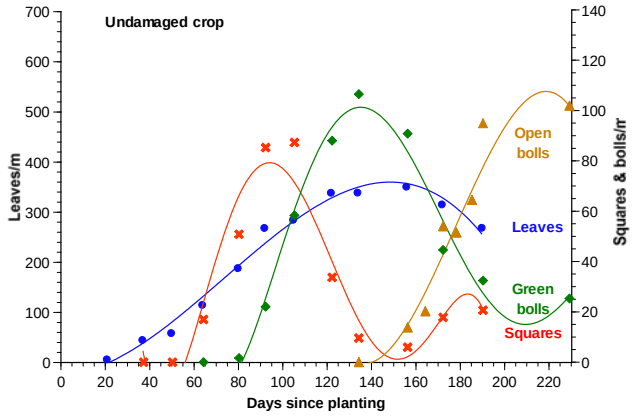
The yellowing of the upper leaves much more apparent on the newly expanded upper leaves 14 days after exposure.

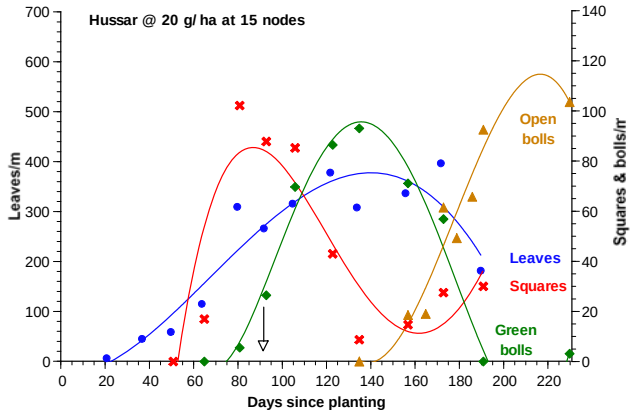
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 15 node cotton. Photo taken on 9th Feb, 37 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained obvious 37 days after exposure.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 15 node cotton. Photo taken on 5th Mar, 62 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 62 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 15 nodes caused some cupping and yellowing on the newly expanded leaves and triggered some vegetative growth, with plants 8 cm taller but 31% smaller by weight at defoliation.

**Leaves:** the herbicide caused some leaf yellowing and cupping, and there was a reduction in leaf size. Plants shed leaves late in the season, retaining 33% fewer leaves and 31% less leaf area at defoliation.

**Squares**: there was no change in the pattern of square production mid-season but plants produced additional late-season squares.

**Bolls:** plants shed some early bolls, retaining fewer bolls mid-season and shed immature bolls late in the season.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final plant data**

| | undamaged comparison | iodosulfuron + mefenpyr 10% @ 15 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.0 |
| **Leaves/m*** | 268 | 180 |
| **Leaf area (cm²/m)*** | 6144 | 4263 |
| **Reduction in leaf area*** | | 31% |
| **Bolls/m** | 127 | 107 |
| **Boll weight (g/open boll)** | 5.6 | 5.4 |
| **Retention posit's 1-3^** | 91% | 94% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 19 |
| **Days to 50% open bolls** | 179 | 174 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 80% | 97% |
| **Lint yield (kg/ha)** | 2079 | 2212 |


## Summary

Exposure to 10% of a typical field rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 15 nodes caused some leaf cupping and yellowing at the top of the plant and reduced subsequent leaf number, leaf area and plant size.

This caused some changes to the pattern of square and boll production, with more late-season squares, but fewer mid-season bolls and the loss of immature bolls late-season. There was no reduction in ginning turnout, fibre quality or lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **5 + 15 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **3rd Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

**Damage key:**

**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 15 node cotton. Photo taken on 12th Jan, 9 days after exposure.

Mild symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 9 days after exposure, with some yellowing of the upper leaves.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 15 node cotton. Photo taken on 17th Jan, 14 days after exposure.

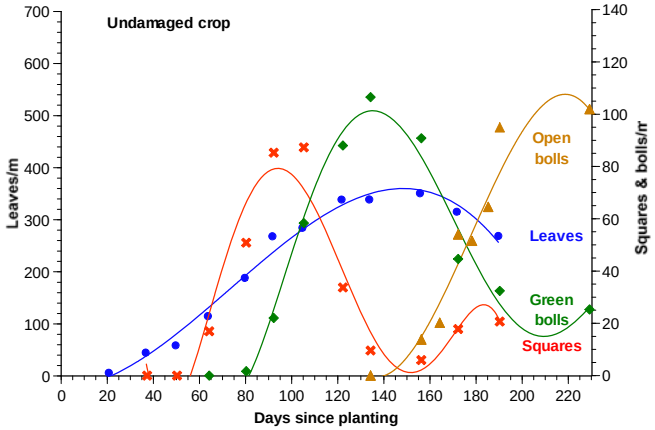
The symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were more apparent 14 days after exposure with cupping and strong yellowing of the upper leaves.

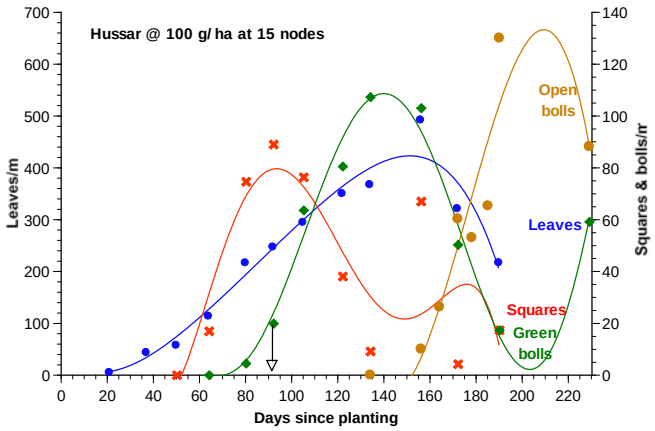
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 15 node cotton. Photo taken on 9th Feb, 37 days after exposure.

The symptoms of the herbicide damage were much less apparent 37 days after exposure, with some mild yellowing of the upper leaves remaining.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 15 node cotton. Photo taken on 5th Mar, 62 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained 62 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 15 nodes caused some yellowing and cupping of the upper leaves and reduced leaf area and plant size, with plants 8 cm shorter at picking.

**Leaves:** the herbicide caused some yellowing and cupping of the upper leaves. There was a reduction in leaf production and a loss the leaves late-season, with 19% fewer leaves at defoliation and a 19% reduction in leaf area.

**Squares**: there was no change in the pattern of square production.

**Bolls:** there was no reduction in peak boll retention, but plants shed mature bolls during defoliation and retained more green bolls late season, retaining 16% more bolls in total at picking, but 14% fewer mature bolls.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final plant count data**

| | undamaged comparison | iodosulfuron + mefenpyr 50% @ 15 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 24.3 |
| **Leaves/m*** | 268 | 217 |
| **Leaf area (cm²/m)*** | 6144 | 5005 |
| **Reduction in leaf area*** | | 19% |
| **Bolls/m** | 127 | 147 |
| **Boll weight (g/open boll)** | 5.6 | 6.0 |
| **Retention posit's 1-3^** | 91% | 84% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 17 |
| **Days to 50% open bolls** | 179 | 180 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 80% | 60% |
| **Lint yield (kg/ha)** | 2079 | 1950 |


## Summary

Exposure to 50% of a typical field rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 15 nodes caused some leaf yellowing and cupping. There was a reduction in leaf number, leaf area and plant size.

Square and boll production were largely unaffected but there was a flush of late season bolls which didn't contribute to yield. There was no change in ginning turnout, fibre quality, or lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **1 + 3 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **18th Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **18 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 18 node cotton. Photo taken on 9th Feb, 22 days after exposure.

Mild symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 22 days after exposure with mild yellowing and cupping of the newly expanded leaves.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 18 node cotton. Photo taken on 15th Feb, 28 days after exposure.

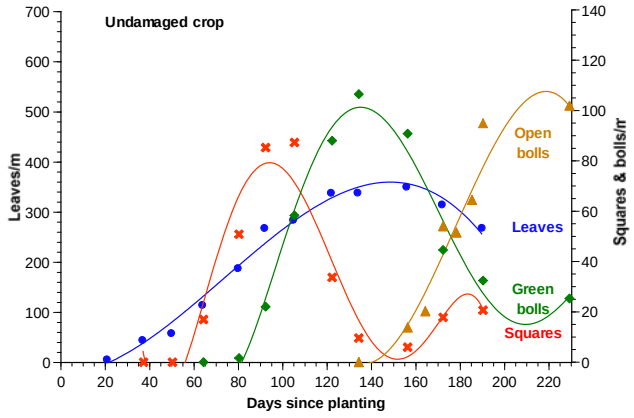
No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained obvious 28 days after exposure.

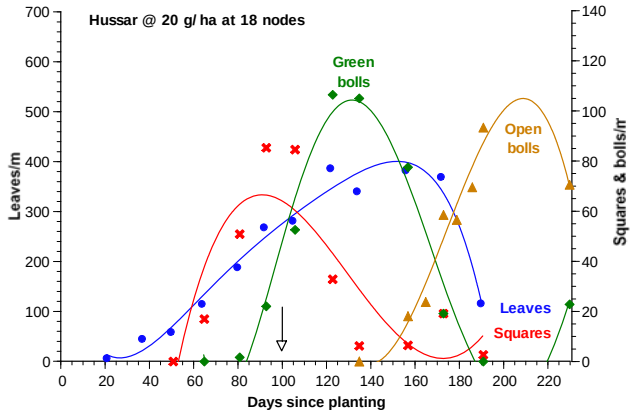
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 18 node cotton. Photo taken on 22nd Feb, 35 days after exposure.

There were no symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage 35 days after exposure.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 20 g/ha to 18 node cotton. Photo taken on 14th Mar, 56 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 56 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 18 nodes caused some cupping and yellowing on the newly expanded leaves, and reduced plant size and leaf area. Plants had reduced internode lengths and were 11 cm and 39% smaller by weight at picking.

**Leaves:** the herbicide caused some leaf yellowing and cupping. Plants shed leaves late in the season, retaining 57% fewer leaves and 51% less leaf area at defoliation.

**Squares**: there was no change in the pattern of square production.

**Bolls:** there was no change in early boll retention or the pattern of boll retention, but plants shed bolls late in the season, retaining 31% fewer open bolls at picking. There was no delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure but there was an 11% reduction in lint yield.

**Final plant data**

| | undamaged comparison | iodosulfuron + mefenpyr 10% @ 18 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.5 |
| **Leaves/m*** | 268 | 115 |
| **Leaf area (cm²/m)*** | 6144 | 3008 |
| **Reduction in leaf area*** | | 51% |
| **Bolls/m** | 127 | 93 |
| **Boll weight (g/open boll)** | 5.6 | 5.2 |
| **Retention posit's 1-3^** | 91% | 96% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 - 17 |
| **Days to 50% open bolls** | 179 | 170 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 80% | 76% |
| **Lint yield (kg/ha)** | 2079 | 1844 |


## Summary

Exposure to 10% of a typical field rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 18 nodes caused some leaf cupping and yellowing at the top of the plant and reduced subsequent leaf number, leaf area and plant size.

This caused some changes to the pattern of boll production, with plants shedding late-season squares and bolls. There was no reduction in ginning turnout or fibre quality, but there was an 11% reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **iodosulfuron-methyl sodium + mefenpyr diethyl** |
| **Rate:** | **5 + 15 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **18th Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **18 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 12 months

### iodosulfuron-methyl sodium

**Soil half-life:** 1 - 3 days, but the main breakdown product is metsulfuron-methyl (up to 89%), which has a plant-back to cotton that can exceed 2 years

### mefenpyr diethyl

**Soil half-life:** < 10 days

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 18 node cotton. Photo taken on 9th Feb, 22 days after exposure.

Strong symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were apparent 22 days after exposure, with bright yellowing of the newly expanding leaves and reddening of the veins.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 18 node cotton. Photo taken on 15th Feb, 28 days after exposure.

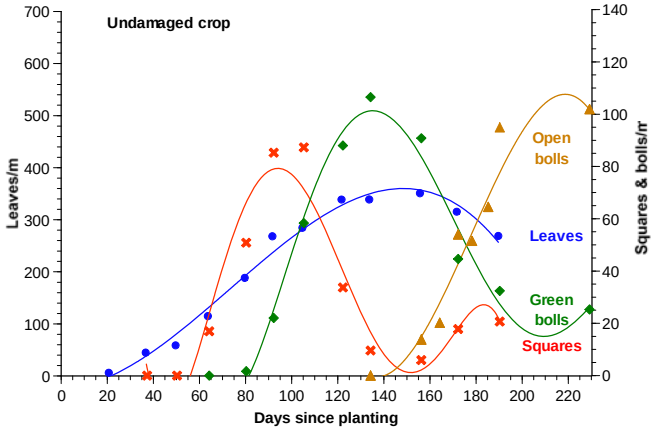
The symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage were strongly apparent 28 days after exposure with cupping and strong yellowing of the new leaves of both the main growing tips and the lateral branches. The new growth was bunched with shortened internodes.

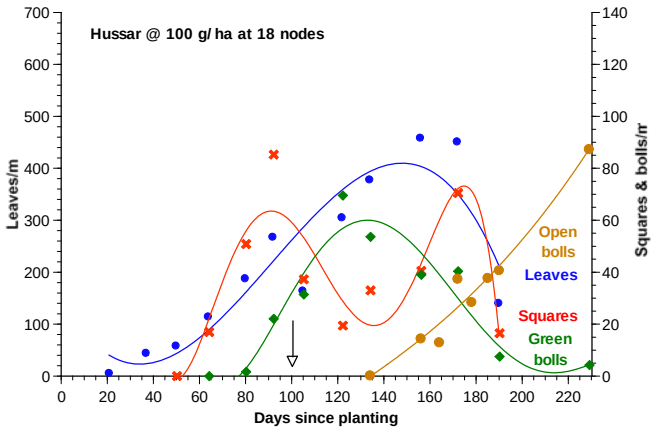
Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 18 node cotton. Photo taken on 22nd Feb, 35 days after exposure.

The symptoms of the herbicide damage were still strongly apparent 35 days after exposure, with yellowing of the new leaves and bunching at the growing tips.

Hussar® (iodosulfuron-methyl sodium + mefenpyr diethyl) applied broadcast at 100 g/ha to 15 node cotton. Photo taken on 14th Mar, 56 days after exposure.

No symptoms of iodosulfuron-methyl sodium + mefenpyr diethyl damage remained 56 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 18 nodes caused cupping and yellowing of new leaves, and reduced plant size and leaf area. Plants had reduced internode lengths and were 8 cm and 62% smaller by weight at defoliation.

**Leaves:** the herbicide caused strong yellowing and cupping of the new leaves. There was a reduction in leaf area and a loss of leaves late-season, with 48% fewer leaves and 45% less leaf area at defoliation.

**Squares**: plants produced a flush of mid- and late-season squares.

**Bolls:** there was a 35% reduction in peak boll retention, plants retained 28% fewer bolls at picking and average boll maturity was delayed by 17 days.

**Lint**: ginning turnout was down by 5% and fibre quality fell below base grade, with reduced fibre length and strength, a 21% increase in short fibres and reduced maturity (micronaire of 3.91 compared to 4.48 for the undamaged crop). Lint yield was reduced by 51%.

**Final plant count data**

| | undamaged comparison | iodosulfuron + mefenpyr 50% @ 18 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.1 |
| **Leaves/m*** | 268 | 140 |
| **Leaf area (cm²/m)*** | 6144 | 3387 |
| **Reduction in leaf area*** | | 63% |
| **Bolls/m** | 127 | 91 |
| **Boll weight (g/open boll)** | 5.6 | 5.2 |
| **Retention posit's 1-3^** | 91% | 93% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 17 |
| **Days to 50% open bolls** | 179 | 196 |
| **Maturity delay (days)** | | 17 |
| **% Open bolls at picking** | 80% | 95% |
| **Lint yield (kg/ha)** | 2079 | 1011 |


## Summary

Exposure to 50% of a typical field rate of iodosulfuron-methyl sodium + mefenpyr diethyl at 18 nodes caused strong leaf yellowing and cupping. There was a reduction in leaf number, leaf area, internode length and plant size.

Square production and boll retention were both affected with fewer bolls retained and a flush of late season squares. Average boll maturity was delayed by 17 days. Ginning turnout was down, fibre quality reduced below base grade and lint yield was down by 51%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **24 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 9 days after crop emergence.

Initial symptoms of imazapic damage were apparent on emerging seedlings, with some yellowing/bleaching and sagging of the cotyledons.

Flame® (imazapic) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 12th Nov, 17 days after crop emergence.

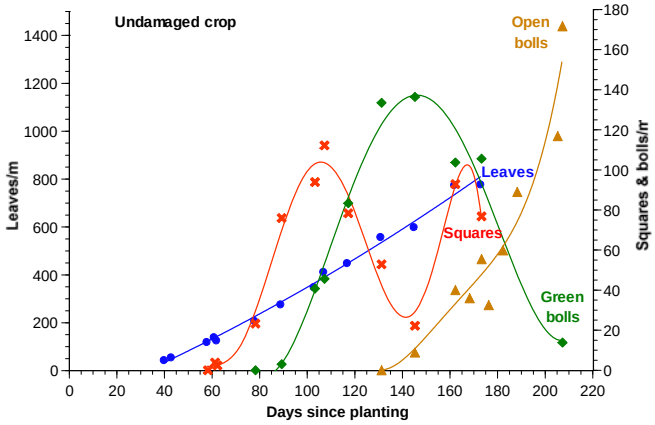
Seedlings displayed a wide range of symptoms 17 days after emergence, ranging from minimal symptoms of damage, through to yellowing, bleaching, necrotic spots and completely down-tuned cotyledons. The stems of some seedlings failed to elongate, leaving the cotyledons at ground level.

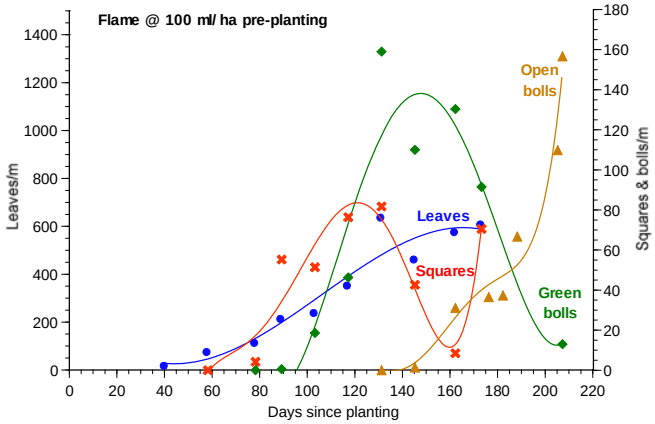
Flame® (imazapic) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 9th Dec, 44 days after crop emergence.

Some seedlings continued to show strong symptoms of damage 44 days after crop emergence, and did not develop beyond the cotyledon stage. Other seedlings were less affected, with some inter-vienal yellowing and bleaching and necrotic spots on the lower leaves.

Flame® (imazapic) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 7th Jan, 73 days after crop emergence.

Many seedlings continued to display strong symptoms of imazapic damage 73 days after crop emergence, with severe stunting (as seen in the bottom of this photo). However, a proportion of seedlings (less than 25%), developed normally.




## Impact on plant growth

**Plants**: exposure to residual imazapic caused extensive and prolonged damage to most plants, affecting plant growth and development. The final plant stand was reduced by 19%, an additional 16% of plants were tipped-out, and plants were shorter by 6 cm.

**Leaves:** the herbicide exposure caused yellowing, bleaching, necrosis, and cotyledon sagging. Plants had 22% fewer leaves and 19% less leaf area.

**Squares**: there was little change in the pattern of square production.

**Bolls:** the herbicide exposure had a small affect on boll retention, with some lower bolls shed and bolls retained 3 nodes higher up the plant. Plants had 9% fewer bolls at picking, boll weight was down 5%, and boll maturity was delayed by 5 days.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but the cotton was immature, with low micronaire (2.99) and reduced fibre strength. Lint yield was down by 25%.

**Final plant count data**

| | undamaged comparison | imazapic 50% pre-plant |
|---|---|---|
| **Nodes/plant** | 26.9 | 25.7 |
| **Leaves/m*** | 775 | 605 |
| **Leaf area (cm²/m)*** | 30138 | 24431 |
| **Reduction in leaf area*** | | 19% |
| **Bolls/m** | 186 | 170 |
| **Boll weight (g/open boll)** | 4.2 | 3.9 |
| **Retention posit's 1-3^** | 91% | 87% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 – 22 |
| **Days to 50% open** | 193 | 198 |
| **Maturity delay (days)** | | 5 |
| **% Open bolls at picking** | 92% | 91% |
| **Lint yield (kg/ha)** | 2099 | 1576 |

## Summary

Exposure to 50% of a typical field rate of residual imazapic caused extensive and prolonged damage to most plants, reducing the plant stand, and stunting and tipping-out surviving plants.

The herbicide had little affect on square production or boll retention and development, although some lower bolls were shed. Plants had fewer, smaller bolls at picking, there was a delay in boll maturity, fibre quality was reduced and lint yield was down by 25%.

**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **4.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **25th Nov** (4 weeks post-emergence) |
| **Growth stage at exposure:** | **4 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 20 ml/ha to 4 node cotton. Photo taken on 9th Dec, 14 days after exposure.

Symptoms of imazapic damage were apparent soon after exposure, with necrotic spots and some yellowing and reddening of the older leaves. Damage was more evident on newly emerged leaves, with stunting, cupping, underlying yellowing and distinct reddening of the leaves, and reddening of the leaf margins and veins. Petioles were bright red.

Flame® (imazapic) applied broadcast at 20 ml/ha to 4 node cotton. Photo taken on 14th Dec, 19 days after exposure.

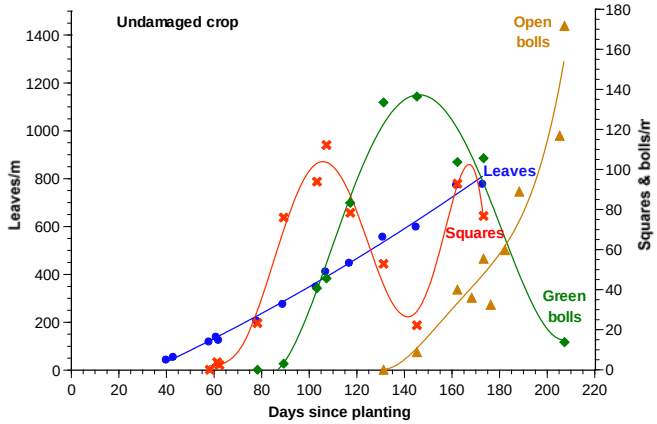
Most of the red had faded from the leaves by 19 days after exposure, but leaves remained a pale green/yellow. The petioles of young leaves remained bright red.

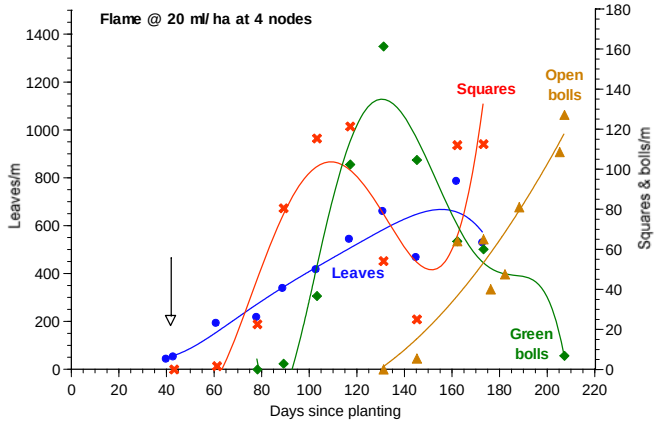
Flame® (imazapic) applied broadcast at 20 ml/ha to 4 node cotton. Photo taken on 22nd Dec, 27 days after exposure.

Few symptoms of damage remained after 27 days, although the upper leaves were still light green/yellowish. The leaf veins were also yellowish, with red streaks radiating from the petioles of some leaves.

Flame® (imazapic) applied broadcast at 20 ml/ha to 4 node cotton. Photo taken on 29th Dec, 34 days after exposure.

No symptoms of imazapic damage remained 34 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazapic at 4 nodes caused some damage to the young cotton plants which were 5 cm shorter and 36% smaller by weight at the final observation.

**Leaves:** the herbicide exposure caused some damage to the upper leaves and delayed plant growth. Plants had 32% fewer leaves and 31% less leaf area at the final observation.

**Squares**: the herbicide damage did not appear to affect squaring.

**Bolls:** there was no apparent affect on boll initiation or retention until late in the season when some bolls were shed. Plants retained 26% fewer open bolls at picking.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazapic 10% @ 4 nodes** |
| **Nodes/plant** | 26.9 | 25.8 |
| **Leaves/m*** | 775 | 528 |
| **Leaf area (cm²/m)*** | 30138 | 20910 |
| **Reduction in leaf area*** | | 31% |
| **Bolls/m** | 186 | 134 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention posit's 1-3^** | 91% | 96% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 - 18 |
| **Days to 50% open** | 193 | 187 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 95% |
| **Lint yield (kg/ha)** | 2099 | 2119 |


## Summary

Exposure to 10% of a typical field rate of imazapic at 4 nodes caused some damage to the young plants, reducing plant height and size, leaf production and leaf area.

There was no delay in square or boll initiation and no reduction in peak square or boll production, but plants shed bolls later in the season. There was a reduction in the number of open bolls at picking, but no delay in crop maturity, no affect on fibre quality and no reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **24 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **25th Nov (4 weeks post-emergence)** |
| **Growth stage at exposure:** | **4 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 100 ml/ha to 4 node cotton. Photo taken on 9th Dec, 14 days after exposure.

Symptoms of imazapic damage were apparent soon after exposure on the older leaves, with necrotic spots and patches and some yellowing and reddening. Damage was more evident on newly emerged leaves, with stunting, cupping, underlying yellowing and distinct reddening of the leaves, and reddening of the leaf margins and veins. The petioles were bright red.

Flame® (imazapic) applied broadcast at 100 ml/ha to 4 node cotton. Photo taken on 22nd Dec, 27 days after exposure.

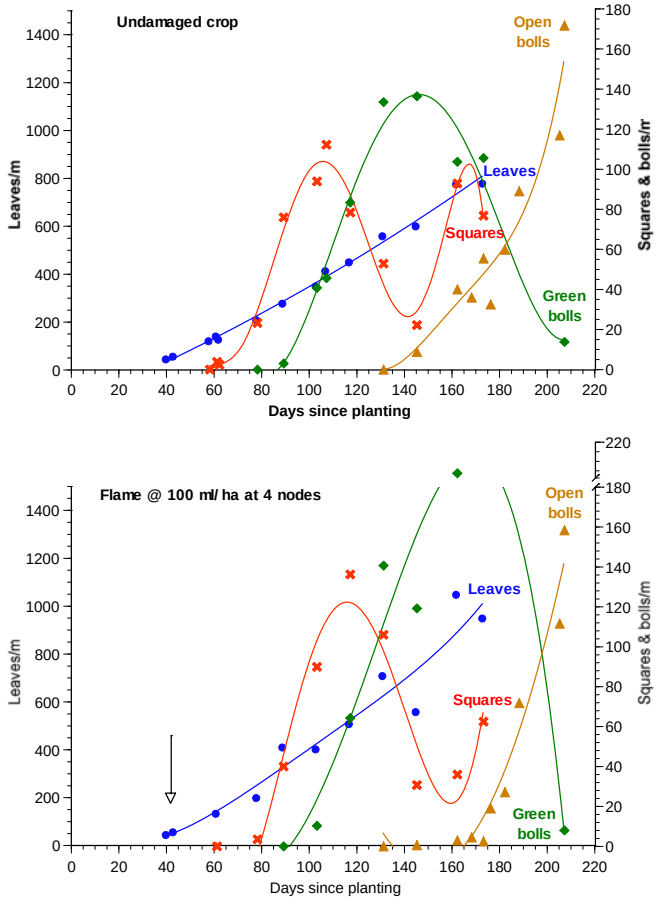
Damage was evident on the upper leaves, which were bright yellow and with red patches, and reddening of the leaf margins and veins. The petioles were bright red and red streaks radiated out from the petioles along the veins of some leaves 27 days after exposure.

Flame® (imazapic) applied broadcast at 100 ml/ha to 4 node cotton. Photo taken on 7th Jan, 43 days after exposure.

Some of the upper leaves were still light green/yellowish 43 days after exposure. The leaf veins were also yellowish, with red streaks radiating from the petioles of some leaves.

Flame® (imazapic) applied broadcast at 100 ml/ha to 4 node cotton. Photo taken on 17 Jan, 53 days after exposure.

No symptoms of imazapic damage remained on most leaves 53 days after exposure, although a few leaves were still pale yellowish.




## Impact on plant growth

**Plants**: exposure to imazapic at 4 nodes caused extensive leaf discolouration to the young cotton plants and delayed plant growth. However, there was no reduction in plant height at picking and damaged plants were 38% larger by weight at the final observation.

**Leaves:** the herbicide exposure caused some damage to the upper leaves. Plants compensated for this damage and at the final observation had 22% more leaves and 26% more leaf area.

**Squares**: square initiation was delayed by around 20 days, but there was no reduction in peak squaring.

**Bolls:** boll initiation was delayed by 15 days but plants retained a large number of green bolls 3 nodes higher up the plant. There was a 30 day delay in initial boll opening, but only an 8% reduction in the number of open bolls at picking. There was no delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 6% reduction in lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazapic 50% @ 4 nodes** |
| **Nodes/plant** | 26.9 | 27.3 |
| **Leaves/m*** | 775 | 945 |
| **Leaf area (cm²/m)*** | 30138 | 38058 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 166 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention posit's 1-3^** | 91% | 96% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 11 - 22 |
| **Days to 50% open** | 193 | 196 |
| **Maturity delay (days)** | | 3 |
| **% Open bolls at picking** | 92% | 94% |
| **Lint yield (kg/ha)** | 2099 | 1972 |


## Summary

Exposure to 50% of a typical field rate of imazapic at 4 nodes caused extensive discolouration and delayed crop development. Plants compensated for the damage and were larger, with more leaves and more leaf area late in the season.

The damage delayed square and boll initiation, but had little effect on boll retention and development. Plants had fewer bolls at picking. There was no delay in crop maturity or reduction in fibre quality and only a 6% reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **4.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **15th Dec (7 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 20 ml/ha to 9 node cotton. Photo taken on 22nd Dec, 7 days after exposure.

Symptoms of imazapic damage were apparent on the younger leaves soon after exposure, with yellowing of the leaves and main veins and some distinct yellow patches on the leaves. The petioles were bright red and some red streaks radiated from the petioles down the main veins.

Flame® (imazapic) applied broadcast at 20 ml/ha to 9 node cotton. Photo taken on 29th Dec, 14 days after exposure.

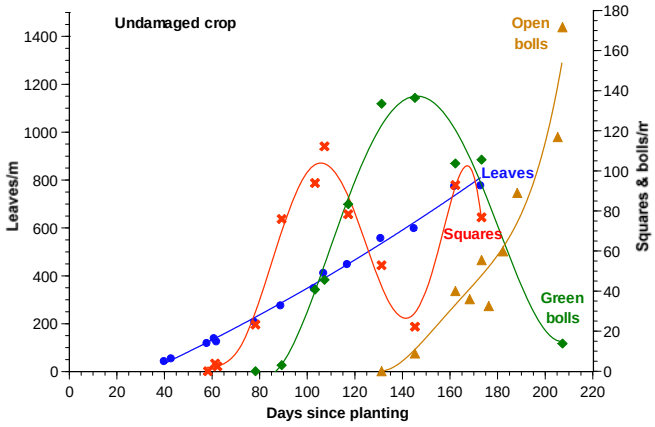
Most of the yellow had faded from the leaves 14 days after exposure, but some yellowish patches and yellowing of the main veins were still evident, as well as some red and necrotic patches.

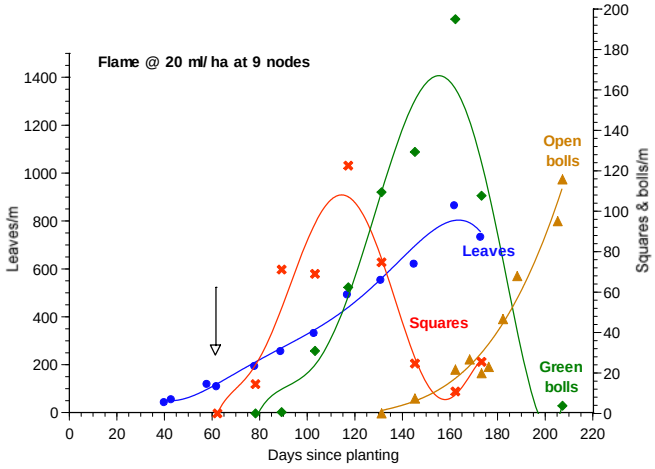
Flame® (imazapic) applied broadcast at 20 ml/ha to 9 node cotton. Photo taken on 7th Jan, 23 days after exposure.

Few symptoms of imazapic damage remained 23 days after exposure, with just a few yellowish spots and patches still evident on the leaves.

Flame® (imazapic) applied broadcast at 20 ml/ha to 9 node cotton. Photo taken on 17th Jan, 33 days after exposure.

No symptoms of imazapic damage remained 33 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazapic at 9 nodes caused only minor to the plants but plants were 6 cm and 2 nodes shorter and 6% smaller by weight at the final observations.

**Leaves:** the herbicide exposure caused minor damage to the upper leaves. Plants had 6% fewer leaves at the final observation.

**Squares**: the herbicide damage did not appear to affect early squaring, but there was a marked reduction in the production of late-season squares.

**Bolls:** there was no apparent affect on boll initiation or retention until late in the season when plants set a large number of additional bolls (35% more than the undamaged plants) and then shed 41% of the boll load, retaining 33% fewer open boll at picking. There was no reduction in average boll weight or delay in average boll maturity, indicating that it was mainly late-season bolls which were shed.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 7% reduction in lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazapic 10% @ 9 nodes** |
| **Nodes/plant** | 26.9 | 24.9 |
| **Leaves/m*** | 775 | 731 |
| **Leaf area (cm²/m)*** | 30138 | 29302 |
| **Reduction in leaf area*** | | 3% |
| **Bolls/m** | 186 | 120 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention posit's 1-3^** | 91% | 87% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 11 – 22 |
| **Days to 50% open** | 193 | 190 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 96% |
| **Lint yield (kg/ha)** | 2099 | 1954 |


## Summary

Exposure to 10% of a typical field rate of imazapic at 9 nodes caused only minor leaf damage to the plants, but caused some stunting, reducing plant height, plant size and leaf number.

There was no apparent impact on square initiation or retention, but plants shed bolls both early and again later in the season. Plants retained fewer open bolls at picking, but there was no impact on boll size or maturity, or fibre quality. There was a 7% reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **24 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **15th Dec (7 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 100 ml/ha to 9 node cotton. Photo taken on 22nd Dec, 7 days after exposure.

Symptoms of imazapic damage were apparent soon after exposure, with yellowing of the leaves and main veins; some newly expanding leaves were bright yellow. The petioles were bright red and red streaks radiated from the petioles down the main veins.

Flame® (imazapic) applied broadcast at 100 ml/ha to 9 node cotton. Photo taken on 29th Dec, 14 days after exposure.

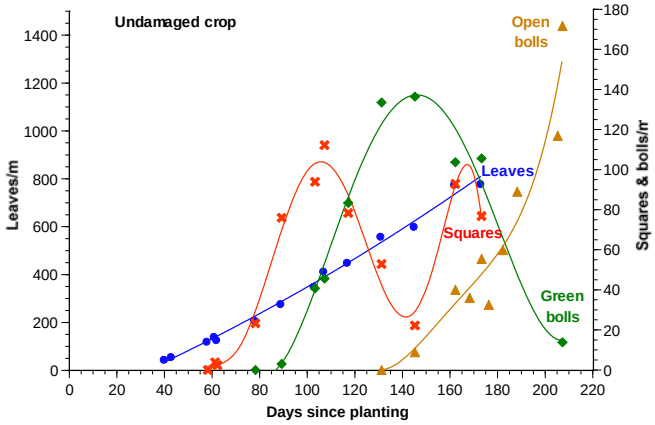
The younger leaves remain distinctly yellow 14 days after exposure to imazapic, with some of the yellow developing into a reddish, almost burned appearance. The yellowing of the main veins has faded, but the red petioles and the red streaks radiated from the petioles are still evident on some leaves.

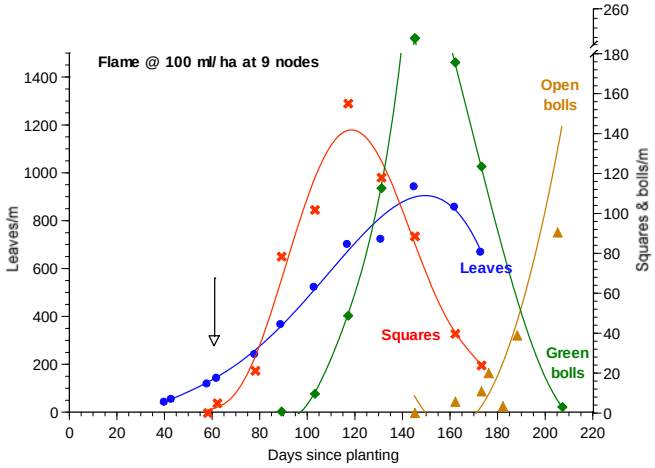
Flame® (imazapic) applied broadcast at 100 ml/ha to 9 node cotton. Photo taken on 7th Jan, 23 days after exposure.

The upper leaves remain distinctly yellowish 23 days after exposure to imazapic, with reddish areas.

Flame® (imazapic) applied broadcast at 100 ml/ha to 9 node cotton. Photo taken on 17th Jan, 33 days after exposure.

The yellowish colouration is fading from the leaves 33 days after exposure, although the reddish areas are now more distinct.
No symptoms of imazapic damage remain 44 days after exposure.




## Impact on plant growth

**Plants**: exposure to imazapic at 9 nodes caused extensive leaf damage. Plants were 15% smaller by weight at the final observation.

**Leaves:** the herbicide exposure caused extensive discolouration and damage to the upper leaves. Plants had 14% fewer leaves and 16% less leaf area at the final observation.

**Squares**: the herbicide damage did not appear to affect early squaring, but there was a marked reduction in the production of late-season squares.

**Bolls:** there was a 12 day delay in boll retention, with few bolls retained below 10 nodes, but plants went on to set a large number of additional bolls (54% more than the undamaged plants) and then shed 46% of that boll load. There was a 16% reduction in final boll weight and a 7 day delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 10% reduction in lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazapic 50% @ 9 nodes** |
| **Nodes/plant** | 26.9 | 25.8 |
| **Leaves/m*** | 775 | 667 |
| **Leaf area (cm²/m)*** | 30138 | 25339 |
| **Reduction in leaf area*** | | 16% |
| **Bolls/m** | 186 | 189 |
| **Boll weight (g/open boll)** | 4.2 | 3.5 |
| **Retention posit's 1-3^** | 91% | 92% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 10 – 22 |
| **Days to 50% open** | 193 | 200 |
| **Maturity delay (days)** | | 7 |
| **% Open bolls at picking** | 92% | 97% |
| **Lint yield (kg/ha)** | 2099 | 1891 |


## Summary

Exposure to 50% of a typical field rate of imazapic at 9 nodes caused extensive discolouration and damage to the upper leaves and affected plant size, leaf number and leaf area.

Squaring was largely unaffected, but boll retention was delayed and plants retained and then shed many mid-season bolls. There was a reduction in boll size, a delay in average boll maturity and a 10% reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **4.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 20 ml/ha to 12 node cotton. Photo taken on 21st Jan, 8 days after exposure.

Symptoms of imazapic damage were apparent on the younger leaves soon after exposure, with yellow patches on the leaves, sometimes covering most of the leaf. The main veins on some leaves were also paler than normal.

Flame® (imazapic) applied broadcast at 20 ml/ha to 12 node cotton. Photo taken on 28th Jan, 15 days after exposure.

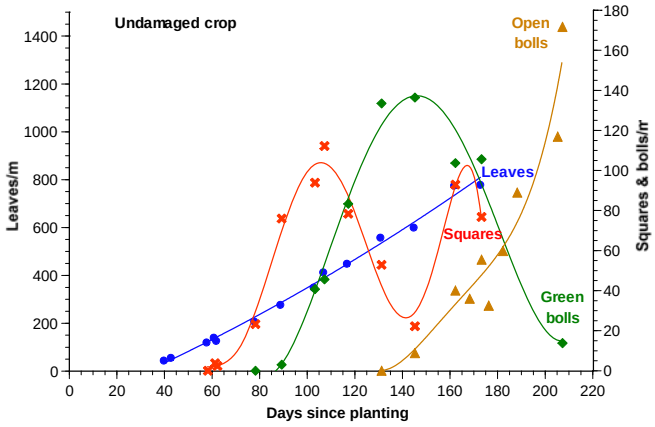
Most of the yellow had faded from the leaves 15 days after exposure, although the cop still appeared slightly yellow and the main veins on most leaves were pale.

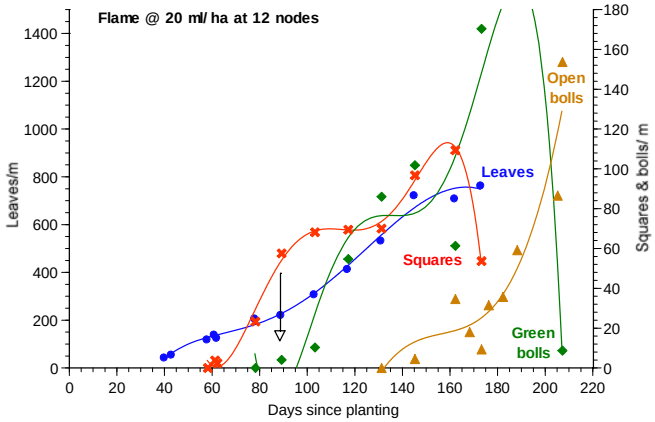
Flame® (imazapic) applied broadcast at 20 ml/ha to 12 node cotton. Photo taken on 7th Feb, 25 days after exposure.

No symptoms of imazapic damage remained 25 days after exposure.

Flame® (imazapic) applied broadcast at 20 ml/ha to 12 node cotton. Photo taken on 18th Feb, 36 days after exposure.

No symptoms of imazapic damage were visible 36 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazapic at 12 nodes appeared to cause only minor damage to the plants. Plants were 6 cm taller and 35% heavier at the final observation.

**Leaves:** the herbicide exposure caused transient yellowing on the upper leaves and a flush of late vegetative growth. Plants had 22% more leaf area at the last observation.

**Squares**: many squares were shed following the herbicide exposure delayed peak squaring by 40 days.

**Bolls:** plants shed bolls mid-season and produced a flush of green bolls later in the season, most of which were no retained at picking. There were 10% fewer open bolls at picking, a 9% reduction in average boll weight and a 6 day delay in average boll maturity.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but the cotton was below base-grade with 10.36% short fibres and lint yield was down by 39%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazapic 10% @ 12 nodes** |
| **Nodes/plant** | 26.9 | 26.7 |
| **Leaves/m*** | 775 | 761 |
| **Leaf area (cm²/m)*** | 30138 | 36909 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 162 |
| **Boll weight (g/open boll)** | 4.2 | 3.8 |
| **Retention posit's 1-3^** | 91% | 88% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 – 20 |
| **Days to 50% open** | 193 | 199 |
| **Maturity delay (days)** | | 6 |
| **% Open bolls at picking** | 92% | 95% |
| **Lint yield (kg/ha)** | 2099 | 1290 |


## Summary

Exposure to 10% of a typical field rate of imazapic at 12 nodes caused transient yellowing, followed by a flush of late-season vegetative growth, affecting plant size and leaf area.

Squares and bolls were shed following the exposure. Plants set a late-crop, most of which was subsequently shed. There was a reduction in the number of mature bolls at picking, boll weight was down and average boll maturity was delayed. Fibre quality was reduced and lint yield was down by 39%.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **24 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 100 ml/ha to 12 node cotton. Photo taken on 21st Jan, 8 days after exposure.

Symptoms of imazapic damage were apparent on the top leaves soon after exposure, with yellow spots and patches on the leaves, sometimes covering most of the leaf.

Flame® (imazapic) applied broadcast at 100 ml/ha to 12 node cotton. Photo taken on 28th Jan, 15 days after exposure.

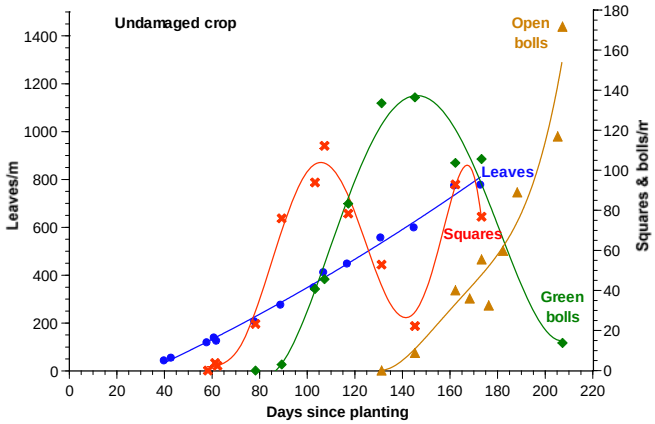
The yellow discolouration had begun to fade from some leaves, but yellow spots and patches were still very obvious on many of the upper leaves, especially the expanding leaves, many of which were entirely yellow 15 days after exposure.

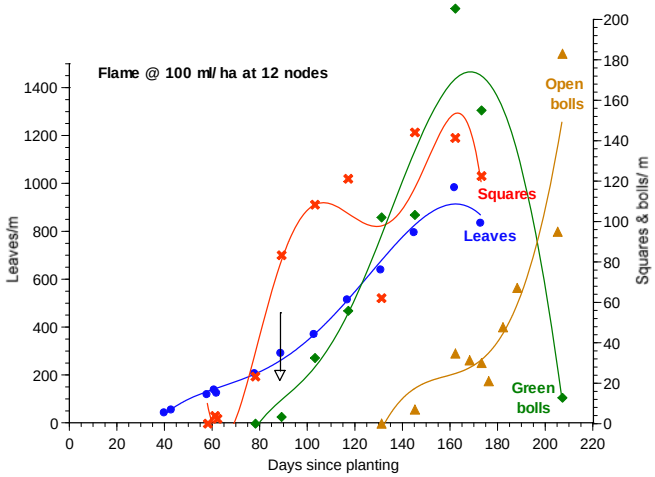
Flame® (imazapic) applied broadcast at 100 ml/ha to 12 node cotton. Photo taken on 7th Feb, 25 days after exposure.

Normal growth had overshadowed most of the discoloured leaves 25 days after exposure. However, bunched, cupped and distorted, yellow growth is obvious on the terminals of some main stems. These leaves have areas of reddish discolouration, especially on the leaf margins.

Flame® (imazapic) applied broadcast at 100 ml/ha to 12 node cotton. Photo taken on 18th Feb, 36 days after exposure.

No visible symptoms of imazapic damage remained 36 days after exposure.




## Impact on plant growth

**Plants**: exposure to imazapic at 12 nodes caused extensive damage to the plants, resulting in a flush of vegetative growth. Plants were 8 cm taller at the final observation, when compared to undamaged plants.

**Leaves:** the herbicide exposure caused extensive yellowing on the upper leaves and damaged the terminals of some stems. Plants produced a flush of late vegetative growth and had 7% more leaves and leaf area at the final observation.

**Squares**: many squares were shed following the herbicide exposure delayed peak squaring by 50 days.

**Bolls:** plants shed early-season bolls and set a heavy late-crop, much of which wasn't retained at picking. There was a 19% reduction in average boll weight and an 8 day delay in crop maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but lint yield was down by 52%, even though plants retained 7% more open bolls at picking than the undamaged crop.

**Final plant count data**

| | undamaged comparison | imazapic 50% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 28.2 |
| **Leaves/m*** | 775 | 833 |
| **Leaf area (cm²/m)*** | 30138 | 32608 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 196 |
| **Boll weight (g/open boll)** | 4.2 | 3.4 |
| **Retention posit's 1-3^** | 91% | 89% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 - 20 |
| **Days to 50% open** | 193 | 201 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 92% | 92% |
| **Lint yield (kg/ha)** | 2099 | 1003 |


## Summary

Exposure to 50% of a typical field rate of imazapic at 12 nodes caused yellowing of the upper leaves and some terminal damage to the plants, triggering additional vegetative growth.

Early-season squares and bolls were shed following the herbicide exposure, but plants set additional late bolls, resulting in no reduction in boll number at picking. There was a reduction in boll weight, a delay in average boll maturity and a 52% reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **4.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **31st Jan (14 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 20 ml/ha to 16 node cotton. Photo taken on 7th Feb, 7 days after exposure.

Few symptoms of imazapic damage were apparent 7 days after exposure other than some yellowing of the younger leaves at the top of the crop.

Flame® (imazapic) applied broadcast at 20 ml/ha to 16 node cotton. Photo taken on 18th Feb, 18 days after exposure.

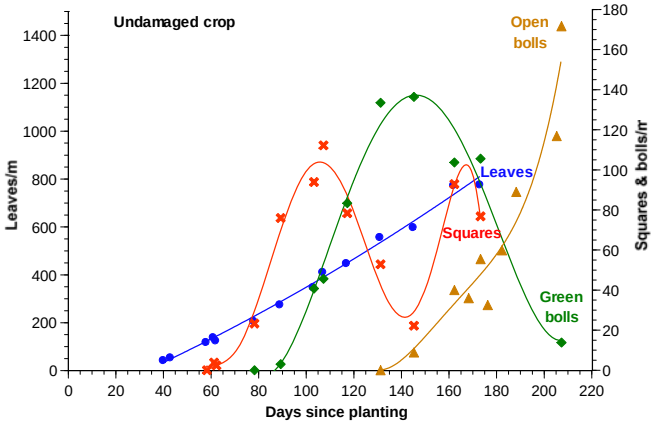
Yellowish patches were visible on some of the terminal leaves 18 days after exposure. On some leaves the yellow appearance was general, while on other leaves it was inter-vienal.

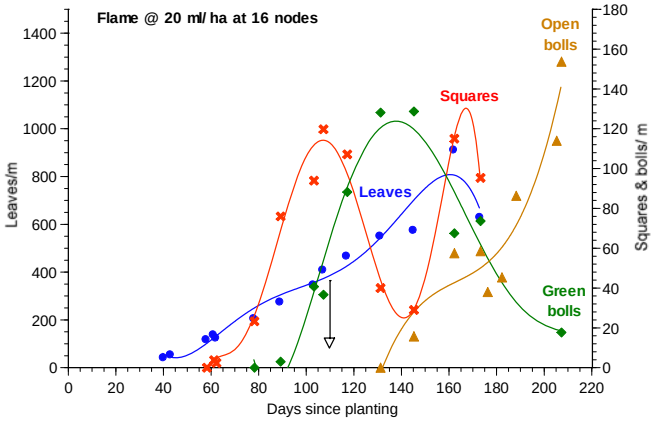
Flame® (imazapic) applied broadcast at 20 ml/ha to 16 node cotton. Photo taken on 3rd Mar, 31 days after exposure.

No symptoms of imazapic damage remained 31 days after exposure.

Flame® (imazapic) applied broadcast at 20 ml/ha to 12 node cotton. Photo taken on 14th Mar, 42 days after exposure.

No symptoms of imazapic damage were visible 42 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazapic at 16 nodes caused only minor damage, although the plants were 25% lighter at the final observation, when compared to undamaged plants.

**Leaves:** the herbicide exposure caused transient yellowing on the upper leaves and some stunting. Plants had 19% fewer leaves and 16% less leaf area at the final observation.

**Squares**: the herbicide damage didn't affect squaring appreciably.

**Bolls:** the herbicide didn't affect boll set or boll retention appreciably, although some bolls were lost mid-season. Plants had 8% fewer bolls and 10% fewer open bolls at picking. There was no reduction in boll weight or delay in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final plant count data**

| | undamaged comparison | imazapic 10% @ 16 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 26.5 |
| **Leaves/m*** | 775 | 628 |
| **Leaf area (cm²/m)*** | 30138 | 25196 |
| **Reduction in leaf area*** | | 16% |
| **Bolls/m** | 186 | 171 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention posit's 1-3^** | 91% | 93% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 8 – 18 |
| **Days to 50% open** | 193 | 194 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 90% |
| **Lint yield (kg/ha)** | 2099 | 2008 |


## Summary

Exposure to 10% of a typical field rate of imazapic at 16 nodes caused transient yellowing to the plants, and affected subsequent growth and development. Plants were smaller and had fewer leaves and less leaf area late in the season.

There was no obvious impact on squaring. Some bolls were shed later in the season, with a reduction in the number of open bolls at picking, but there was no delay in average boll maturity, or reduction in lint quality or lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazapic** |
| **Rate:** | **24 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **31st Jan** |
| | **(14 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity, with a 2 year plant-back period to cotton
**Soil half-life:** 120 days and is relatively immobile in the soil.

Flame® (imazapic) applied broadcast at 100 ml/ha to 16 node cotton. Photo taken on 7th Feb, 7 days after exposure.

Few symptoms of imazapic damage were apparent 7 days after exposure other than yellowing of the younger terminal leaves and yellowish spots and patches on the older terminal leaves.

Flame® (imazapic) applied broadcast at 100 ml/ha to 16 node cotton. Photo taken on 18th Feb, 18 days after exposure.

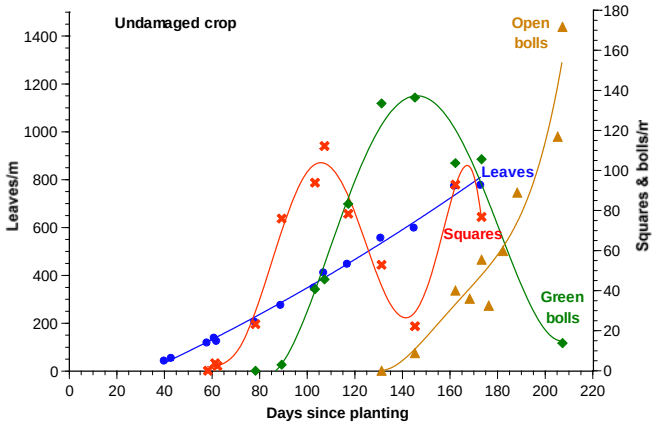
Yellowish patches were still visible on some of the terminal leaves 18 days after exposure. On some leaves the yellow appearance was general, while on other leaves it was inter-vienal.

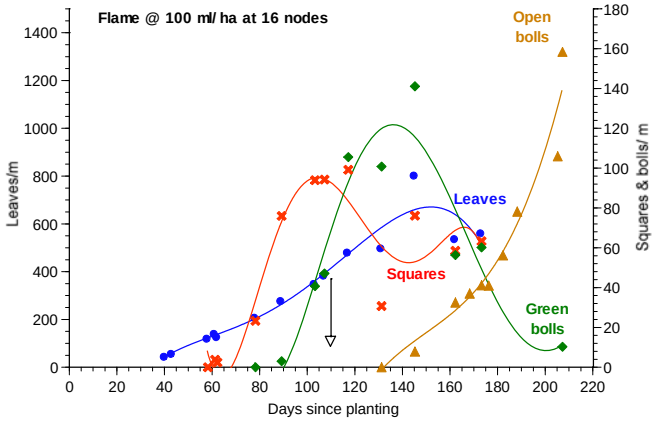
Flame® (imazapic) applied broadcast at 100 ml/ha to 16 node cotton. Photo taken on 3rd Mar, 31 days after exposure.

No symptoms of imazapic damage remained 31 days after exposure.

Flame® (imazapic) applied broadcast at 100 ml/ha to 12 node cotton. Photo taken on 14th Mar, 42 days after exposure.

No symptoms of imazapic damage were visible 42 days after exposure.




## Impact on plant growth

**Plants**: exposure to imazapic at 16 nodes appeared to cause only minor damage to the plants, but plants were 36% lighter at the final observation, when compared to undamaged plants.

**Leaves:** the herbicide exposure caused transient yellowing on the terminal leaves and some stunting. Plants had 28% fewer leaves and 25% less leaf area at the final observation.

**Squares**: the damage reduced peak squaring and the normal flush of later-season squares.

**Bolls:** the herbicide didn't affect boll set or boll retention until late in the season, when many small bolls were shed. Plants had 9% fewer bolls at picking and average boll weight was down by 18%. There was no change in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 32% reduction in lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazapic 50% @ 16 nodes** |
| **Nodes/plant** | 26.9 | 27.0 |
| **Leaves/m*** | 775 | 557 |
| **Leaf area (cm²/m)*** | 30138 | 22749 |
| **Reduction in leaf area*** | | 25% |
| **Bolls/m** | 186 | 169 |
| **Boll weight (g/open boll)** | 4.2 | 3.4 |
| **Retention posit's 1-3^** | 91% | 94% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 8 – 18 |
| **Days to 50% open** | 193 | 193 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 94% |
| **Lint yield (kg/ha)** | 2099 | 1437 |


## Summary

Exposure to 50% of a typical field rate of imazapic at 16 nodes caused transient yellowing to the plants, and affected subsequent growth and development. There was a reduction in plant size, leaf number and leaf area late in the season.

Some squares and bolls were shed following the exposure. Plants retained fewer bolls at picking and there was a large reduction in average boll weight, but there was no impact on average boll maturity or fibre quality. There was a 32% reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **2.5 + 1.1 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **10th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **X** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **X** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 18 days after crop emergence.

Symptoms of imazamox + imazapyr damage were apparent on most seedlings at emergence, with some seedlings dying soon after emergence and surviving seedlings damaged with sagging cotyledons and reddening of the petioles.

Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha and incorporated prior to planting cotton. Photo taken on 21st Nov, 35 days after crop emergence.

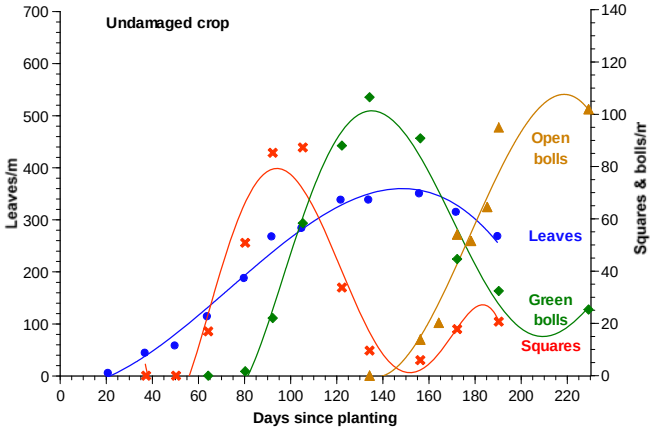
The surviving seedlings were still obviously affected by the herbicide 35 days after emergence. Seedlings were stunted, many still at the cotyledon stage, most other seedlings with cupped and stunted new leaves with areas of reddening.

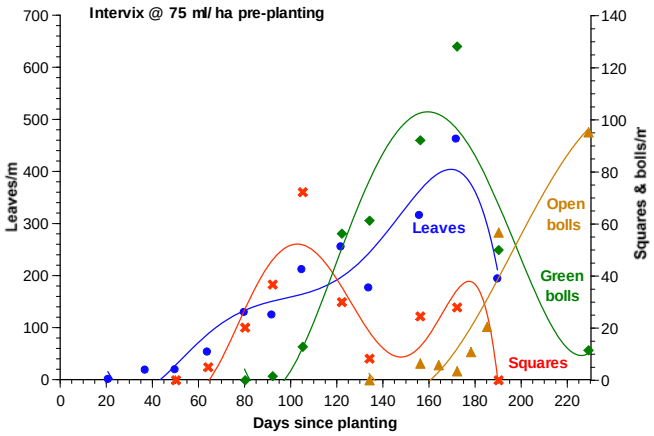
Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha and incorporated prior to planting cotton. Photo taken on 16th Dec, 60 days after crop emergence.

Plants were resuming normal growth 60 days after emergence, but were still noticeably shorter than the undamaged plants, with a long delay in development, some seedlings still at little more than cotyledon growth stage.

Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha and incorporated prior to planting cotton. Photo taken on 17th Jan, 92 days after crop emergence.

No symptoms of imazamox + imazapyr damage remained 92 days after emergence except a reduction in the plant stand and a delay in plant growth and development.




## Impact on plant growth

**Plants**: exposure to the lighter rate of residual imazamox + imazapyr killed some seedlings, reducing the plant stand by 20%. Most surviving seedlings were damaged and stunted. Plants compensated for the early-season damage but lost late leaves and produced a delayed crop.

**Leaves:** the herbicide caused extensive cotyledon damage, with leaf discolouration, cupping and stunting. Plants compensated with late growth but had 28% fewer leaves and had 29% less leaf area at defoliation.

**Squares**: there was a 15 day delay in the start of square production.

**Bolls:** there was a 10 day delay in initial boll retention, with peak boll retention delayed by 15 days and the first open bolls by 20 days. Plants shed some early bolls and there was an 11 day delay in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final plant count data**

| | undamaged comparison | imazamox + imazapyr 10% pre-plant |
|---|---|---|
| **Nodes/plant** | 24.9 | 24.4 |
| **Leaves/m*** | 268 | 193 |
| **Leaf area (cm²/m)*** | 6144 | 4353 |
| **Reduction in leaf area*** | | 29% |
| **Bolls/m** | 127 | 107 |
| **Boll weight (g/open boll)** | 5.6 | 5.2 |
| **Retention posit's 1-3^** | 91% | 87% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 18 |
| **Days to 50% open bolls** | 179 | 190 |
| **Maturity delay (days)** | | 11 |
| **% Open bolls at picking** | 80% | 89% |
| **Lint yield (kg/ha)** | 2079 | 1987 |


## Summary

Exposure to 10% of a typical field rate of residual imazamox + imazapyr killed some seedlings and caused cotyledon damage to most survivors, delaying early crop growth and development by up to 60 days.

Square and boll production were delayed and some early bolls were shed. Plants compensated for this damage, although average crop maturity was delayed by 11 days. There was no reduction in ginning turnout, fibre quality or lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **12.4 + 5.6 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **10th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **X** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **X** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 375 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 18 days after crop emergence.

Symptoms of imazamox + imazapyr damage were apparent on most seedlings at emergence, with some seedlings dying soon after emergence and surviving seedlings damaged with sagging cotyledons and reddening of the petioles.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha and incorporated prior to planting cotton. Photo taken on 21st Nov, 35 days after crop emergence.

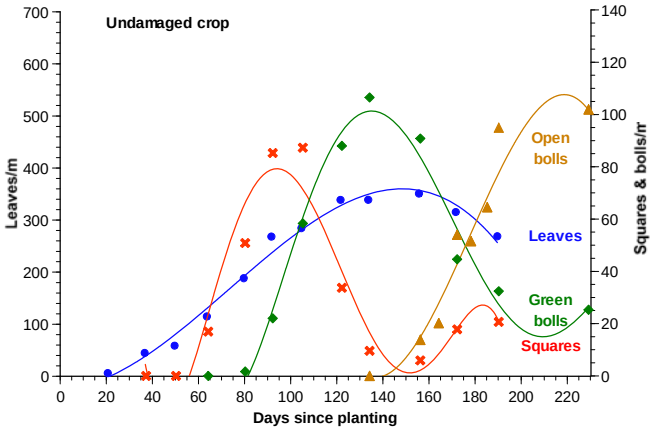
The surviving seedlings were still obviously affected by the herbicide 35 days after emergence. Seedlings were stunted, many still at the cotyledon stage and other seedlings with cupped and stunted new leaves with areas of reddening.

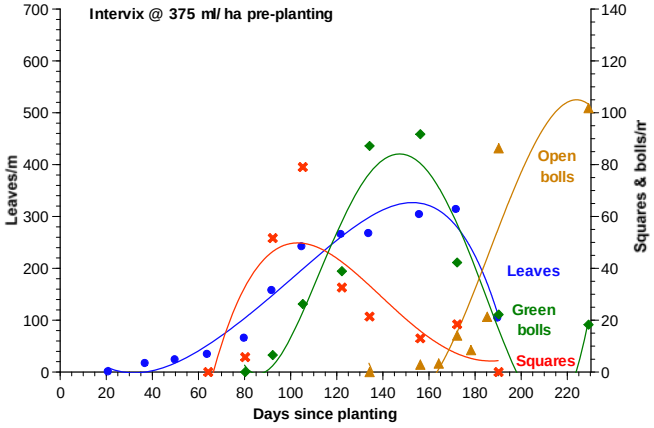
Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha and incorporated prior to planting cotton. Photo taken on 16th Dec, 60 days after crop emergence.

Some plants had resumed normal growth 60 days after emergence, but were still noticeably shorter than the undamaged plants, with a long delay in development, some seedlings still at little more than cotyledon growth stage, with cupped and stunted new leaves with areas of reddening.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha and incorporated prior to planting cotton. Photo taken on 17th Jan, 92 days after crop emergence.

Symptoms of imazamox + imazapyr damage remained obvious 92 days after emergence, with a reduction in the plant stand and a long delay in plant growth and development. Many plants were still in the seedling growth stage with cupped and stunted new leaves with areas of reddening.




## Impact on plant growth

**Plants**: exposure to the heavier rate of residual imazamox + imazapyr killed some seedlings, reducing the plant stand by 35%. Most surviving seedlings were damaged and stunted. Damage was still obvious mid-season and the crop was unable to compensate for the damage.

**Leaves:** the herbicide caused extensive cotyledon damage, with leaf cupping, stunting and discolouration. Plant growth was delayed. Plants were 20% smaller by weight, with 61% fewer leaves and 47% less leaf area at defoliation.

**Squares**: there was a 10 day delay in the start of square production.

**Bolls:** there was a 10 day delay in initial boll retention, with peak boll retention delayed by 15 days and the first open bolls by 20 days. Plants shed some early bolls, with 23% fewer bolls retained in the positions 1 – 3, and there was a 9 day delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 44% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | imazamox + imazapyr 50% pre-plant |
|---|---|---|
| **Nodes/plant** | 24.9 | 23.5 |
| **Leaves/m*** | 268 | 104 |
| **Leaf area (cm²/m)*** | 6144 | 3277 |
| **Reduction in leaf area*** | | 47% |
| **Bolls/m** | 127 | 120 |
| **Boll weight (g/open boll)** | 5.6 | 5.7 |
| **Retention posit's 1-3^** | 91% | 70% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 18 |
| **Days to 50% open bolls** | 179 | 188 |
| **Maturity delay (days)** | | 9 |
| **% Open bolls at picking** | 80% | 85% |
| **Lint yield (kg/ha)** | 2079 | 1164 |


## Summary

Exposure to 50% of a typical field rate of residual imazamox + imazapyr killed some seedlings and caused cotyledon damage to most survivors, causing a long delay in early crop growth and development.

Square and boll production were delayed and some early bolls were shed. Most bolls were retained on a small percentage of largely undamaged plants. Average crop maturity was delayed by 9 days. There was no reduction in ginning turnout or fibre quality but lint yield was reduced by 44%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **2.5 + 1.1 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **20th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **X** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 5 node cotton. Photo taken on 5th Dec, 15 days after exposure.

Symptoms of imazamox + imazapyr damage were apparent soon after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves. There was also some discolouration and crinkling on the older leaves.

Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 5 node cotton. Photo taken on 16th Dec, 26 days after exposure.

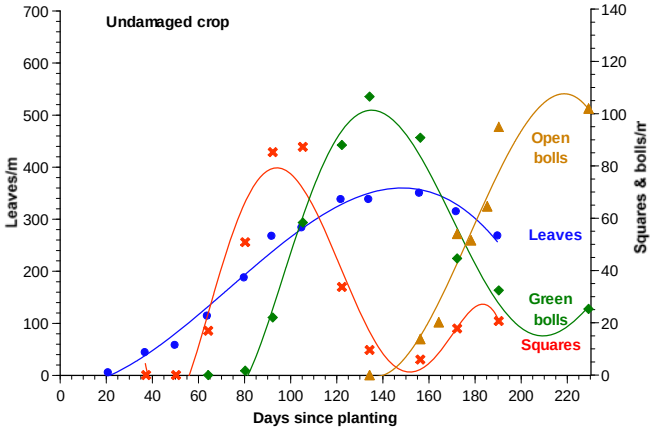
No symptoms of the herbicide damage remained 26 days after exposure.

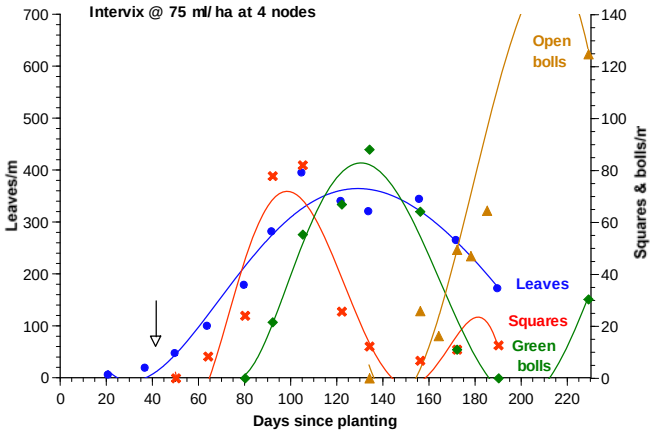
Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 5 node cotton. Photo taken on 29th Dec, 39 days after exposure.

No symptoms of the herbicide damage were apparent 39 days after exposure.

Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 5 node cotton. Photo taken on 17th Jan, 58 days after exposure.

No symptoms of the herbicide damage were apparent 58 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazamox + imazapyr at 5 nodes initially caused strong leaf discolouration and petiole reddening, but plants soon recovered from this damage. However, there were some season-long effects and plants were 18% smaller by weight with fewer leaves and leaf area at defoliation.

**Leaves:** the herbicide initially caused extensive leaf discolouration. Plants lost leaves later in the season and had 36% fewer leaves and 39% less leaf area at defoliation.

**Squares**: there were no obvious impacts on square production.

**Bolls:** there were few obvious impacts on boll retention. There was a 17% reduction in peak green boll retention and a reduction in average boll size, but plants retained 22% more mature bolls at picking with no delay in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final plant data**

| | undamaged comparison | imazamox + imazapyr 10% @ 5 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 22.8 |
| **Leaves/m*** | 268 | 171 |
| **Leaf area (cm²/m)*** | 6144 | 3740 |
| **Reduction in leaf area*** | | 39% |
| **Bolls/m** | 127 | 155 |
| **Boll weight (g/open boll)** | 5.6 | 4.6 |
| **Retention posit's 1-3^** | 91% | 93% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 16 |
| **Days to 50% open bolls** | 179 | 181 |
| **Maturity delay (days)** | | 2 |
| **% Open bolls at picking** | 80% | 80% |
| **Lint yield (kg/ha)** | 2079 | 2019 |


## Summary

Exposure to 10% of a typical field rate of imazamox + imazapyr at 5 nodes initially caused strong leaf discolouration and petiole reddening. Plants compensated for this damage but were smaller, with fewer leaves and less leaf area at defoliation.

Square and boll production were largely unaffected, with plants retaining more smaller bolls at picking. There was no delay in average crop maturity and no reduction in ginning turnout, fibre quality or lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **12.4 + 5.6 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **20th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 5 node cotton. Photo taken on 5th Dec, 15 days after exposure.

Symptoms of imazamox + imazapyr damage were apparent soon after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves. There was also some discolouration and crinkling on the older leaves.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 5 node cotton. Photo taken on 16th Dec, 26 days after exposure.

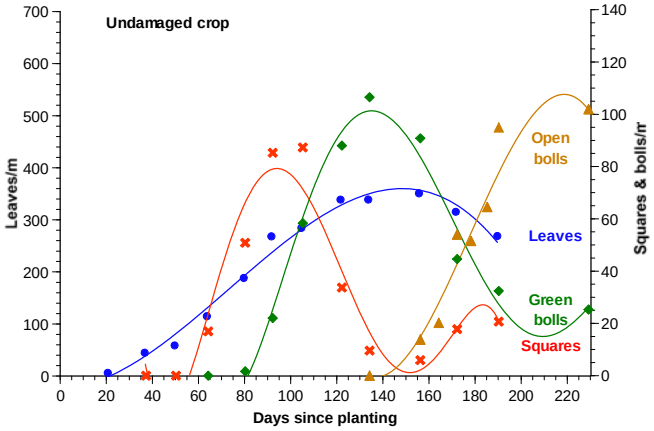
No symptoms of the herbicide damage remained 26 days after exposure.

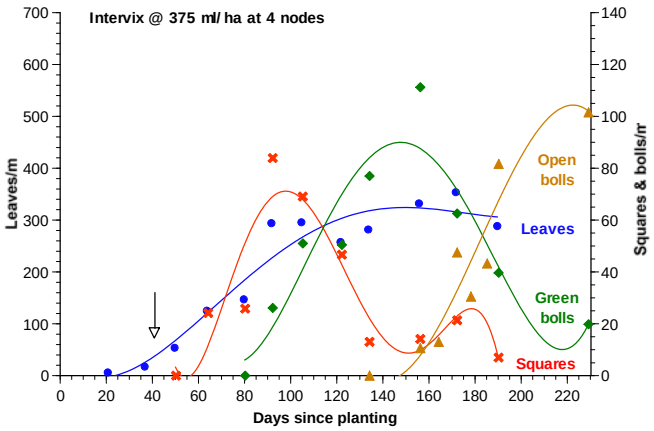
Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 5 node cotton. Photo taken on 29th Dec, 39 days after exposure.

No symptoms of the herbicide damage remained 39 days after exposure. The leaf damage apparent on some leaves in this photo was inadvertently caused by a 2nd herbicide.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 5 node cotton. Photo taken on 17th Jan, 58 days after exposure.

No symptoms of the herbicide damage remained 58 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of imazamox + imazapyr at 5 nodes initially caused strong leaf discolouration and petiole reddening, but plants soon recovered from this damage. There was some delay in crop growth and development but few observable season-long effects on the plants.

**Leaves:** the herbicide initially caused extensive leaf discolouration, but plants recovered from this damage, having fewer leaves mid-season but more leaves and 54% more leaf area at defoliation. Average leaf size was up by 44%

**Squares**: there were no obvious impacts on square production.

**Bolls:** there were no obvious impacts on boll retention boll size. There was an 8 day delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was an 18% reduction in lint yield.

**Final plant data**

| | undamaged comparison | imazamox + imazapyr 50% @ 5 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 25.0 |
| **Leaves/m*** | 268 | 287 |
| **Leaf area (cm²/m)*** | 6144 | 9471 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 121 |
| **Boll weight (g/open boll)** | 5.6 | 5.7 |
| **Retention posit's 1-3^** | 91% | 95% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 – 17 |
| **Days to 50% open bolls** | 179 | 187 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 80% | 84% |
| **Lint yield (kg/ha)** | 2079 | 1714 |


## Summary

Exposure to 50% of a typical field rate of imazamox + imazapyr at 5 nodes initially caused strong leaf discolouration and petiole reddening. Plant growth was delayed, but plants compensated and were larger, with more leaves and more leaf area at defoliation.

Square and boll production were largely unaffected by the herbicide exposure. There was an 8 day delay in average crop maturity, but no reduction in ginning turnout or fibre quality. There was, however, an 18% reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **2.5 + 1.1 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **15th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 12 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Symptoms of imazamox + imazapyr damage were apparent soon after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 12 node cotton. Photo taken on 4th Jan, 20 days after exposure.

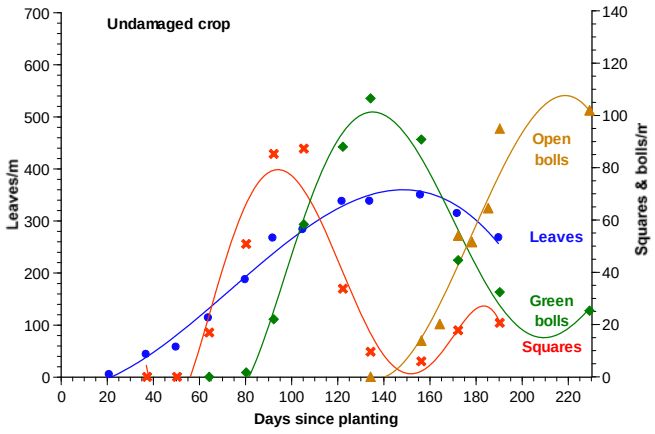
Strong symptoms of imazamox + imazapyr damage remained 20 days after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

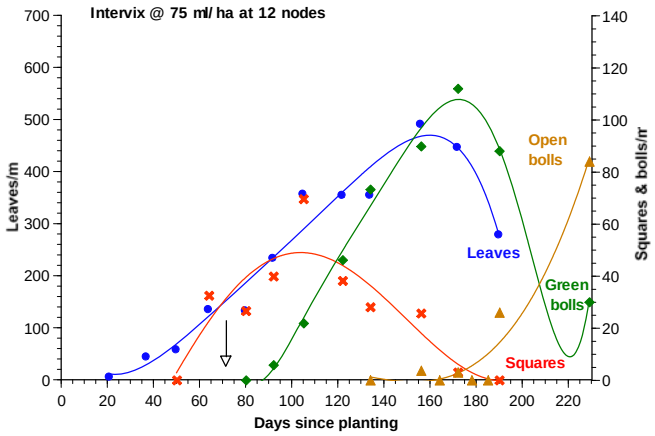
Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 12 node cotton. Photo taken on 17th Jan, 33 days after exposure.

The symptoms of imazamox + imazapyr damage were less obvious 33 days after exposure. Some initial symptoms remained on the newly expanded leaves with cupping, reddening of the petioles, and red and yellow discolouration. Most new leaves were small and distorted with wavy edges.

Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 12 node cotton. Photo taken on 9th Feb, 56 days after exposure.

By 56 days after exposure the earlier discolouration symptoms of imazamox + imazapyr damage had disappeared. However, most new leaves were small and distorted with wavy edges. Undamaged new growth was emerging from some lateral branches.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazamox + imazapyr at 12 nodes caused strong leaf discolouration and petiole reddening, with the damage persisting for more than 40 days post-exposure. The herbicides also caused leaf distortion.

**Leaves:** the herbicide caused extensive leaf discolouration followed by leaf distortion and leaf loss. Plants compensated and had more leaves and leaf area mid-season.

**Squares**: there was a 20% reduction in peak square production and a loss of late-season squares.

**Bolls:** the herbicide delayed peak boll production by 35 days and the first open bolls by 20 days, with 33% fewer bolls retained in the first 3 fruiting positions and more bolls retained at the top of the plant. Average boll size was down 37% and plants had 18% fewer open bolls at picking. There was a 35 day delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure but lint yield was reduced by 23%.

**Final plant data**

| | undamaged comparison | imazamox + imazapyr 10% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.7 |
| **Leaves/m*** | 268 | 278 |
| **Leaf area (cm²/m)*** | 6144 | 6598 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 114 |
| **Boll weight (g/open boll)** | 5.6 | 3.5 |
| **Retention posit's 1-3^** | 91% | 61% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 21 |
| **Days to 50% open bolls** | 179 | 214 |
| **Maturity delay (days)** | | 35 |
| **% Open bolls at picking** | 80% | 74% |
| **Lint yield (kg/ha)** | 2079 | 1608 |


## Summary

Exposure to 10% of a typical field rate of imazamox + imazapyr at 12 nodes caused strong leaf discolouration and distortion and petiole reddening. Crop growth and development was affected but plants compensated for the damage.

Squares and bolls were shed, with fewer bolls retained in the first 3 fruiting positions and a reduction in average boll size. There was no impact on ginning turnout or fibre quality, but there was a 35 day delay in average crop maturity and 23% reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **12.4 + 5.6 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **15th Dec** |
| | **(9 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **X** |
| **Petiole distortion** | |
| **Plant stunting** | **X** |
| **Square shedding** | **X** |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 12 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Symptoms of imazamox + imazapyr damage were apparent soon after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 12 node cotton. Photo taken on 4th Jan, 20 days after exposure.

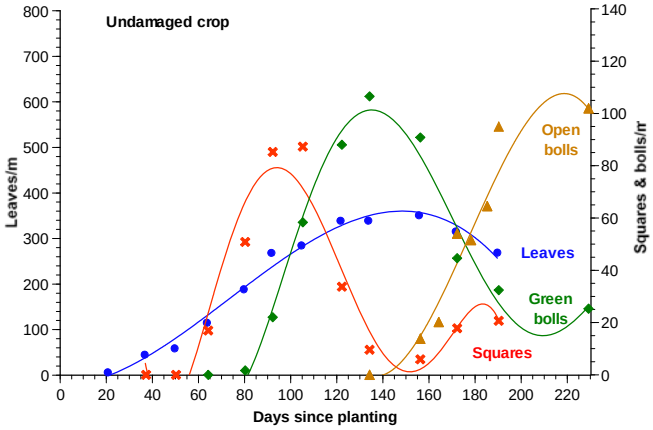
Strong symptoms of imazamox + imazapyr damage remained 20 days after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

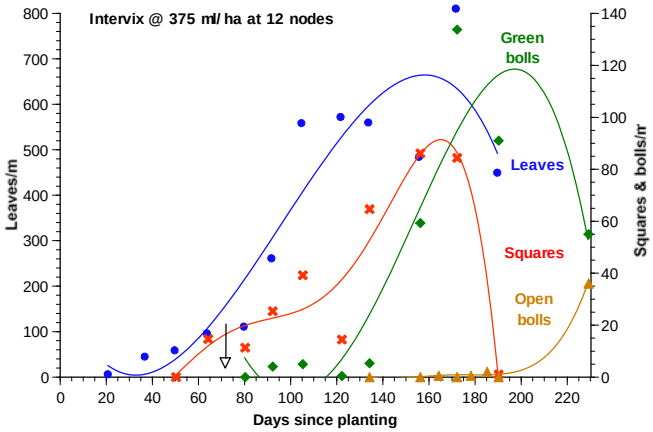
Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 12 node cotton. Photo taken on 17th Jan, 33 days after exposure.

The initial symptoms of imazamox + imazapyr damage were less obvious 33 days after exposure. The damage was now most obvious as discolouration and severe stunting of the newly emerged leaves and reduced internode lengths, giving the new growth a bunched appearance.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 12 node cotton. Photo taken on 9th Feb, 56 days after exposure.

By 56 days after exposure the earlier discolouration symptoms of imazamox + imazapyr damage had disappeared. However, plants were stunted and most new leaves were small and distorted with wavy edges giving a bunchy appearance to the top growth.




## Impact on plant growth

**Plants**: exposure to the heavier rate of imazamox + imazapyr at 12 nodes caused strong leaf discolouration and petiole reddening followed by leaf stunting and a flush of late-season compensatory growth. Plants had shortened internodes and remained 6 cm shorter at picking.

**Leaves:** the herbicide initially caused extensive leaf discolouration, followed by severe leaf stunting. Plants put on a flush of late growth, retaining 67% more leaves and 61% more leaf area at defoliation.

**Squares**: most early squares were shed, delaying peak squaring by 80 days.

**Bolls:** most early bolls were also shed, with 49% fewer bolls retained in positions 1 - 3. Peak boll production was delayed 70 days, average boll weight was down 77% and there were 51% fewer mature bolls at picking. There was a 56 day delay in average boll maturity.

**Lint**: ginning turnout was down 5%, the cotton was immature (micronaire of 2.83) and lint yield was down 83%.

**Final plant data**

| | undamaged comparison | imazamox + imazapyr 50% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 24.7 |
| **Leaves/m*** | 268 | 448 |
| **Leaf area (cm²/m)*** | 6144 | 9881 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 91 |
| **Boll weight (g/open boll)** | 5.6 | 1.3 |
| **Retention posit's 1-3^** | 91% | 46% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 5 – 17 |
| **Days to 50% open bolls** | 179 | 235 |
| **Maturity delay (days)** | | 56 |
| **% Open bolls at picking** | 80% | 40% |
| **Lint yield (kg/ha)** | 2079 | 353 |


**Summary**

Exposure to 50% of a typical field rate of imazamox + imazapyr at 12 nodes caused strong leaf discolouration, petiole reddening, and leaf and plant stunting

Early squares and bolls were shed, leading to a flush of late-season growth, squares and bolls. Bolls were small and immature, with few retained in the first 3 fruiting positions. There was a 56 day delay in average crop maturity, a reduction in ginning turnout, low micronaire and an 83% reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **2.5 + 1.1 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **3rd Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **X** |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 15 node cotton. Photo taken on 12th Jan, 9 days after exposure.

Mild symptoms of imazamox + imazapyr damage were apparent soon after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 15 node cotton. Photo taken on 17th Jan, 14 days after exposure.

Stronger symptoms of imazamox + imazapyr damage remained apparent 20 days after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

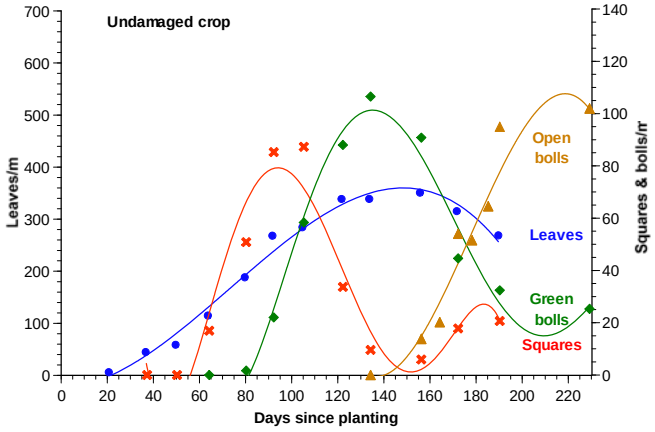
Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 15 node cotton. Photo taken on 9th Feb, 37 days after exposure.

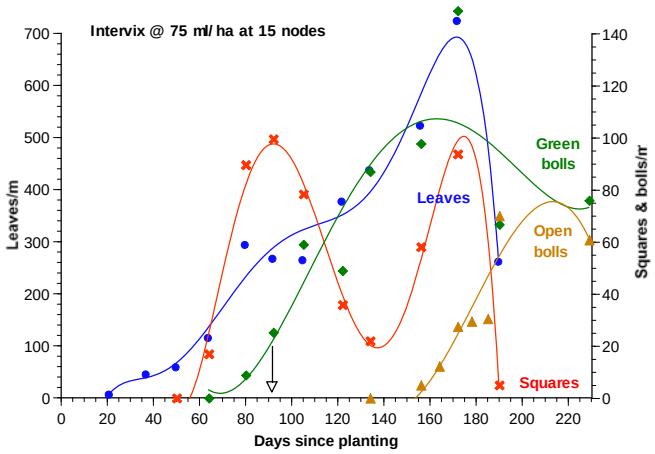
The symptoms of imazamox + imazapyr damage were less obvious 37 days after exposure. Some initial symptoms remained on the newly expanded leaves with cupping, reddening of the petioles, and red and yellow discolouration. Most new leaves were small

and distorted with wavy edges and shortened internodes giving a bunchy appearance.

Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 15 node cotton. Photo taken on 5th Mar, 62 days after exposure.

By 62 days after exposure most symptoms of imazamox + imazapyr damage had disappeared.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazamox + imazapyr at 15 nodes caused petiole reddening and leaf discolouration, with these damage symptoms persisting for around 40 days. The herbicides also caused bunching and leaf distortion.

**Leaves:** the herbicide caused extensive leaf discolouration and distortion, but plants compensated with additional late-season growth, retaining 131% more leaves and 70% more leaf area late in the season.

**Squares**: plants produced a flush of late-season squares and bolls.

**Bolls:** some early bolls were shed following the herbicide exposure, with 11% fewer bolls retained in positions 1 - 3. Plants compensated with a flush of late squares and bolls, delaying peak boll production by 40 days, reducing average boll weight by 25% and resulting in 44% fewer open bolls at picking. There was a 51 day delay in average boll maturity.

**Lint**: crop maturity was delayed, but there was no change in ginning turnout, fibre quality or lint yield.

**Final plant data**

| | undamaged comparison | imazamox + imazapyr 10% @ 15 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.0 |
| **Leaves/m*** | 268 | 260 |
| **Leaf area (cm²/m)*** | 6144 | 8465 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 137 |
| **Boll weight (g/open boll)** | 5.6 | 4.2 |
| **Retention posit's 1-3^** | 91% | 81% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 15 |
| **Days to 50% open bolls** | 179 | 230 |
| **Maturity delay (days)** | | 51 |
| **% Open bolls at picking** | 80% | 44% |

| | | |
|---|---|---|
| **Lint yield (kg/ha)** | 2079 | |

## Summary

Exposure to 10% of a typical field rate of imazamox + imazapyr at 15 nodes caused leaf discolouration and distortion and petiole reddening. Plants compensated with a flush of late growth.

Some early bolls were shed and there was a flush of late-season growth, squares and bolls, with fewer bolls retained in the first 3 fruiting positions and a reduction in average boll size. There was no impact on ginning turnout, fibre quality or lint yield, but there was a 51 day delay in crop maturity.

**Note*** These parameters were recorded at defoliation, the remainder at picking.

**Note**^ Percentage of retained bolls in positions 1 – 3.
**Note**# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **12.4 + 5.6 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **3rd Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **X** |
| **Petiole distortion** | |
| **Plant stunting** | **X** |
| **Square shedding** | **X** |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 15 node cotton. Photo taken on 12th Jan, 9 days after exposure.

Strong symptoms of imazamox + imazapyr damage were apparent soon after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

Intervix® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 15 node cotton. Photo taken on 17th Jan, 14 days after exposure.

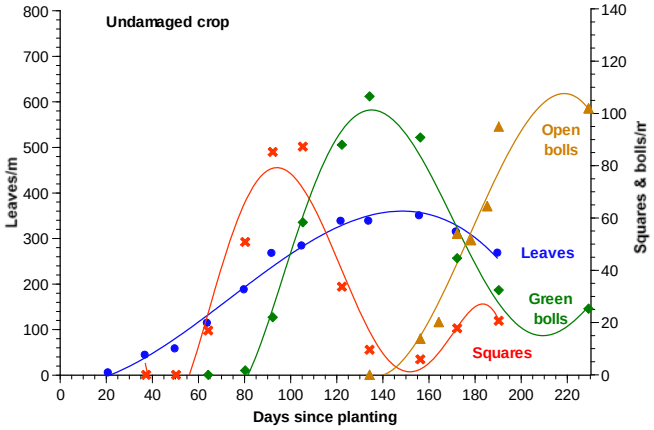
Symptoms of imazamox + imazapyr damage remained 14 days after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

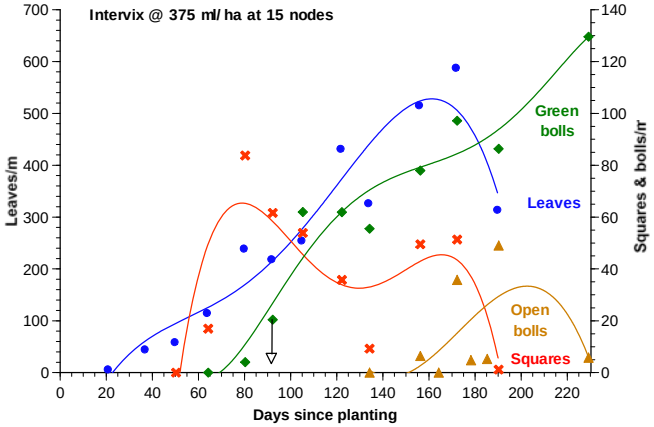
Intervix® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 15 node cotton. Photo taken on 9th Feb, 37 days after exposure.

The initial symptoms of imazamox + imazapyr damage were less obvious 37 days after exposure. The damage was now most obvious as discolouration and severe stunting of the newly emerged leaves and reduced internode lengths, giving the new growth a bunched appearance.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 15 node cotton. Photo taken on 5th Mar, 62 days after exposure.

By 62 days after exposure, the earlier discolouration symptoms of imazamox + imazapyr damage had disappeared. However, plants were stunted and most new leaves were small and distorted with wavy edges giving a bunchy appearance to the top growth.




## Impact on plant growth

**Plants**: exposure to the heavier rate of imazamox + imazapyr at 15 nodes caused massive damage to the plants, with strong leaf discolouration and petiole reddening followed by leaf stunting. Plants compensated with a flush of late growth.

**Leaves:** the herbicide initially caused extensive leaf discolouration, followed by severe leaf stunting. Plants put on a flush of late growth and had 17% more leaves and 16% more leaf area at defoliation.

**Squares**: many squares were initially shed, followed by a flush of late squares.

**Bolls:** many early bolls were shed, with 54% fewer bolls retained in positions 1 – 3 and few bolls retained above node 12. Peak boll production was delayed, average boll weight was down 54% and there were 94% fewer mature bolls at picking. There was an estimated delay in average boll maturity of over 100 days.

**Lint**: ginning turnout was down 8%, the cotton was immature (micronaire of 3.27) and lint yield was down 97%.

**Final plant data**

| | undamaged comparison | imazamox + imazapyr 50% @ 15 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 29.2 |
| **Leaves/m*** | 268 | 313 |
| **Leaf area (cm²/m)*** | 6144 | 7117 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 6 |
| **Boll weight (g/open boll)** | 5.6 | 2.6 |
| **Retention posit's 1-3^** | 91% | 56% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 – 12 |
| **Days to 50% open bolls** | 179 | >280 |
| **Maturity delay (days)** | | 100+ |
| **% Open bolls at picking** | 80% | 4% |
| **Lint yield (kg/ha)** | 2079 | 55 |


**Summary**

Exposure to 50% of a typical field rate of imazamox + imazapyr at 15 nodes caused massive damage to the plants, with strong leaf discolouration, petiole reddening, and leaf and plant stunting

Early squares and bolls were shed, leading to a flush of late-season growth, squares and bolls. Bolls were small and immature, with few retained in the first 3 fruiting positions. There was a >100 day delay in average crop maturity, immature fibre with low micronaire and a 97% reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **2.5 + 1.1 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **18th Jan** |
| | **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **18 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **X** |
| **Petiole distortion** | |
| **Plant stunting** | **X** |
| **Square shedding** | **X** |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 18 node cotton. Photo taken on 9th Feb, 22 days after exposure.

Strong symptoms of imazamox + imazapyr damage were apparent 22 days after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 18 node cotton. Photo taken on 15th Feb, 28 days after exposure.

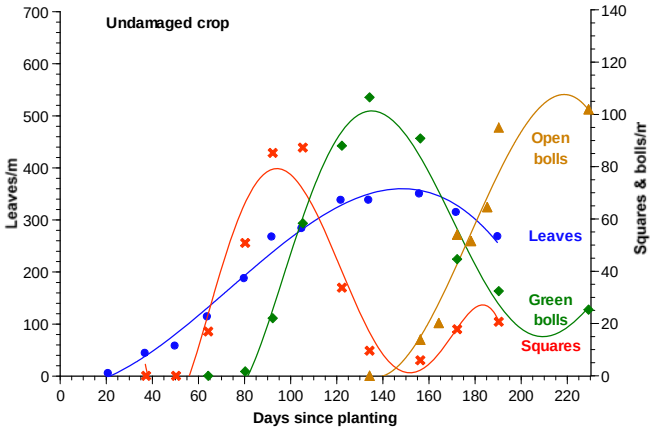
Stronger symptoms of imazamox + imazapyr damage remained apparent 28 days after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves which were greatly reduced in size and had a bunched appearance with shortened internodes.

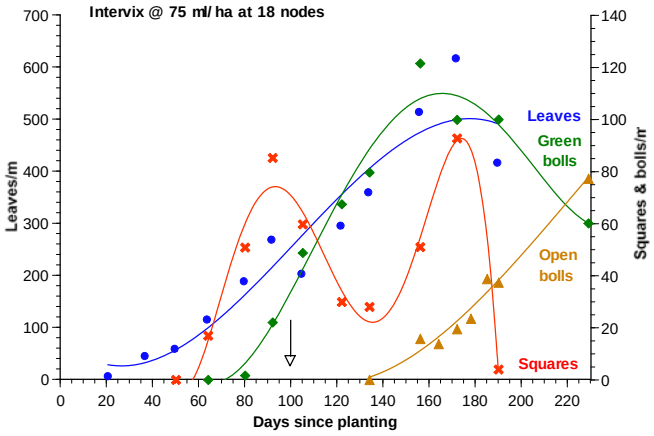
Intervix® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 18 node cotton. Photo taken on 22nd Feb, 35 days after exposure.

The symptoms of imazamox + imazapyr damage were still obvious 35 days after exposure. Symptoms were strongest on the newly expanded leaves with reddening of the petioles, cupping, red and yellow leafb discolouration, greatly reduced leaf size and shortened internodes giving a bunchy appearance.

Intervix ® (imazamox + imazapyr) applied broadcast at 75 ml/ha to 18 node cotton. Photo taken on 14th Mar, 56 days after exposure.

By 56 days after exposure most symptoms of imazamox + imazapyr damage had disappeared.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazamox + imazapyr at 18 nodes caused petiole reddening and leaf discolouration on the new leaves. The herbicides also caused bunching leaf distortion and a big reduction in leaf size.

**Leaves:** the herbicide caused extensive leaf discolouration followed by leaf distortion and a reduction in leaf size. Plants had a flush of late growth, with 55% more leaves and 60% more leaf area at defoliation.

**Squares**: plants shed many squares and produced a flush of late-season squares.

**Bolls:** many early bolls were shed following the herbicide exposure, with 14% fewer bolls retained in positions 1 - 3. Plants compensated with a flush of late squares and bolls, delaying peak boll production by 20 days, reducing average boll weight 36% and resulting in 30% fewer open bolls at picking. There was a 39 day delay in average boll maturity.

**Lint**: crop maturity was delayed, but there was no change in ginning turnout or fibre quality. Lint yield was reduced by 68%.

**Final plant data**

| | undamaged comparison | imazamox + imazapyr 10% @ 18 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 27.5 |
| **Leaves/m*** | 268 | 415 |
| **Leaf area (cm²/m)*** | 6144 | 9817 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 137 |
| **Boll weight (g/open boll)** | 5.6 | 3.6 |
| **Retention posit's 1-3^** | 91% | 78% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 17 |
| **Days to 50% open bolls** | 179 | 218 |
| **Maturity delay (days)** | | 39 |
| **% Open bolls at picking** | 80% | 56% |
| **Lint yield (kg/ha)** | 2079 | 661 |


## Summary

Exposure to 10% of a typical field rate of imazamox + imazapyr at 18 nodes caused leaf discolouration and petiole reddening, leaf distortion and a reduction in leaf number and leaf area.

Early bolls were shed and there was a flush of late-season growth, squares and bolls, with fewer bolls retained in positions 1 – 3 and a reduction in average boll size. There was no impact on ginning turnout or fibre quality but lint yield was reduced by 68% with a 39 day delay in average crop maturity.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazamox + imazapyr** |
| **Rate:** | **12.4 + 5.6 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **18th Jan** |
| | **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **18 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **X** |
| **Petiole distortion** | |
| **Plant stunting** | **X** |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton of 34 months

### imazamox

**Soil half-life:** 20 - 30 days

### imazapyr

**Soil half-life:** 25 - 142 days

Intervix® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 18 node cotton. Photo taken on 9th Feb, 22 days after exposure.

Strong symptoms of imazamox + imazapyr damage were apparent soon after exposure. Symptoms included reddening of the petioles, and red and yellow discolouration and cupping on the youngest leaves.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 18 node cotton. Photo taken on 15th Feb, 28 days after exposure.

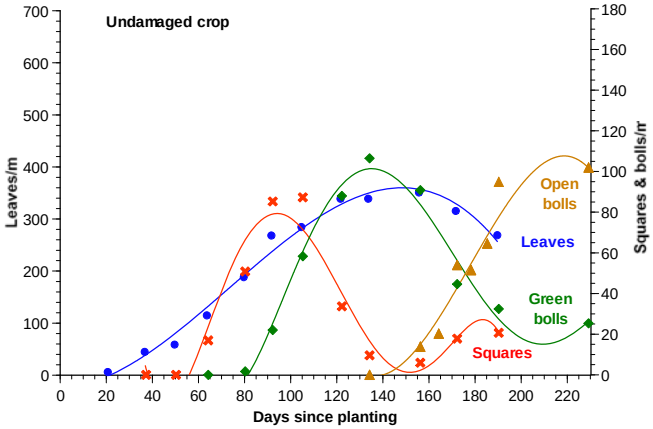
The initial symptoms of imazamox + imazapyr damage were beginning to fade 28 days after exposure. The damage was now most obvious as discolouration and severe stunting of the newly emerged leaves and reduced internode lengths, giving the new growth a bunched appearance

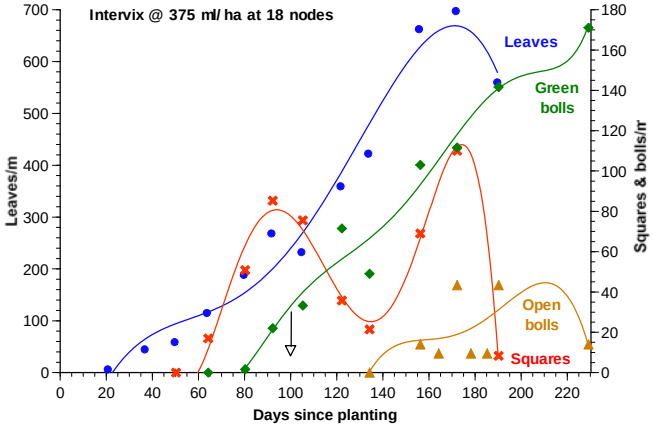
Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 18 node cotton. Photo taken on 22nd Feb, 35 days after exposure.

The discolouration and bunchy appearance of the new growth was very obvious 35 days after exposure, with small leaves and reduced internode lengths giving the new growth a bunched appearance.

Intervix ® (imazamox + imazapyr) applied broadcast at 375 ml/ha to 18 node cotton. Photo taken on 14th Mar, 56 days after exposure.

By 56 days after exposure, the symptoms of imazamox + imazapyr damage had disappeared.




## Impact on plant growth

**Plants**: exposure to the heavier rate of imazamox + imazapyr at 18 nodes caused massive damage to the plants, with leaf discolouration and petiole reddening followed by leaf stunting and bunching. Plants compensated with a flush of late-season growth.

**Leaves:** the herbicide initially caused leaf discolouration, followed by severe leaf stunting. Plants put on a flush of late growth but had smaller leaves, with more than double the number of leaves but only 47% more leaf area at defoliation.

**Squares**: plants produced a flush of late squares and bolls.

**Bolls:** many early bolls were shed and few open bolls retained. Peak boll production was delayed, average boll weight was down 56% and there were 91% fewer mature bolls at picking. Few bolls were retained above the 10th node and there was an estimated delay in average boll maturity of over 100 days.

**Lint**: fibre quality was unaffected, but ginning turnout was down 7% and lint yield 89%.

**Final plant data**

| | undamaged comparison | imazamox + imazapyr 50% @ 18 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 27.7 |
| **Leaves/m*** | 268 | 558 |
| **Leaf area (cm²/m)*** | 6144 | 9058 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 185 |
| **Boll weight (g/open boll)** | 5.6 | 2.5 |
| **Retention posit's 1-3^** | 91% | 84% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 10 |
| **Days to 50% open bolls** | 179 | >280 |
| **Maturity delay (days)** | | 100+ |
| **% Open bolls at picking** | 80% | 8% |
| **Lint yield (kg/ha)** | 2079 | 237 |


## Summary

Exposure to 50% of a typical field rate of imazamox + imazapyr at 18 nodes caused massive damage to the plants, with strong leaf discolouration, petiole reddening, and leaf and plant stunting

Early squares and bolls were shed, leading to a flush of late-season growth, squares and bolls. Bolls were small and immature, with few retained in the first 3 fruiting positions. There was a >100 day delay in average crop maturity, immature fibre with low micronaire and a 97% reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **9.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **10th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 18 days after crop emergence.

No obvious symptoms of imazethapyr damage were apparent on the seedlings at any stage although there was an increased level of seedling mortality, reducing the plant stand by 15%.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha and incorporated prior to planting cotton. Photo taken on 21st Nov, 35 days after crop emergence.

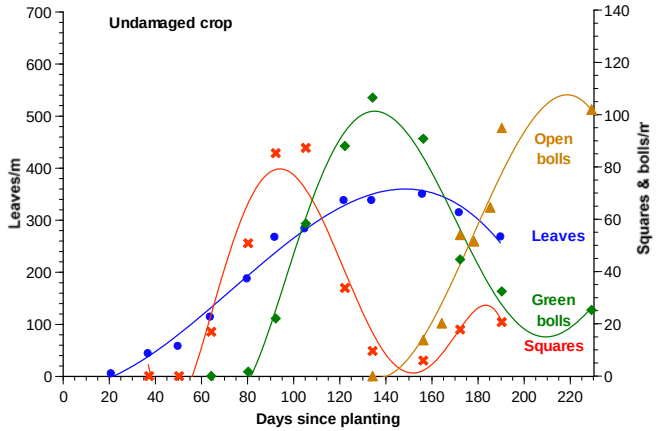
No symptoms of imazethapyr damage were apparent at any stage.

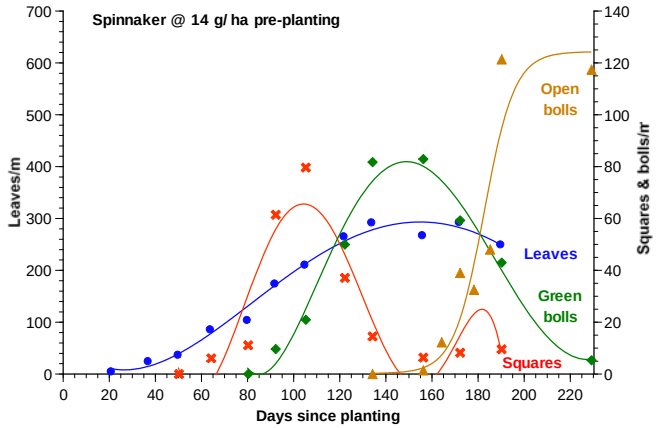
Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha and incorporated prior to planting cotton. Photo taken on 16th Dec, 60 days after crop emergence.

No symptoms of imazethapyr damage were apparent at any stage.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha and incorporated prior to planting cotton. Photo taken on 17th Jan, 92 days after crop emergence.

No symptoms of imazethapyr damage were apparent at any stage.




## Impact on plant growth

**Plants**: exposure to the lighter rate of residual imazethapyr had no observable affect on crop growth or development, with no damage symptoms apparent at any stage. However, there was an increased level of seedling mortality, reducing the plant stand by 15%, and some delay in plant growth, with plants shorter by 2.3 nodes at picking.

**Leaves:** the herbicide caused no obvious leaf damage.

**Squares**: the herbicide had no obvious impact on square production.

**Bolls:** there was no obvious affect on boll production or retention, but plants 7% fewer bolls in the first 3 fruiting positions and retained fewer green bolls at picking. There was no change in average crop maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 28% reduction in lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazethapyr 10% pre-plant** |
| **Nodes/plant** | 24.9 | 22.7 |
| **Leaves/m*** | 268 | 249 |
| **Leaf area (cm²/m)*** | 6144 | 6391 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 123 |
| **Boll weight (g/open boll)** | 5.6 | 5.4 |
| **Retention posit's 1-3^** | 91% | 84% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 17 |
| **Days to 50% open bolls** | 179 | 182 |
| **Maturity delay (days)** | | 3 |
| **% Open bolls at picking** | 80% | 96% |
| **Lint yield (kg/ha)** | 2079 | 1499 |


## Summary

Exposure to 10% of a typical field rate of residual imazethapyr caused no observable damage symptoms at any stage.

Nevertheless, plants were damaged by the herbicide, with a reduction in the plant stand, a reduction in plant height (nodes) and fewer bolls retained in positions 1 – 3. There was delay in crop maturity and no reduction in ginning turnout or fibre quality but lint yield was reduced by 28%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **49 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **10th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **X** |
| **Square shedding** | **X** |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 18 days after crop emergence.

Seedlings were severely damaged by this level of residual imazethapyr, with a high level of seedling death, resulting in a 49% reduction in the plant stand. Most of the surviving seedlings had some leaf damage, with some necrotic spots and the cotyledons folded.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha and incorporated prior to planting cotton. Photo taken on 21st Nov, 35 days after crop emergence.

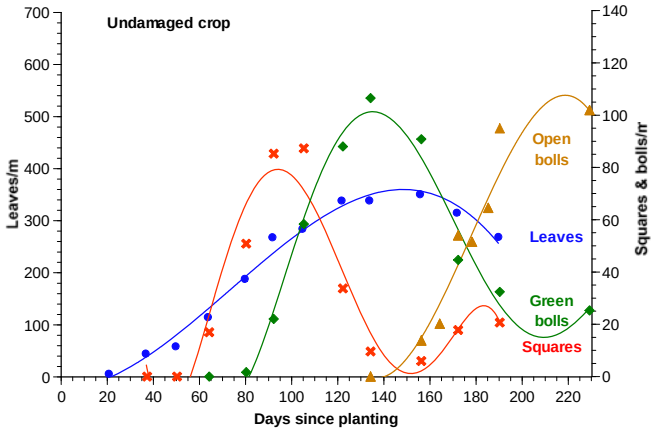
Many of the seedlings were still at cotyledon stage, 35 days after emergence, although some growth had resumed on some seedlings. This growth was very distorted, with minute and cupped leaves developing.

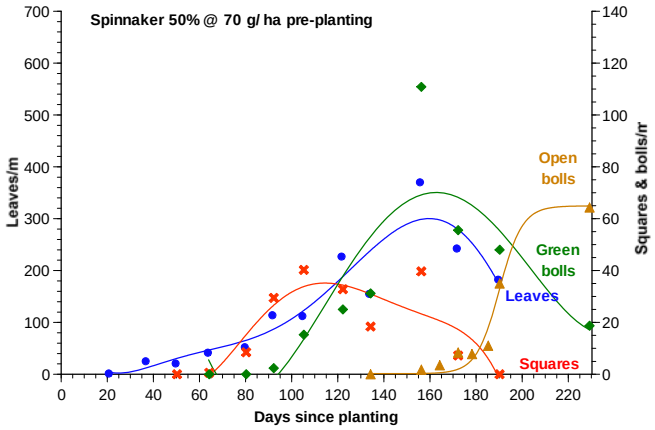
Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha and incorporated prior to planting cotton. Photo taken on 16th Dec, 60 days after crop emergence.

Most plants were growing normally 60 days after emergence, although there had been a long delay in crop growth and development.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha and incorporated prior to planting cotton. Photo taken on 17th Jan, 92 days after crop emergence.

No symptoms of imazethapyr damage remained 92 days after emergence.




## Impact on plant growth

**Plants**: exposed to the heavier rate of residual imazethapyr were severely damaged, with a 49% reduction in the plant stand. There was a long delay in growth and development of the surviving seedlings and plants remained 10 cm and 2.5 nodes shorter at picking.

**Leaves:** the herbicide caused severe early damage, delaying leaf development and reducing leaf size. Plants had 32% fewer leaves at defoliation, but no reduction in leaf area as there was a 42% increase in average leaf size.

**Squares**: the herbicide had a large impact on square production, reducing peak squaring by 54%.

**Bolls:** there was a 15 day delay in boll production, but no reduction in peak boll number. Plants retained 9% fewer bolls in positions 1 – 3, with 35% fewer bolls and 37% fewer open bolls at picking. Average boll maturity was delayed by 14 days.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 53% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | imazethapyr 50% pre-plant |
|---|---|---|
| **Nodes/plant** | 24.9 | 22.4 |
| **Leaves/m*** | 268 | 181 |
| **Leaf area (cm²/m)*** | 6144 | 5890 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 83 |
| **Boll weight (g/open boll)** | 5.6 | 5.8 |
| **Retention posit's 1-3^** | 91% | 83% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 16 |
| **Days to 50% open bolls** | 179 | 193 |
| **Maturity delay (days)** | | 14 |
| **% Open bolls at picking** | 80% | 78% |
| **Lint yield (kg/ha)** | 2079 | 979 |


## Summary

Exposure to 50% of a typical field rate of residual imazethapyr severely damaged the seedlings, reducing the plant stand and delaying crop growth and development.

Plants remained shorter and had fewer leaves at defoliation. Squaring was severely affected, bolls were lost from positions 1 – 3 and fewer green and mature bolls retained at picking. There was no reduction in ginning turnout or fibre quality but a 14 day delay in crop maturity and 53% reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **9.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **20th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 5 node cotton. Photo taken on 5th Dec, 15 days after exposure.

No obvious symptoms of imazethapyr damage were apparent on the seedlings at any stage.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 5 node cotton. Photo taken on 16th Dec, 26 days after exposure.

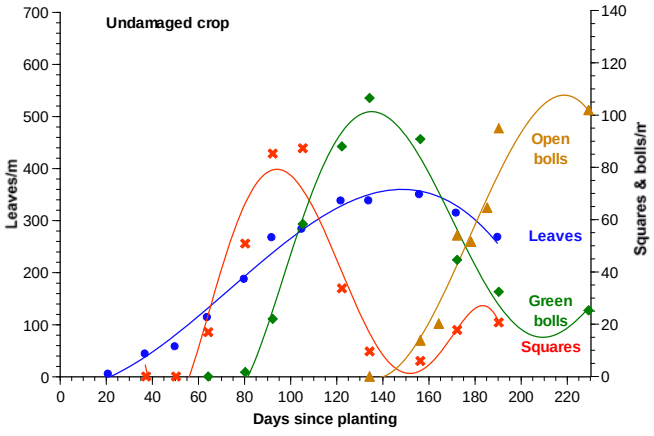
No symptoms of imazethapyr damage were apparent at any stage.

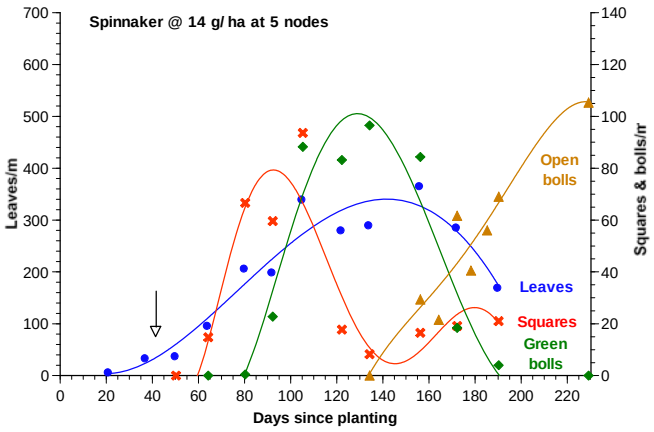
Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 5 node cotton. Photo taken on 29th Dec, 39 days after exposure.

No symptoms of imazethapyr damage were apparent at any stage.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 5 node cotton. Photo taken on 17th Jan, 58 days after exposure.

No symptoms of imazethapyr damage were apparent at any stage.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazethapyr at 5 nodes had no observable affect on crop growth or development, with no damage symptoms apparent at any stage, although plants were 43% smaller by weight at defoliation.

**Leaves:** the herbicide caused no obvious leaf damage, although plants did shed leaves late in the season, carrying 37% fewer leaves and 35% less leaf area at defoliation.

**Squares**: the herbicide had no obvious impact on square production.

**Bolls:** there was no obvious affect on boll production or retention up until the end of the season when plants shed leaves and green bolls, retaining fewer immature bolls at picking. There was no change in average crop maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazethapyr 10% @ 5 nodes** |
| **Nodes/plant** | 24.9 | 24.1 |
| **Leaves/m*** | 268 | 168 |
| **Leaf area (cm²/m)*** | 6144 | 4013 |
| **Reduction in leaf area*** | | 35% |
| **Bolls/m** | 127 | 105 |
| **Boll weight (g/open boll)** | 5.6 | 5.5 |
| **Retention posit's 1-3^** | 91% | 94% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 16 |
| **Days to 50% open bolls** | 179 | 180 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 80% | 100% |
| **Lint yield (kg/ha)** | 2079 | 2207 |


## Summary

Exposure to 10% of a typical field rate of imazethapyr at 5 nodes caused no observable damage symptoms at any stage.

The herbicide exposure had no obvious impact on the plants other than the loss of some leaves late in the season and green bolls prior to picking. There was no delay in crop maturity and no reduction in ginning turnout, fibre quality or lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **49 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **20th Nov (5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 5 node cotton. Photo taken on 5th Dec, 15 days after exposure.

Symptoms of imazethapyr damage were apparent soon after exposure, with yellowing and cupping of the top leaves and reddening of the petioles. These symptoms were more apparent on some plants.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 5 node cotton. Photo taken on 16th Dec, 26 days after exposure.

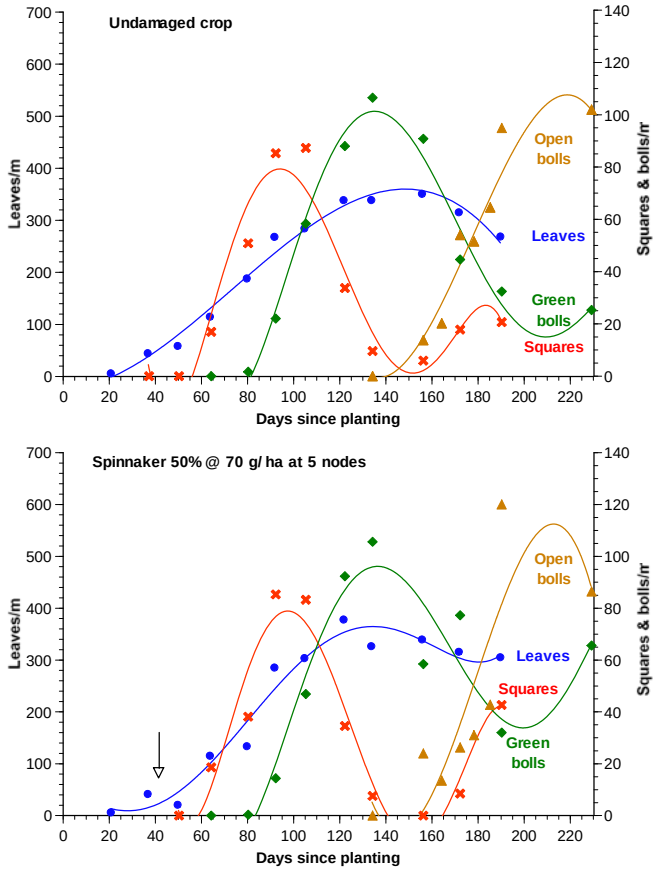
Symptoms of imazethapyr damage had largely disappeared 26 days after exposure.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 5 node cotton. Photo taken on 29th Dec, 39 days after exposure.

Plants were growing normally with no obvious symptoms of herbicide damage 39 days after exposure.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 5 node cotton. Photo taken on 17th Jan, 58 days after exposure.

No symptoms of imazethapyr damage remained 58 days after emergence.




## Impact on plant growth

**Plants**: exposure to the heavier rate of imazethapyr at 5 nodes caused some initial yellowing and cupping of the upper leaves and reddening of the petioles. However, plants compensated for this damage with added late-season growth.

**Leaves:** the herbicide caused yellowing and cupping of the upper leaves and reddening of the petioles. Plants carried 14% more leaves at defoliation.

**Squares**: the herbicide exposure had no impact on early- and mid-season square production, but plants produced a flush of late-season squares.

**Bolls:** there was no obvious impact on boll production until late in the season when plants shed 28% of mature bolls and retained a flush of green bolls. Plants retained 29% fewer mature bolls at picking and average boll maturity was delayed by 8 days.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 9% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | imazethapyr 50% @ 5 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 25.9 |
| **Leaves/m*** | 268 | 304 |
| **Leaf area (cm²/m)*** | 6144 | 6493 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 152 |
| **Boll weight (g/open boll)** | 5.6 | 5.4 |
| **Retention posit's 1-3^** | 91% | 97% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 19 |
| **Days to 50% open bolls** | 179 | 187 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 80% | 57% |
| **Lint yield (kg/ha)** | 2079 | 1887 |


## Summary

Exposure to 50% of a typical field rate of imazethapyr at 5 nodes caused mild damage, with some initial yellowing and cupping of the upper leaves and reddening of the petioles. This had little impact on crop growth and development.

There was a flush of late-season growth, with additional leaves, squares and bolls set, but plants shed mature bolls, retaining fewer open bolls at picking and delaying maturity. There was no reduction in ginning turnout or fibre quality but lint yield was reduced by 9%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **9.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **15th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 12 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Symptoms of imazethapyr damage were apparent soon after exposure, with yellowing and folding of the top leaves.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 12 node cotton. Photo taken on 4th Jan, 20 days after exposure.

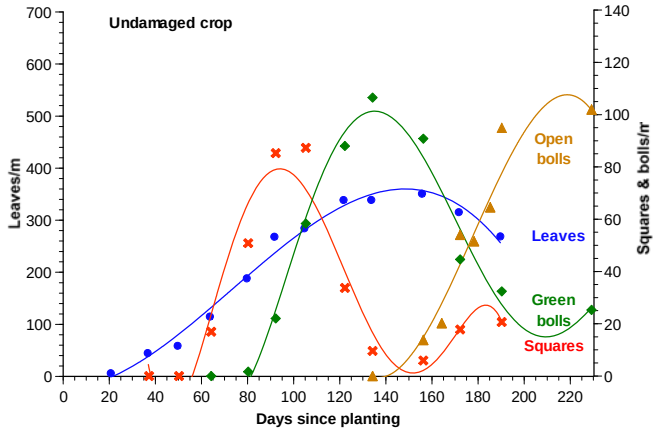
Symptoms of imazethapyr damage remained obvious 20 days after exposure, with yellowing and folding of the top leaves. The yellowing deepened towards red in the centres of the most affected leaves. The dark patches and necrosis seen on a few leaves was due to inadvertent damage from a 2nd herbicide.

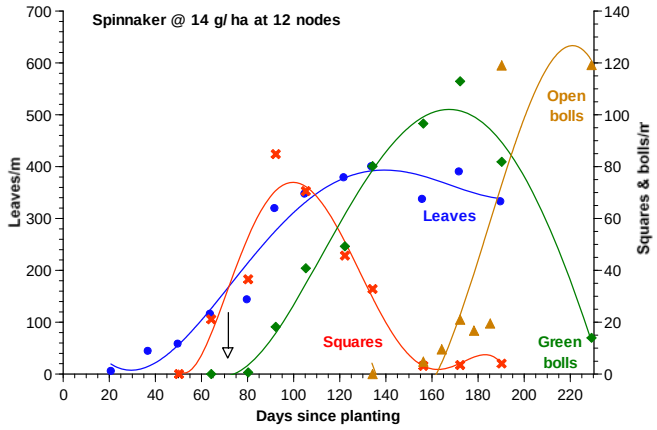
Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 12 node cotton. Photo taken on 17th Jan, 33 days after exposure.

Most symptoms of imazethapyr damage had faded by 33 days following exposure, although yellowing was still apparent in the centres of a few leaves.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 12 node cotton. Photo taken on 9th Feb, 56 days after exposure.

No symptoms of imazethapyr damage remained 56 days following exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazethapyr at 12 nodes caused yellowing and folding of the upper leaves and reddening of the petioles. Plants compensated for this damage.

**Leaves:** the herbicide caused yellowing and folding of the upper leaves and reddening of the petioles. Plants were 46% larger and retained 24% more leaves at defoliation although the average leaf size was down by 12%.

**Squares**: the herbicide exposure had no impact on the pattern of squaring, although plants set fewer late-season squares.

**Bolls:** the herbicide exposure had little obvious impact on boll retention. There was a delay in peak green boll retention and plants retained more top crop, with 17% more open bolls at picking, but these bolls were smaller by 17% on average and average boll maturity was delayed 8 days.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 21% reduction in lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazethapyr 10% @ 12 nodes** |
| **Nodes/plant** | 24.9 | 26.3 |
| **Leaves/m*** | 268 | 332 |
| **Leaf area (cm²/m)*** | 6144 | 6674 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 133 |
| **Boll weight (g/open boll)** | 5.6 | 4.7 |
| **Retention posit's 1-3^** | 91% | 86% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 – 19 |
| **Days to 50% open bolls** | 179 | 187 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 80% | 89% |
| **Lint yield (kg/ha)** | 2079 | 1634 |


## Summary

Exposure to 10% of a typical field rate of imazethapyr at 12 nodes caused yellowing and folding of the upper leaves and reddening of the petioles. This had little impact on crop growth and development.

There was little impact on squaring and boll retention, but plants retained additional green bolls and top crop, reducing boll size and delaying maturity. There was no reduction in ginning turnout or fibre quality but lint yield was reduced by 21%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **49 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **15th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 12 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Symptoms of imazethapyr damage were apparent soon after exposure, with yellowing and folding of the top leaves and reddening of the petioles. The yellowing deepened towards red in the centres of the most affected leaves.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 12 node cotton. Photo taken on 4th Jan, 20 days after exposure.

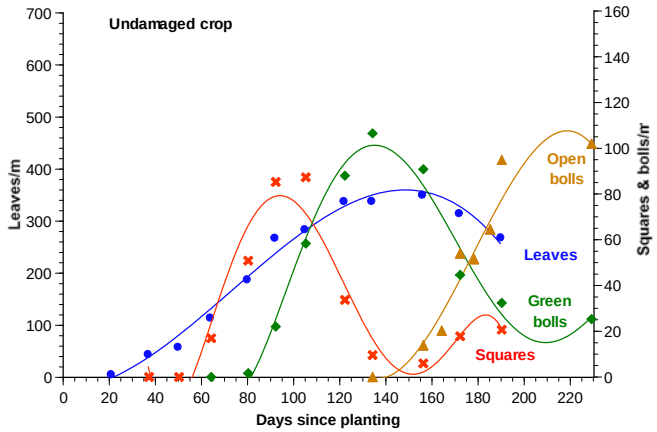
Symptoms of imazethapyr damage remained obvious 20 days after exposure, with yellowing and folding of the top leaves.

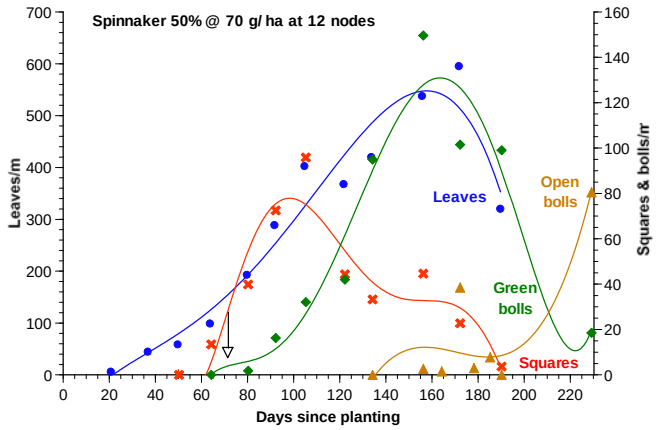
Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 12 node cotton. Photo taken on 17th Jan, 33 days after exposure.

Most symptoms of imazethapyr damage had faded by 33 days following exposure, although yellowing was still apparent in the centres of a few leaves.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 12 node cotton. Photo taken on 9th Feb, 56 days after exposure.

No symptoms of imazethapyr damage remained 56 days after emergence.




## Impact on plant growth

**Plants**: exposure to the heavier rate of imazethapyr at 12 nodes caused yellowing and folding of the upper leaves and reddening of the petioles. Crop growth and development was affected with plants 12 cm and 2 nodes larger at picking.

**Leaves:** the herbicide caused yellowing and folding of the upper leaves and reddening of the petioles. Plants produced a mass of later vegetative growth, with more leaves and 69% more leaf area at defoliation.

**Squares**: the herbicide exposure had no initial impact on square production, but plants produced more squares mid-season.

**Bolls:** early bolls were shed delaying peak boll production by 20 days and plants retained more top bolls with few open bolls until very late in the season. Plants had 21% fewer open bolls at picking, boll size was down by 31% and average boll maturity was delayed by 45 days.

**Lint**: ginning turnout was down 3% and microaire was reduced, at 3.89 compared to 4.48 for the undamaged crop. There was a 35% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | imazethapyr 50% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.9 |
| **Leaves/m*** | 268 | 319 |
| **Leaf area (cm²/m)*** | 6144 | 10353 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 99 |
| **Boll weight (g/open boll)** | 5.6 | 3.8 |
| **Retention posit's 1-3^** | 91% | 86% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 20 |
| **Days to 50% open bolls** | 179 | 224 |
| **Maturity delay (days)** | | 45 |
| **% Open bolls at picking** | 80% | 81% |
| **Lint yield (kg/ha)** | 2079 | 1352 |


## Summary

Exposure to 50% of a typical field rate of imazethapyr at 12 nodes caused yellowing and folding of the upper leaves and reddening of the petioles. Development was delayed.

Early bolls were shed and few open bolls were retained until very late in the season. Late-season compensatory growth occurred, but plants had fewer open boll at picking, boll size was down and maturity was delayed. Ginning turnout and fibre quality were down and lint yield was reduced by 35%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **9.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **3rd Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 15 node cotton. Photo taken on 12th Jan, 9 days after exposure.

Mild symptoms of imazethapyr damage were apparent on some of the top leaves soon after exposure, with yellowing, reddening and folding of the leaves and reddening of some petioles.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 15 node cotton. Photo taken on 17th Jan, 14 days after exposure.

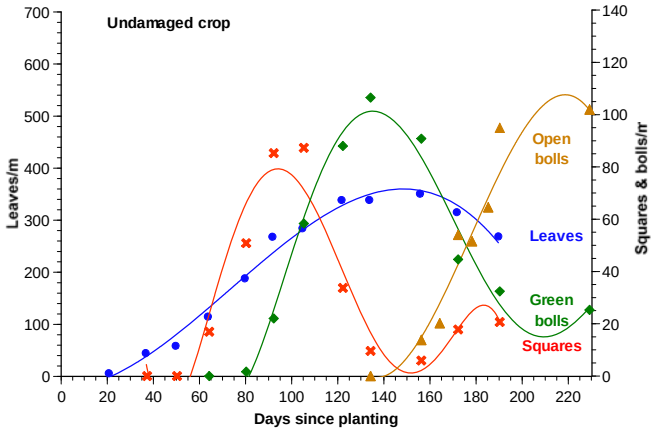
Few symptoms of imazethapyr damage remained on most leaves 14 days after exposure. Mild yellowing was still apparent on a small number of the top leaves.

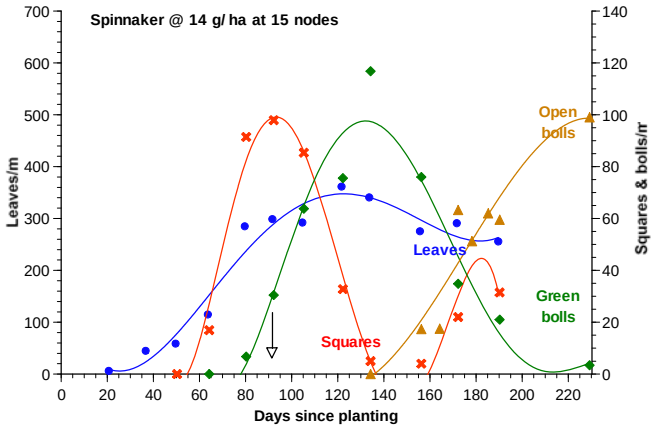
Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 15 node cotton. Photo taken on 9th Feb, 37 days after exposure.

No symptoms of imazethapyr damage were apparent 37 days after exposure.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 15 node cotton. Photo taken on 5th Mar, 62 days after exposure.

No symptoms of imazethapyr damage remained 62 days following exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazethapyr at 15 nodes caused mild yellowing, reddening and folding of some of the upper leaves and reddening of some petioles. This damage had subtle effects on the plants.

**Leaves:** the herbicide caused yellowing, reddening and folding of some upper leaves. Plants compensated for any damage.

**Squares**: the herbicide exposure had no impact on the pattern of squaring until late in the season when plants produced a flush of squares.

**Bolls:** the herbicide exposure had little obvious impact on boll retention, although fewer immature bolls were present at picking. There was no change in average boll size, the pattern of boll retention or boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazethapyr 10% @ 15 nodes** |
| **Nodes/plant** | 24.9 | 24.6 |
| **Leaves/m*** | 268 | 254 |
| **Leaf area (cm²/m)*** | 6144 | 6082 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 102 |
| **Boll weight (g/open boll)** | 5.6 | 5.7 |
| **Retention posit's 1-3^** | 91% | 91% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 17 |
| **Days to 50% open bolls** | 179 | 178 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 80% | 97% |
| **Lint yield (kg/ha)** | 2079 | 2317 |


## Summary

Exposure to 10% of a typical field rate of imazethapyr at 15 nodes caused yellowing and folding of some upper leaves and reddening of some petioles. This damage had little impact on crop growth and development.

There was little impact on squaring and boll retention, with some additional late-season squares and fewer immature bolls at picking. There was no change in average boll size, average boll maturity, ginning turnout, fibre quality or lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **49 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **3rd Jan** |
| | **(11 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **X** |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 15 node cotton. Photo taken on 12th Jan, 9 days after exposure.

Mild symptoms of imazethapyr damage were apparent on some of the top leaves soon after exposure, with yellowing, reddening and folding of the leaves and reddening of some petioles.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 15 node cotton. Photo taken on 17th Jan, 14 days after exposure.

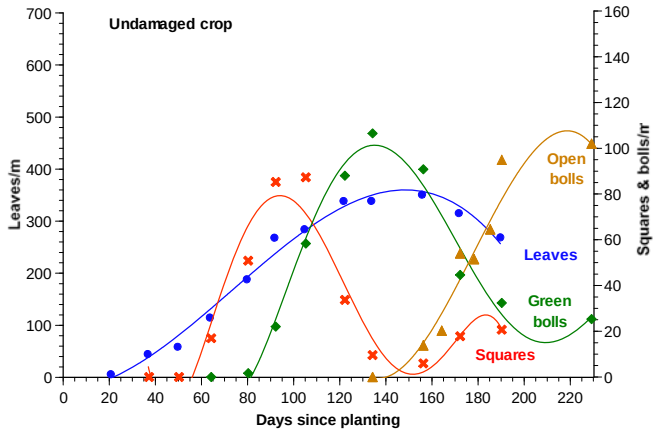
The symptoms of imazethapyr damage were more strongly apparent 14 days after exposure, with yellowing, reddening and folding of the top leaves and reddening of some petioles.

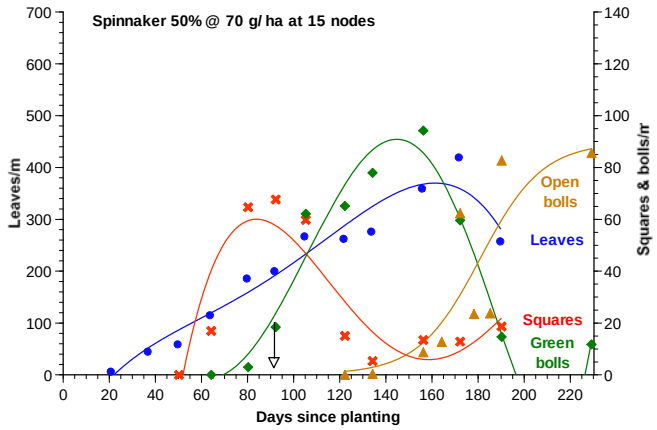
Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 15 node cotton. Photo taken on 9th Feb, 37 days after exposure.

Few symptoms of imazethapyr damage remained on most leaves 37 days after exposure. Folding and mild yellowing was still apparent on a small number of the top leaves.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 15 node cotton. Photo taken on 5th Mar, 62 days after exposure.

No symptoms of imazethapyr damage remained 62 days after emergence.




## Impact on plant growth

**Plants**: exposure to the heavier rate of imazethapyr at 15 nodes caused yellowing and folding of the upper leaves and reddening of the petioles. Crop growth and development were delayed by the damage and plants remained 32% smaller by weight at defoliation.

**Leaves:** the herbicide caused yellowing and folding of the upper leaves and a delay in leaf production. Average leaf size was reduced by 25% and plants had 28% less leaf area at defoliation.

**Squares**: the herbicide exposure cause the loss of some squares.

**Bolls:** some early bolls were shed delaying peak boll production by 20 days. Plants had 16% fewer open bolls at picking and boll size was down by 19%, but average boll maturity was not affected.

**Lint**: ginning turnout was unaffected by the herbicide exposure but microaire was reduced, at 3.94 compared to 4.48 for the undamaged crop. There was a 36% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | imazethapyr 50% @ 15 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 25.9 |
| **Leaves/m*** | 268 | 256 |
| **Leaf area (cm²/m)*** | 6144 | 4417 |
| **Reduction in leaf area*** | | 28% |
| **Bolls/m** | 127 | 97 |
| **Boll weight (g/open boll)** | 5.6 | 4.5 |
| **Retention posit's 1-3^** | 91% | 88% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 17 |
| **Days to 50% open bolls** | 179 | 183 |
| **Maturity delay (days)** | | 4 |
| **% Open bolls at picking** | 80% | 88% |
| **Lint yield (kg/ha)** | 2079 | 1328 |


## Summary

Exposure to 50% of a typical field rate of imazethapyr at 15 nodes caused yellowing and folding of some upper leaves and reddening of some petioles. Crop growth and development was delayed. Plants were smaller with less leaf area at defoliation.

Some squares and bolls were shed soon after exposure and fewer open bolls were retained at picking. Average boll size was down, fibre quality was reduced and lint yield was down by 36%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **9.8 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **18th Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **18 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 18 node cotton. Photo taken on 9th Feb, 22 days after exposure.

Mild symptoms of imazethapyr damage were apparent on some of the top leaves soon after exposure, with yellowing, reddening and folding of the leaves and reddening of some petioles.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 18 node cotton. Photo taken on 15th Feb, 28 days after exposure.

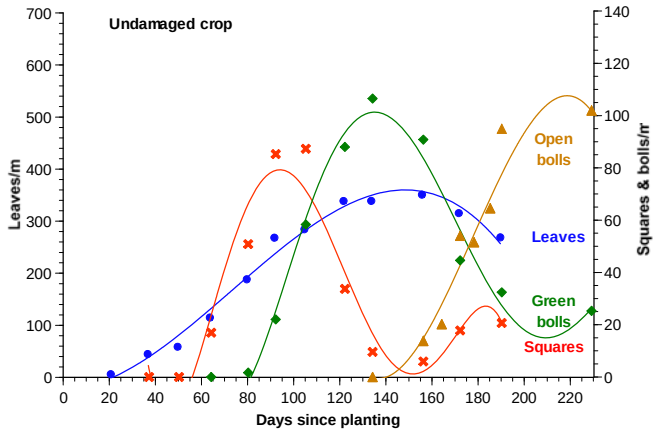
Few symptoms of imazethapyr damage remained on most leaves 28 days after exposure. Mild yellowing was still apparent on a small number of the top leaves.

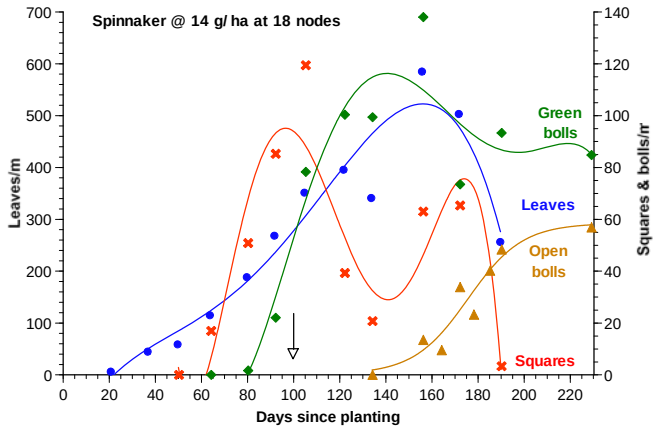
Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 18 node cotton. Photo taken on 22nd Feb, 35 days after exposure.

No symptoms of imazethapyr damage were apparent 35 days after exposure.

Spinnaker ® (imazethapyr) applied broadcast at 14 g/ha to 18 node cotton. Photo taken on 14th Mar, 56 days after exposure.

No symptoms of imazethapyr damage remained 56 days following exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of imazethapyr at 18 nodes caused mild yellowing, reddening and folding of some upper leaves and petiole reddening. Plants produced a mass of late-season growth and were 7.6 cm and 2.1 nodes taller and 21% heavier at defoliation.

**Leaves:** the herbicide caused yellowing, reddening and folding of some upper leaves.

**Squares**: the herbicide exposure had no impact on the pattern of squaring until late in the season when plants produced a flush of late squares.

**Bolls:** the herbicide exposure had little initial impact on boll retention, but resulted in a 3-fold increase in the number of green bolls at picking and a 32% reduction in average boll weight. With this mass of immature bolls, plants did not achieve 50% open bolls before picking.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but there was an increase in immature fibre (micronaire 3.98 compared to 4.48) and lint yield was down by 20%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **imazethapyr 10% @ 18 nodes** |
| **Nodes/plant** | 24.9 | 27.0 |
| **Leaves/m*** | 268 | 255 |
| **Leaf area ($cm^2$/m)*** | 6144 | 5877 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 142 |
| **Boll weight (g/open boll)** | 5.6 | 3.8 |
| **Retention posit's 1-3^** | 91% | 95% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 16 |
| **Days to 50% open bolls** | 179 | >280 |
| **Maturity delay (days)** | | >100 |
| **% Open bolls at picking** | 80% | 40% |
| **Lint yield (kg/ha)** | 2079 | 1659 |

## Summary

Exposure to 10% of a typical field rate of imazethapyr at 18 nodes caused yellowing and folding of some upper leaves and petiole reddening.

Plants responded with a flush of late-season vegetative growth, squares and green bolls. There was no change in the pattern of boll retention, but plants retained fewer mature bolls, with a long delay in average boll maturity, reduced boll size, reduced fibre quality and a 20% reduction in lint yield.

**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **imazethapyr** |
| **Rate:** | **49 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **18th Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **18 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by leaves but less rapidly by roots
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** strong residual activity. Plant-back to cotton of 18 - 34 months
**Soil half-life:** 60 - 90 days

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 18 node cotton. Photo taken on 9th Feb, 22 days after exposure.

Mild symptoms of imazethapyr damage were apparent soon after exposure as yellowing of the top leaves.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 18 node cotton. Photo taken on 15th Feb, 28 days after exposure.

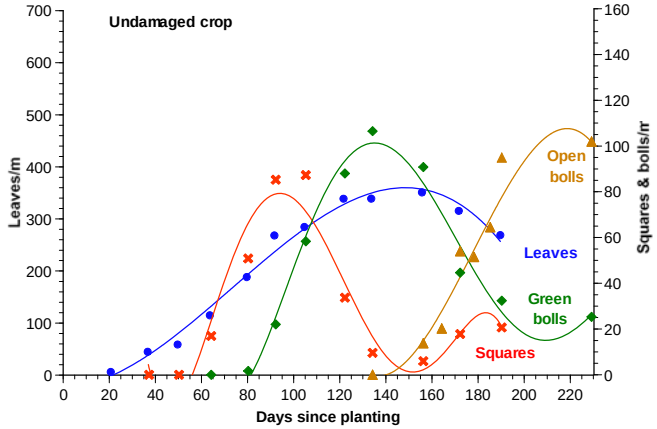
Mild symptoms of imazethapyr damage remained 28 days after exposure as yellowing of the top leaves.

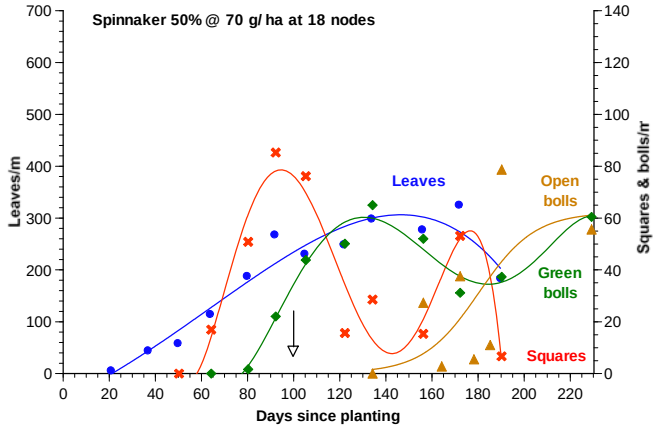
Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 18 node cotton. Photo taken on 22nd Feb, 35 days after exposure.

Few symptoms of imazethapyr damage remained 35 days after exposure.

Spinnaker ® (imazethapyr) applied broadcast at 70 g/ha to 18 node cotton. Photo taken on 14th Mar, 56 days after exposure.

No symptoms of imazethapyr damage remained 56 days after emergence.




## Impact on plant growth

**Plants**: exposure to the heavier rate of imazethapyr at 18 nodes caused mild yellowing of the upper leaves, but had a large impact on the crop triggering late vegetative growth. Crop growth and development were delayed and plants were 7 cm and 2 nodes taller but 42% smaller by weight at defoliation.

**Leaves:** the herbicide caused yellowing and a delay in leaf production. Plants had 32% fewer leaves and leaf area at defoliation.

**Squares**: plants produced a flush of late squares.

**Bolls:** most bolls above node 13 were shed and plants produced a flush of late green bolls delaying average boll maturity by 34 days. Plants had 45% fewer open bolls at picking and boll size was down by 42%.

**Lint**: ginning turnout was unaffected by the herbicide exposure but the fibre was immature and below base grade. Microaire was 3.18 compared to 4.48 for the undamaged crop, fibre length was down to 1.105" and short fibre% was up by 4%. There was an 86% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | imazethapyr 50% @ 18 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.8 |
| **Leaves/m*** | 268 | 183 |
| **Leaf area (cm²/m)*** | 6144 | 4181 |
| **Reduction in leaf area*** | | 32% |
| **Bolls/m** | 127 | 116 |
| **Boll weight (g/open boll)** | 5.6 | 3.3 |
| **Retention posit's 1-3^** | 91% | 84% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 – 13 |
| **Days to 50% open bolls** | 179 | 213 |
| **Maturity delay (days)** | | 34 |
| **% Open bolls at picking** | 80% | 48% |
| **Lint yield (kg/ha)** | 2079 | 289 |


## Summary

Exposure to 50% of a typical field rate of imazethapyr at 18 nodes caused yellowing of the upper leaves. Crop growth and development was delayed, with a flush of late vegetative growth. Plants were taller but lighter, with less leaf area at defoliation.

Most bolls above node 13 were shed and fewer open bolls were retained at picking. Average boll size was down, fibre quality was poor with low micronaire and short fibres and lint yield was down by 86%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **0.42 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 9 days after crop emergence.

No symptoms of metsulfuron-methyl damage were apparent on the newly emerged seedlings.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha and incorporated prior to planting cotton. Photo taken on 12th Nov, 17 days after crop emergence.

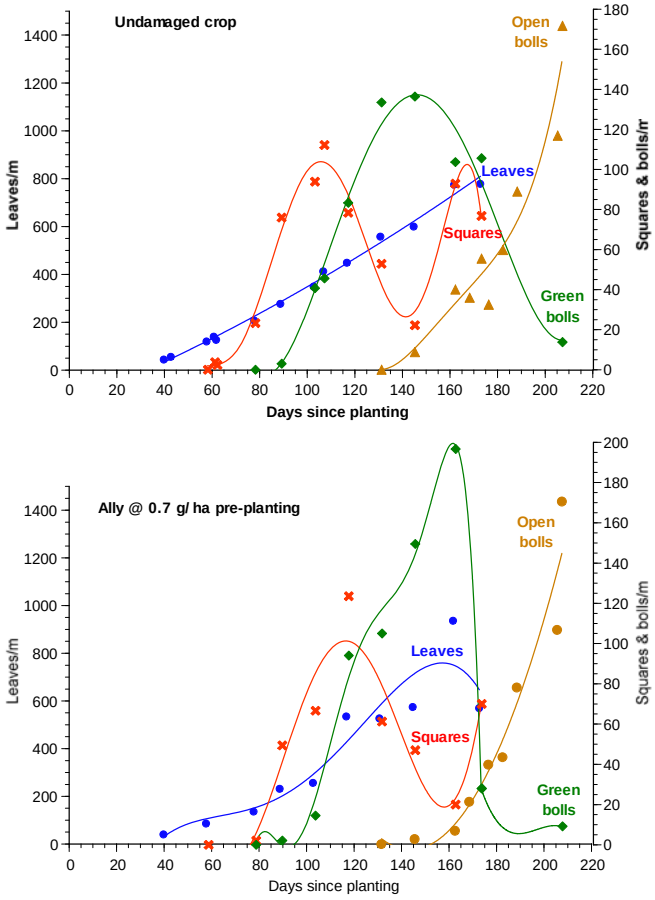
Most seedlings showed no symptoms of metsulfuron-methyl damage 17 days after emergence. However, damage was apparent on some seedlings with sagging cotyledons and yellowish patches. There may have also been some discolouration of the emerging true-leaves.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha and incorporated prior to planting cotton. Photo taken on 9th Dec, 44 days after crop emergence.

Symptoms of metsulfuron-methyl damage were more obvious on newly emerged leaves 44 days after crop emergence. Symptoms included stunting, sagging lower leaves, yellowing of the younger leaves with reddish leaf margins and reddening of the cotyledons. Some seedlings were apparently unaffected and growing normally.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha and incorporated prior to planting cotton. Photo taken on 7th Jan, 73 days after crop emergence.

No symptoms of metsulfuron-methyl damage were apparent 73 days after emergence.




## Impact on plant growth

**Plants**: exposure to the lighter rate of residual metsulfuron-methyl caused damage to some seedlings, although a proportion of seedlings were relatively unaffected. The plants compensated for the early-season damage and produced a normal crop but remained 37% lighter at the final observation.

**Leaves:** damage symptoms included petiole distortion, cotyledon and leaf yellowing and reddening of the leaf margins. Plants had 27% fewer leaves and 32% less leaf area at the final observation.

**Squares**: there was 20 day delay in the start of square production.

**Bolls:** boll production appeared to be largely unaffected until later in the season when plants set a heavy crop, but then a large proportion of these late bolls were shed. There was no impact on the number of open bolls at picking, average boll size or boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was an 8% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | metsulfuron 10% pre-plant |
|---|---|---|
| **Nodes/plant** | 26.9 | 26.0 |
| **Leaves/m*** | 775 | 567 |
| **Leaf area (cm²/m)*** | 30138 | 20552 |
| **Reduction in leaf area*** | | 32% |
| **Bolls/m** | 186 | 179 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention posit's 1-3^** | 91% | 91% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 – 19 |
| **Days to 50% open** | 193 | 193 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 94% |
| **Lint yield (kg/ha)** | 2099 | 1940 |


### Summary

Exposure to 10% of a typical field rate of residual metsulfuron-methyl caused little damage to emerging seedlings, but damage became more apparent 6 weeks post-emergence.

Square and boll production were unaffected until later in the season, when plants retained and then shed an additional heavy crop. There was no impact on the number of open bolls at picking, average boll size, boll maturity or lint quality. Lint yield was down by 8%.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **2.1 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 9 days after crop emergence.

Symptoms of metsulfuron-methyl damage were apparent soon after seedlings emerged. Symptoms included reddening of the petioles and yellowing and sagging of the cotyledons.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha and incorporated prior to planting cotton. Photo taken on 12th Nov, 17 days after crop emergence.

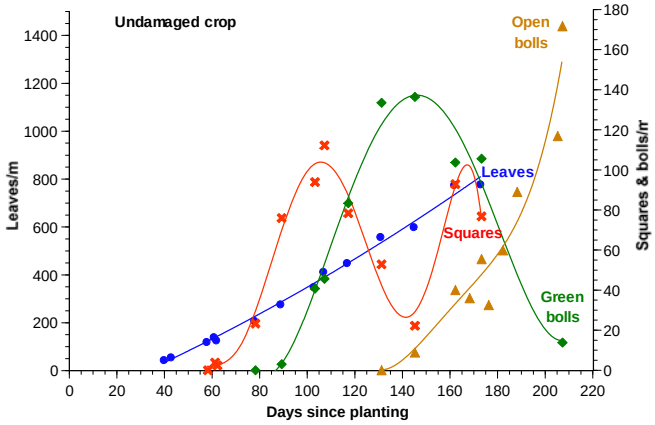
Symptoms of metsulfuron-methyl damage were less apparent 17 days after emergence. Some yellowish patches were apparent on the cotyledons and most cotyledons were still sagging, although some seedlings appeared to be growing more normally.

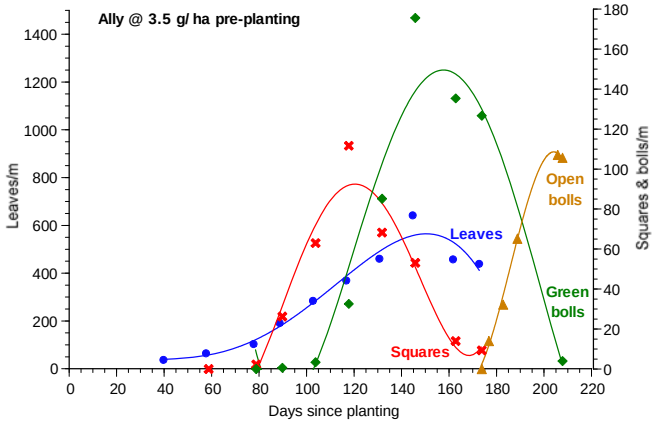
Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha and incorporated prior to planting cotton. Photo taken on 9th Dec, 44 days after crop emergence.

Most seedlings showed strong symptoms of metsulfuron-methyl damage 44 days after emergence, while some seedlings are growing more normally. Symptoms on the damage seedlings included stunting, sagging lower leaves, yellowing of the younger leaves and reddish leaf margins.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha and incorporated prior to planting cotton. Photo taken on 7th Feb, 104 days after crop emergence.

Symptoms of metsulfuron-methyl damage were no longer obvious by 73 days after emergence, and were not apparent on these plants, 104 days after emergence. However, many of the seedlings (such as the small plant at the bottom right-hand side of the photo) remained severely stunted.




## Impact on plant growth

**Plants**: exposure to residual metsulfuron-methyl damaged most emerging seedlings, although a proportion of seedlings were relatively unaffected. The final plant stand was reduced by 25% and plants were 17% lighter at the final observation.

**Leaves:** damage symptoms included petiole distortion, cotyledon and leaf yellowing and reddening of the leaf margins. Damage persisted throughout the season. Plants had 44% fewer leaves and 38% less leaf area at the final observation.

**Squares**: there was 20 day delay in the start of square production and fewer squares were produced later in the season.

**Bolls:** there was a 25 day delay in the onset of boll production. Plants retained 38% fewer open bolls at picking, with few bolls retained below node 11.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but the cotton was immature with 10.3% short fibres, reduced fibre strength and low micronaire (3.38). Lint yield was reduced by 23%.

**Final plant count data**

| | undamaged comparison | metsulfuron 50% pre-plant |
|---|---|---|
| **Nodes/plant** | 26.9 | 24.3 |
| **Leaves/m*** | 775 | 436 |
| **Leaf area (cm²/m)*** | 30138 | 18540 |
| **Reduction in leaf area*** | | 38% |
| **Bolls/m** | 186 | 110 |
| **Boll weight (g/open boll)** | 4.2 | 4.0 |
| **Retention posit's 1-3^** | 91% | 96% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 11 - 20 |
| **Days to 50% open** | 193 | 187 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 96% |
| **Lint yield (kg/ha)** | 2099 | 1609 |


## Summary

Exposure to 50% of a typical field rate of residual metsulfuron-methyl caused extensive damage to most emerging seedlings, with some seedlings never recovering from the damage. Plants remained stunted, with fewer leaves and less leaf area.

Square and boll production were delayed, with few bolls retained below the 11th node. Plants retained fewer open bolls at picking and the cotton was immature, with reduced fibre quality. Lint yield was reduced by 23%


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **0.42 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **25th Nov** (4 weeks post-emergence) |
| **Growth stage at exposure:** | **4 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 4 node cotton. Photo taken on 9th Dec, 14 days after exposure.

The only symptoms of metsulfuron-methyl damage apparent 14 days after exposure were some necrotic spots on the upper leaves and the newly emerged leaves on some plants were yellowish with red streaks on the veins radiating out from the petiole.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 4 node cotton. Photo taken on 20th Dec, 25 days after exposure.

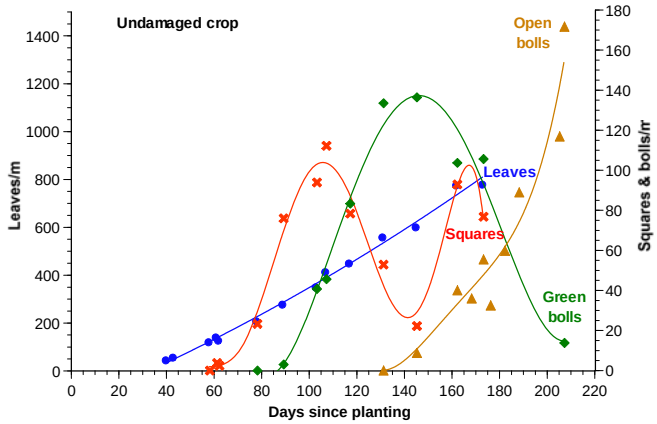
The only symptoms of metsulfuron-methyl damage apparent 25 days after exposure were a slight yellowing of the upper leaves and bleaching of the veins.

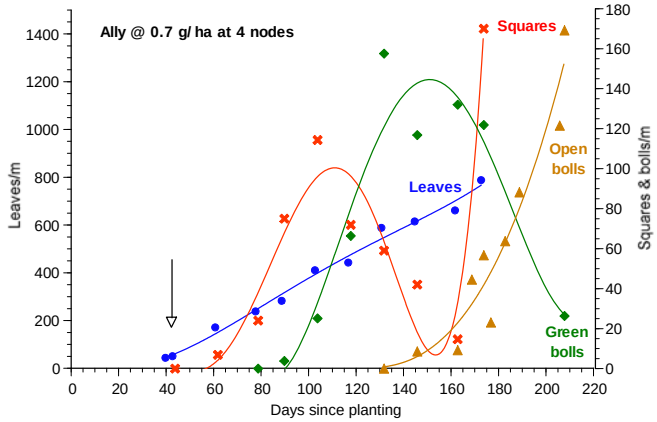
Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 4 node cotton. Photo taken on 29th Dec, 34 days after exposure.

Few symptoms of metsulfuron-methyl damage were obvious 34 days after exposure, other than bleaching of the veins.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 4 node cotton. Photo taken on 7th Jan, 43 days after exposure.

No symptoms of metsulfuron-methyl damage remained 43 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of metsulfuron-methyl at 4 nodes caused little obvious damage other than yellowing a proportion of new leaves. There was no adverse affect on height, nodes or plant size, but an additional 25% of plants were tipped-out.

**Leaves:** the herbicide damage caused no reduction in leaf number or leaf area.

**Squares**: there was no impact on square production until later in the season when plants produced a flush of new squares.

**Bolls:** boll production appeared to be largely unaffected by the herbicide damage until late in the season when additional bolls were retained, although more bolls were retained on the lateral branches as a result of the increased proportion of tipped-out plants. There was no reduction in the number of bolls open at picking, boll weight or average crop maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final plant count data**

| | undamaged comparison | metsulfuron 10% @ 4 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 25.9 |
| **Leaves/m*** | 775 | 785 |
| **Leaf area (cm²/m)*** | 30138 | 37122 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 195 |
| **Boll weight (g/open boll)** | 4.2 | 4.5 |
| **Retention posit's 1-3^** | 91% | 74% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 4 – 17 |
| **Days to 50% open** | 193 | 194 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 87% |
| **Lint yield (kg/ha)** | 2099 | 2112 |


## Summary

Exposure to 10% of a typical field rate of metsulfuron-methyl at 4 nodes tipped-out a quarter of the stand, but caused little other damage to the plants.

Square and boll production were largely unaffected by the herbicide exposure, except for a flush of late squares and bolls. There was no reduction in the number of bolls open at picking, boll weight, average crop maturity, fibre quality or lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **2.1 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **25th Nov** (4 weeks post-emergence) |
| **Growth stage at exposure:** | **4 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 4 node cotton. Photo taken on 9th Dec, 14 days after exposure.

The symptoms of metsulfuron-methyl damage 14 days after exposure include stunting and necrotic spots on the older leaves. Newly emerged leaves were yellowish, with yellow veins and red streaks on the veins radiating out from the petiole. The petioles and leaf rims were also red, and some leaves had reddish patches.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 4 node cotton. Photo taken on 14th Dec, 19 days after exposure.

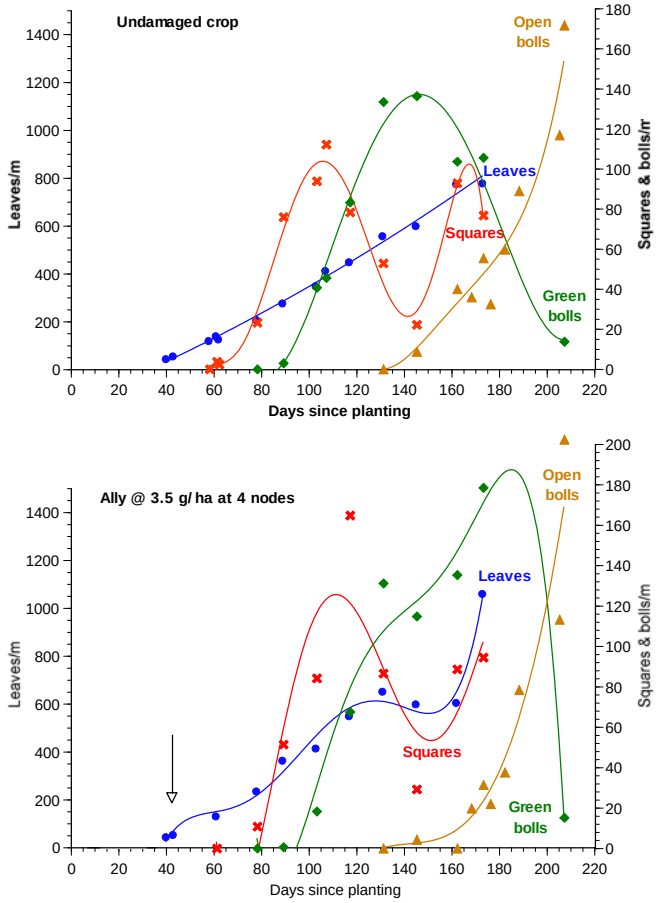
New growth had emerged 19 days after exposure to metsulfuron-methyl. This growth had shortened internodes, giving it a bunched appearance, with yellowish leaves and red patches. Other symptoms included reddening on the rim of the leaf and red streaks along the veins, radiating out from the red petioles.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 4 node cotton. Photo taken on 22nd Dec, 27 days after exposure.

The crop had resumed more normal growth by 27 days after exposure, although the upper leaves (now fully expanded) were still noticeably yellow, with paler veins and reddish streak emanating along the veins from the petioles.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 4 node cotton. Photo taken on 7th Jan, 43 days after exposure.

No symptoms of metsulfuron-methyl damage were still apparent 43 days after exposure, except for mild bleaching of the main veins.




## Impact on plant growth

**Plants**: exposure to metsulfuron-methyl at 4 nodes damaged the new growth, causing some stunting. Plants recovered from this early-season damage, with no reduction in plant weight or node number, although an additional 21% of plants were tipped-out and plants were 5 cm shorter at the final observation.

**Leaves:** the herbicide damage caused leaf yellowing and reddening of the leaf margins, veins and petioles. The damage caused a small delay in plant growth and development, but plants recovered later in the season, with no reduction in leaf area or leaf number at the final observation.

**Squares**: there was a short delay in squaring.

**Bolls:** boll production appeared to be largely unaffected until late in the season when plants produced a flush of late bolls, although more bolls were retained on the lateral branches in response to increased tipping-out. Plants retained 18% more open bolls at picking.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide.

**Final plant count data**

| | undamaged comparison | metsulfuron 50% @ 4 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 25.4 |
| **Leaves/m*** | 775 | 1057 |
| **Leaf area (cm²/m)*** | 30138 | 41892 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 218 |
| **Boll weight (g/open boll)** | 4.2 | 4.4 |
| **Retention posit's 1-3^** | 91% | 68% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 4 – 18 |
| **Days to 50% open** | 193 | 198 |
| **Maturity delay (days)** | | 5 |
| **% Open bolls at picking** | 92% | 93% |
| **Lint yield (kg/ha)** | 2099 | 2103 |


### Summary

Exposure to 50% of a typical field rate of metsulfuron-methyl at 4 nodes damaged young leaves and growing tips and delayed crop development.

Fewer bolls were retained in positions 1 – 3, but more bolls were retained on the lateral branches, resulting in an increased load of mature bolls at picking. There was no reduction in average boll weight, delay in average boll maturity, reduction in fibre quality or loss of lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **0.42 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **15th Dec (7 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 9 node cotton. Photo taken on 22nd Dec, 7 days after exposure.

Symptoms of metsulfuron-methyl damage 7 days after exposure included yellowish spots and some inter-vienal yellowing and bleaching/yellowing of the main veins.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 9 node cotton. Photo taken on 29th Dec, 14 days after exposure.

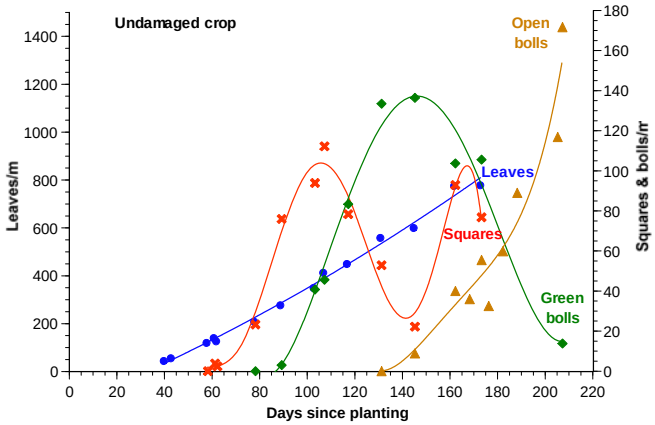
The yellowish spots and bleaching/yellowing of the main veins was still apparent 14 days after exposure to metsulfuron-methyl.

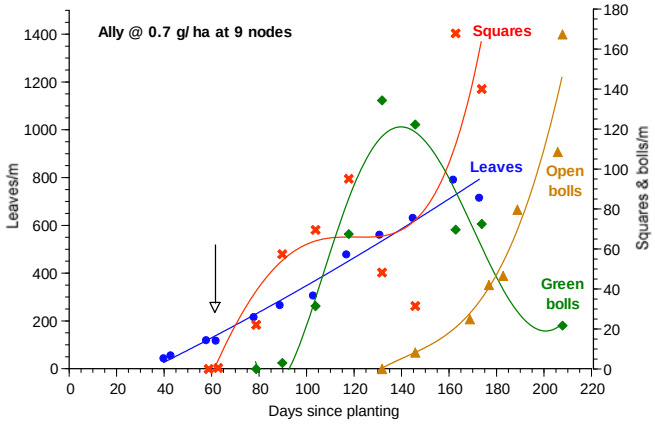
Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 9 node cotton. Photo taken on 7th Jan, 23 days after exposure.

No obvious symptoms of metsulfuron-methyl damage remained 23 days after exposure, although some of the newly expanded leaves were a bit yellowish.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 9 node cotton. Photo taken on 17th Jan, 33 days after exposure.

No symptoms of metsulfuron-methyl damage were still apparent 33 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of metsulfuron-methyl at 9 nodes caused very little obvious damage, other than a few yellowish patches on newly emerged leaves. There was no adverse affect on plant height, node number or plant size.

**Leaves:** the herbicide exposure caused no reduction in leaf number, or leaf area at the final observation when compared to undamaged plants.

**Squares**: there was no impact on square production until later in the season when plants produced a flush of new squares.

**Bolls:** boll production appeared to be largely unaffected, although there was a small reduction in peak boll production. Boll size was no reduced, nor was average boll maturity delayed.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final plant count data**

| | undamaged comparison | metsulfuron 10% @ 9 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 26.3 |
| **Leaves/m*** | 775 | 713 |
| **Leaf area (cm²/m)*** | 30138 | 29503 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 189 |
| **Boll weight (g/open boll)** | 4.2 | 4.3 |
| **Retention posit's 1-3^** | 91% | 95% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 8 - 17 |
| **Days to 50% open** | 193 | 196 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 89% |
| **Lint yield (kg/ha)** | 2099 | 2081 |


## Summary

Exposure to 10% of a typical field rate of metsulfuron-methyl at 9 nodes caused little damage to the plants, other than a few yellowish patches on newly emerged leaves. There was no reduction in size, height, nodes, leaves or leaf area.

Square and boll production were largely unaffected, although there was a flush of late squares and a small reduction in peak boll production. There was no reduction in mature bolls at picking, boll weight, boll maturity, reduction in fibre quality or loss of lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **2.1 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **15th Dec (7 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 9 node cotton. Photo taken on 22nd Dec, 7 days after exposure.

Symptoms of metsulfuron-methyl damage days after exposure included yellowish spots and some blistering on newly expanded leaves, inter-vienal yellowing and yellowing of the main veins. The petioles of the upper leaves were bright red, with red streaks radiating from the petioles into the main veins of some leaves.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 9 node cotton. Photo taken on 29th Dec, 14 days after exposure.

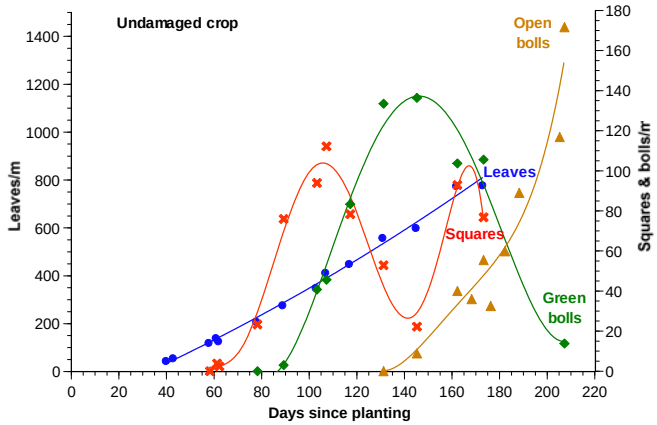
Much of the yellowing had faded 14 days after exposure to metsulfuron-methyl, but there was a general yellowing of the upper leaves and some red and yellow spots and patches as well as necrotic spots and patches. The deep red of the petioles was fading.

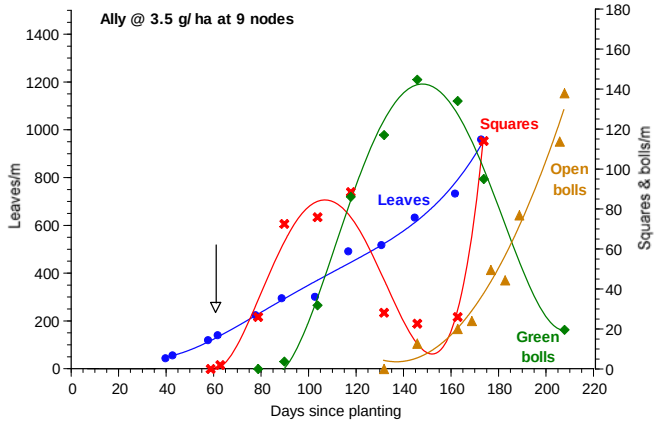
Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 9 node cotton. Photo taken on 7th Jan, 23 days after exposure.

The general yellowing of the upper leaves was still apparent 23 days after exposure to metsulfuron-methyl, with yellowing spots and patches on some leaves and distinct yellowing of the main veins on the upper leaves. Red streaks radiated from the petioles into the main veins of some leaves, although the red only went a small way down the veins.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 9 node cotton. Photo taken on 17th Jan, 33 days after exposure.

A slight yellowing could still be seen 33 days after exposure to metsulfuron-methyl, but most other symptoms had faded.




## Impact on plant growth

**Plants**: exposure to metsulfuron-methyl at 9 nodes caused yellowing of the upper leaves. Plants recovered from the discolouration with no adverse reduction in plant height, nodes or size.

**Leaves:** the herbicide exposure had no adverse affect on leaf number or leaf area at the final observation, when plants had 23% more leaves and 35% more leaf area than the undamaged plants.

**Squares**: there was little impact on square initiation or peak squaring.

**Bolls:** boll production appeared to be largely unaffected by the herbicide exposure. There was no apparent delay in average boll maturity but the later bolls were slow to open. Plants retained 15% fewer bolls at picking and 20% fewer bolls were open at picking.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 7% reduction in lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **metsulfuron 50% @ 9 nodes** |
| **Nodes/plant** | 26.9 | 25.7 |
| **Leaves/m*** | 775 | 956 |
| **Leaf area (cm²/m)*** | 30138 | 40613 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 157 |
| **Boll weight (g/open boll)** | 4.2 | 4.3 |
| **Retention posit's 1-3^** | 91% | 97% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 – 18 |
| **Days to 50% open** | 193 | 190 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 87% |
| **Lint yield (kg/ha)** | 2099 | 1960 |


## Summary

Exposure to 50% of a typical field rate of metsulfuron-methyl at 9 nodes caused little damage to the plants, other than some transient yellowing. There was no reduction plant size, but plants had more leaves and leaf area late in the season.

Squaring and boll retention were largely unaffected by the herbicide damage, but plants retained fewer open bolls at picking. There was no reduction in boll size, delay in crop maturity or reduction in fibre quality, but lint yield was down 7%.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **0.42 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Jan** (11 weeks post-emergence) |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 12 node cotton. Photo taken on 21st Jan, 8 days after exposure.

Metsulfuron-methyl caused yellow discolouration of the upper leaves, ranging from distinct spots and patches to a general yellowing of the whole leaf 8 days after exposure. Some of the newly emerged leaves showed no damage symptoms, or yellowing of the main veins.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 12 node cotton. Photo taken on 28th Jan, 15 days after exposure.

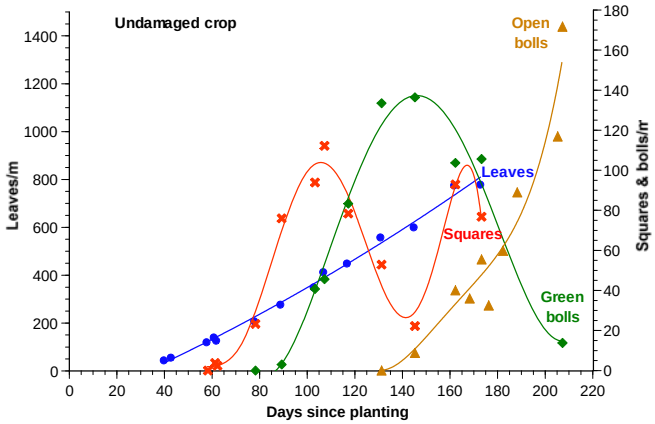
The yellowish spots and patches were fading on most leaves 15 days after exposure, but intense discolouration was still obvious on some leaves.

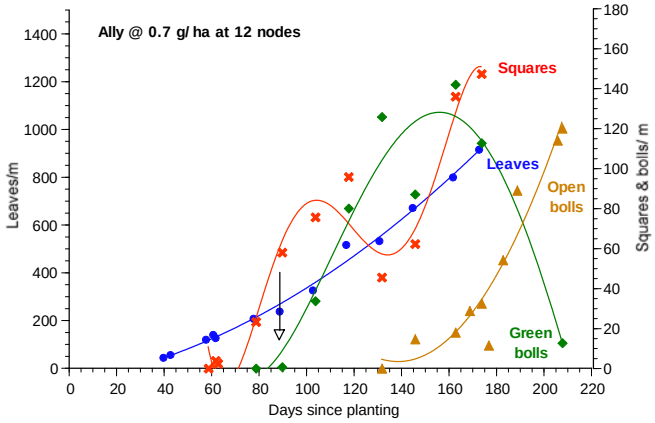
Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 12 node cotton. Photo taken on 7th Feb, 25 days after exposure.

No obvious symptoms of metsulfuron-methyl damage were still apparent 25 days after exposure, although damaged leaves could still be found in the middle of the canopy.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 12 node cotton. Photo taken on 18th Feb, 36 days after exposure.

No symptoms of metsulfuron-methyl damage remained 36 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of metsulfuron-methyl at 12 nodes caused few symptoms of damage. However, plants were11 cm shorter at picking and 28% smaller by weight at the final observation.

**Leaves:** the herbicide exposure caused little obvious damage, other than a few yellowish spots and patches on newly emerged leaves. There was no adverse affect on leaf number or leaf area at the final observation.

**Squares**: there was no impact on square production until later in the season when plants produced a flush of new squares.

**Bolls:** boll production appeared to be largely unaffected by the herbicide exposure. There was no delay in the start of boll opening, but plants retained 30% fewer open bolls at picking. There was a 10% reduction in boll weight, but no delay in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide.

**Final plant count data**

| | undamaged comparison | metsulfuron 10% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 25.1 |
| **Leaves/m*** | 775 | 912 |
| **Leaf area (cm²/m)*** | 30138 | 31259 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 133 |
| **Boll weight (g/open boll)** | 4.2 | 3.7 |
| **Retention posit's 1-3^** | 91% | 92% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 – 18 |
| **Days to 50% open** | 193 | 188 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 90% |
| **Lint yield (kg/ha)** | 2099 | 1965 |


## Summary

Exposure to 10% of a typical field rate of metsulfuron-methyl at 12 nodes caused little obvious damage to the plants, but reduced plant size (but not leaf number or leaf area).

Squaring and boll production were largely unaffected by the herbicide exposure, but plants retained fewer open bolls at picking and there was a reduction in average boll weight. There was no delay in average boll maturity, no loss in fibre quality and no appreciable reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **2.1 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 12 node cotton. Photo taken on 21st Jan, 8 days after exposure.

Metsulfuron-methyl caused yellow discolouration of the newly emerged leaves, ranging from distinct spots and patches to a general yellowing of the whole leaf. Some of the leaves showed no damage symptoms, or yellowing of the main veins 8 days after exposure.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 12 node cotton. Photo taken on 7th Feb, 25 days after exposure.

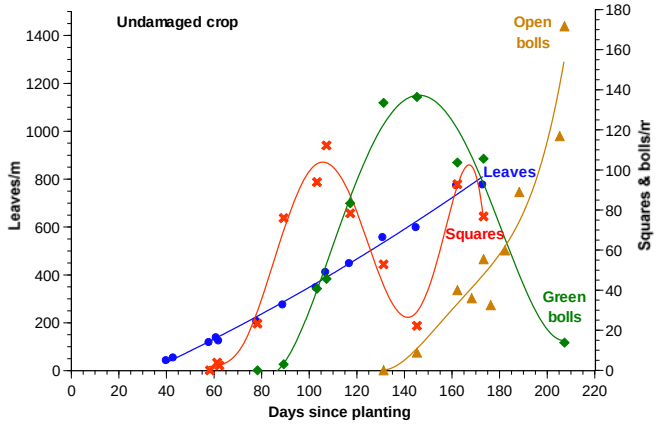
No new leaves had developed on the damaged plants 25 days after exposure. Damaged leaves remained stunted, with reddish and necrotic patches developing on many leaves.

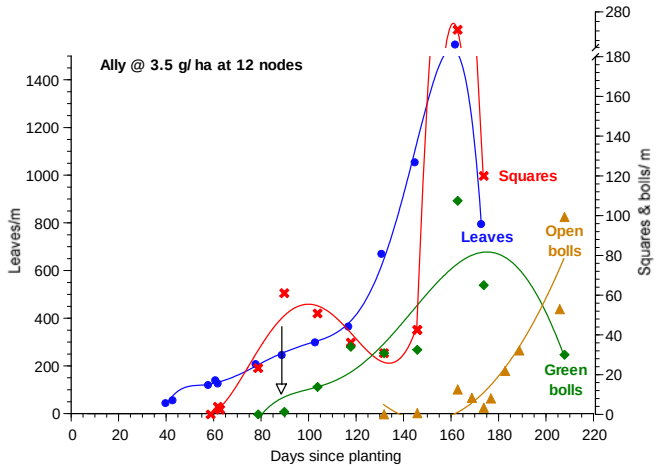
Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 12 node cotton. Photo taken on 18th Feb, 36 days after exposure.

Most plants had been severely damaged, although new growth had begun to emerge from the main stems of the damaged plants 36 days after exposure. Undamaged lateral branches were starting to dominate the crop.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 12 node cotton. Photo taken on 14th Mar, 60 days after exposure.

The crop looked almost normal 60 days after exposure, but undamaged lateral branches had overgrown the main stems. Growth on the tops of the main stems was tightly bunched, with short internodes and numerous small leaves.




## Impact on plant growth

**Plants**: exposure to metsulfuron-methyl at 12 nodes caused extensive damage and plants were 8 cm shorter and weighed 57% less at the final observation.

**Leaves:** the herbicide caused severe damage to the top leaves and growing tips of the main stems. Plants produced a late flush of vegetative growth, with double the leaf number 60 days after exposure, but had 20% less leaf area at the final observation.

**Squares**: many early squares were shed following the exposure and plants produced a flush of late squares.

**Bolls:** a large proportion of bolls were shed following the herbicide exposure, with 14% fewer bolls retained in positions 1 – 3 and 30% fewer bolls retained at picking. There was a 30 delay in the start of boll opening, and plants retained 42% fewer open bolls at picking. There was a 20% reduction in boll weight and a 10 day delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 72% reduction in lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **metsulfuron 50% @ 12 nodes** |
| **Nodes/plant** | 26.9 | 27.4 |
| **Leaves/m*** | 775 | 792 |
| **Leaf area (cm²/m)*** | 30138 | 24065 |
| **Reduction in leaf area*** | | 20% |
| **Bolls/m** | 186 | 129 |
| **Boll weight (g/open boll)** | 4.2 | 3.3 |
| **Retention posit's 1-3^** | 91% | 76% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 – 18 |
| **Days to 50% open** | 193 | 203 |
| **Maturity delay (days)** | | 10 |
| **% Open bolls at picking** | 92% | 77% |
| **Lint yield (kg/ha)** | 2099 | 597 |


## Summary

Exposure to 50% of a typical field rate of metsulfuron-methyl at 12 nodes caused extensive damage to the top leaves and growing tips, delaying crop development. Plants produced a flush of late vegetative growth.

Most squares and bolls were shed in the 60 days following exposure. Plants set a late crop, but there was a reduction in boll number at picking, boll weight, a delay in crop maturity and a 72% reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **0.42 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **31st Jan (14 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 16 node cotton. Photo taken on 7th Feb, 7 days after exposure.

Mild symptoms of exposure to metsulfuron-methyl were apparent 7 days after exposure, with yellow discolouration of the upper leaves, ranging from distinct spots and patches on some leaves to a general yellowing of some expanding leaves.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 16 node cotton. Photo taken on 18th Feb, 18 days after exposure.

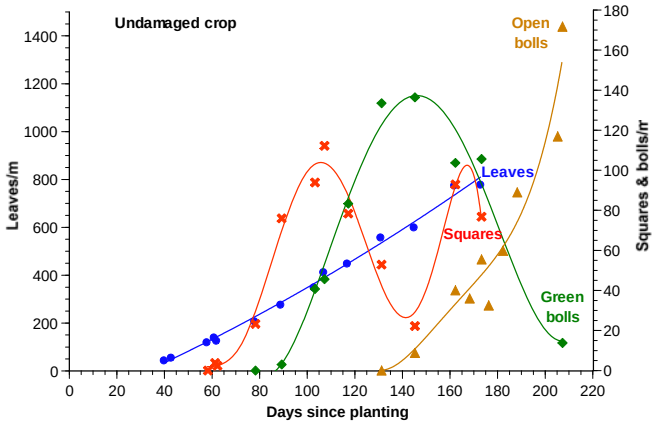
The yellowish spots and patches were less obvious 18 days after exposure, but could still be found on some leaves.

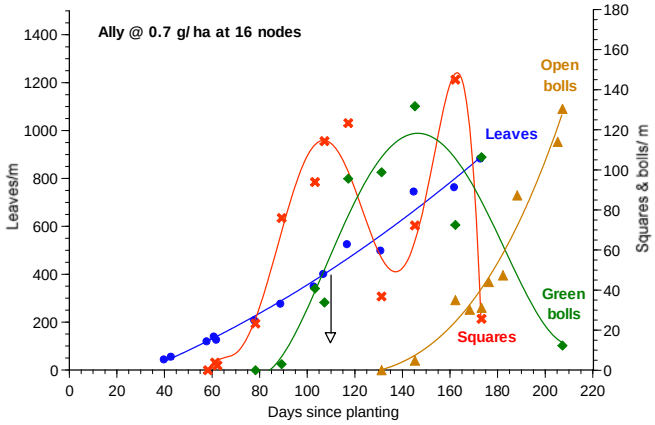
Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 16 node cotton. Photo taken on 3rd Mar, 31 days after exposure.

Yellowish and bleached patches could still be found on some leaves 31 days after exposure.

Ally® (metsulfuron-methyl) applied broadcast at 0.7 g/ha to 16 node cotton. Photo taken on 14th Mar, 42 days after exposure.

Discoloured leaves were difficult to find 42 days after exposure.




## Impact on plant growth

**Plants**: exposed to the lighter rate of metsulfuron-methyl at 16 nodes showed few signs of damage, with no adverse affect on plant height, nodes or plant size.

**Leaves:** the herbicide exposure caused little obvious damage, other than a few yellowish spots and patches on newly emerged leaves. There was no adverse affect on leaf number or leaf area at the final observation.

**Squares**: some squares were shed following the exposure, but plants produced additional squares soon after.

**Bolls:** boll retention appeared to be largely unaffected by the herbicide exposure, but plants retained fewer bolls mid-season, with 7% fewer bolls retained on positions 1 - 3. Plants retained 24% fewer open bolls at picking, but there was no reduction in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final plant count data**

| | undamaged comparison | metsulfuron 10% @ 16 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 26.9 |
| **Leaves/m*** | 775 | 880 |
| **Leaf area (cm²/m)*** | 30138 | 29011 |
| **Reduction in leaf area*** | | 4% |
| **Bolls/m** | 186 | 143 |
| **Boll weight (g/open boll)** | 4.2 | 3.9 |
| **Retention posit's 1-3^** | 91% | 84% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 – 18 |
| **Days to 50% open** | 193 | 188 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 91% |
| **Lint yield (kg/ha)** | 2099 | 1991 |


## Summary

Exposure to 10% of a typical field rate of metsulfuron-methyl at 16 nodes caused little obvious damage to the plants, with no reduction in plant height or size, leaf number of leaf area.

Some squares and bolls were shed following the exposure, with fewer bolls retained in positions 1 – 3. Plants retained fewer open bolls at picking, but there was no reduction in boll size, average boll maturity, fibre quality or lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **Metsulfuron-methyl** |
| **Rate:** | **2.1 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **31st Jan** **(14 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **B**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** inhibits the synthesis of some amino acids, preventing protein synthesis
**Residual activity:** prolonged residual activity. Plant-back to cotton can exceed 2 years depending on rate, soil pH, soil moisture and temperature
**Soil half-life:** 7 - 42 days. Slower breakdown in dry, alkaline soils and cold conditions.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 16 node cotton. Photo taken on 7th Feb, 7 days after exposure.

The symptoms of exposure to metsulfuron-methyl 7 days after exposure, were yellow discolouration of the upper leaves, ranging from distinct spots and patches to a general yellowing of some expanding leaves.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 16 node cotton. Photo taken on 18th Feb, 18 days after exposure.

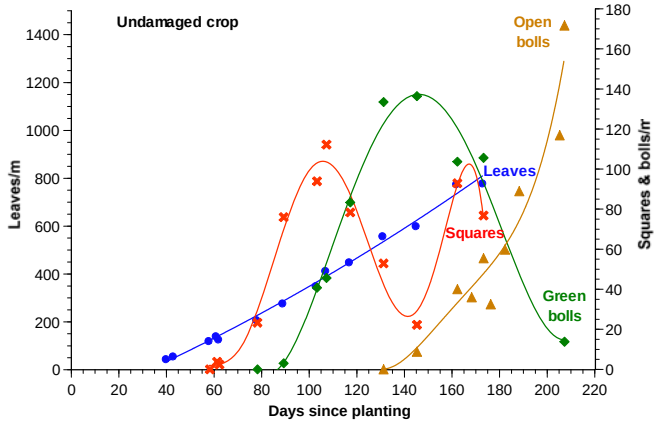
The main damage was apparent on the terminals of the main stems 18 days after exposure, where the new leaves were clumped (shortened petioles and inter-nodes), yellowish and with red and necrotic spots and patches.

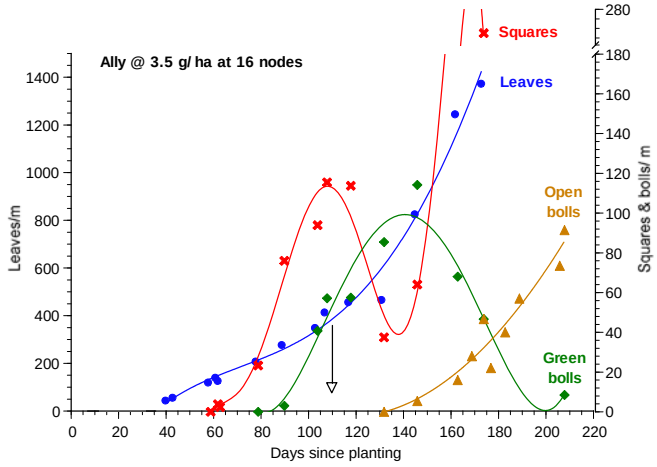
Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 16 node cotton. Photo taken on 3rd Mar, 31 days after exposure.

Most of the discolouration had faded 31 days after exposure. Clumped new growth was still obvious at the terminals of the main stems, with small, round leaves on short petioles and short inter-nodes.

Ally® (metsulfuron-methyl) applied broadcast at 3.5 g/ha to 16 node cotton. Photo taken on 14th Mar, 42 days after exposure.

No signs of metsulfuron-methyl damage remained obvious 42 days after exposure.




## Impact on plant growth

**Plants**: exposed to metsulfuron-methyl at 16 nodes did not appear to be strongly damaged by the herbicide, but were 12 cm shorter and 14% smaller by weight at the final observation.

**Leaves:** the herbicide exposure caused discolouration of some terminal leaves, and damaged the terminals, causing clumping of the new vegetative growth. This resulted in 77% more leaves and 30% more leaf area at the final observation.

**Squares**: there was little impact on early and mid-season square production, but plants produced a flush of late squares.

**Bolls:** boll retention appeared to be largely unaffected, but plants retained fewer bolls mid- and late-season, with few bolls retained above node 16. Plants retained 47% fewer open bolls at picking and boll weight was down by 19%.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but the cotton fell below base grade, with 10.9% short fibres and reduced fibre strength. Lint yield was reduced by 43%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **metsulfuron 50% @ 16 nodes** |
| **Nodes/plant** | 26.9 | 26.9 |
| **Leaves/m*** | 775 | 1370 |
| **Leaf area (cm²/m)*** | 30138 | 39240 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 100 |
| **Boll weight (g/open boll)** | 4.2 | 3.4 |
| **Retention posit's 1-3^** | 91% | 87% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 8 – 16 |
| **Days to 50% open** | 193 | 187 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 91% |
| **Lint yield (kg/ha)** | 2099 | 1190 |

## Summary

Exposure to 50% of a typical field rate of metsulfuron-methyl at 16 nodes damaged the expanding leaves and terminals. Plants produced a flush of bunched, late vegetative growth, with small leaves and stunted inter-nodes.

Bolls were shed, primarily from the top of the plant, following the exposure. There was a reduction in the number of open bolls at picking and in average boll size. Lint quality was reduced and lint yield was down by 43%.

**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** atrazine
**Rate:** 200 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 14th Oct (pre-planting)
**Growth stage at exposure:**

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | |

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by roots and translocated to shoots, absorbed by leaves
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may exceed 1-2 years depending on rate, soil moisture and temperature
**Soil half-life:** 60 days. Breakdown is slower in dry, alkaline soils and cold conditions.

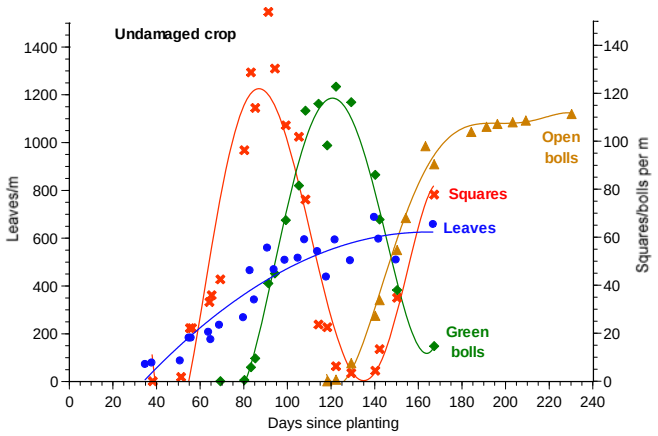
Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

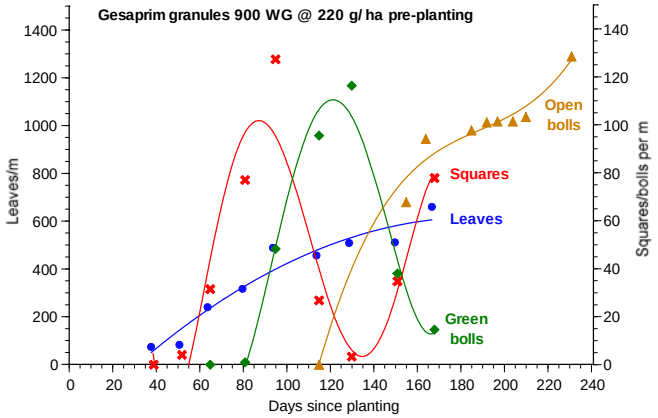
No symptoms of atrazine damage were apparent on these plants at any stage.

Untreated plants on 4th Dec. There was no visual difference between these and the plants exposed to the low rate of atrazine at planting.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha and incorporated prior to planting cotton. Photo taken on 14th Jan, 83 days after emergence.

No symptoms of atrazine damage were apparent on these plants at any stage.




## Impact on plant growth

**Plants:** exposed to the 10% rate of residual atrazine were 10 cm and 1 node shorter at picking.

**Leaves:** the atrazine had no observable impact on the cotton foliage. However, plants were affected season-long, with 17% fewer leaves and 19% less leaf area at the final observation.

**Squares**: there was no effect on square production.

**Bolls:** there was no apparent effect on boll production, retention or maturity. Most bolls (81%) were retained between nodes 6 and 19, a similar retention pattern to the undamaged crop.

**Lint:** ginning turnout and lint yield were unaffected by the herbicide damage, but the cotton fell below base grade, with 12.4% short fibres.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **atrazine** |
| **Nodes/plant** | 30.9 | 29.9 |
| **Leaves/m*** | 543 | 453 |
| **Leaf area (cm²/m)*** | 23764 | 19203 |
| **Reduction in leaf area*** | | 19% |
| **Bolls/m** | 132 | 147 |
| **Boll weight (g/open boll)** | 5.3 | 5.2 |
| **Retention in posit's 1-3^** | 95% | 96% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 6 - 19 |
| **Days to 50% open bolls** | 157 | 154 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 87% |
| **Lint yield/ha** | 2380 | 2309 |

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

Exposure to 10% of a typical field rate of residual atrazine caused only minor damage to the crop, but the crop was affected throughout the season, with a reduction in plant height, leaf number and leaf area.

There was no impact on boll retention, boll weight, crop maturity or yield, but fibre quality was reduced.

Nevertheless, the extent of early season damage from residual herbicides can be greatly influenced by early-season conditions. More damage may have occurred in a season where wetter and/or colder conditions followed planting.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** atrazine
**Rate:** 1 kg a.i./ha
**% of typical field rate** 50%
**Date of exposure:** 14th Oct (pre-planting)
**Growth stage at exposure:**

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by roots and translocated to shoots, absorbed by leaves
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may exceed 1-2 years depending on rate, soil moisture and temperature
**Soil half-life:** 60 days. Breakdown is slower in dry, alkaline soils and cold conditions.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha and incorporated prior to planting cotton. Photo taken on 17th Nov, 24 days after emergence.

Symptoms of atrazine damage were not readily apparent at this growth stage 24 days after emergence, although there was some slight yellowing of the leaves.

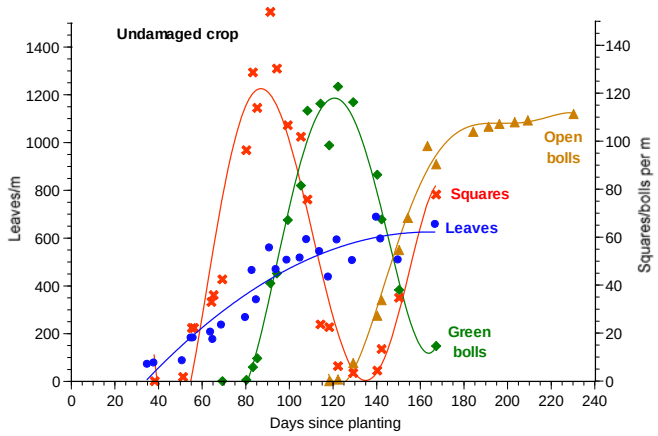
Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

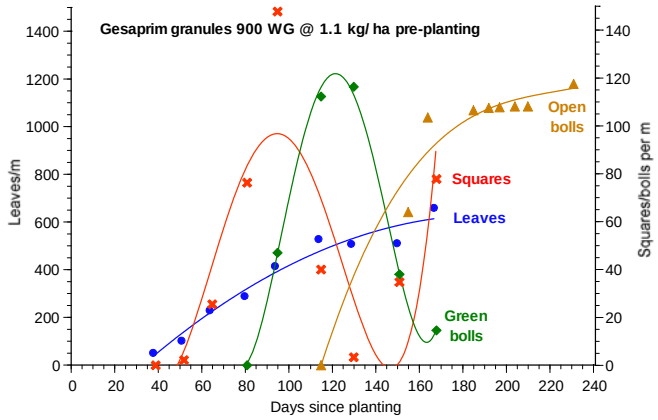
Symptoms of atrazine damage were not readily apparent 42 days after emergence, although there was some slight yellowing on some leaves.

Untreated plants on 4th Dec. There were few visible differences between these and the plants exposed to the high rate of atrazine at planting.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha and incorporated prior to planting cotton. Photo taken on 14th Jan, 82 days after emergence.

No symptoms of atrazine damage were apparent on these plants at this or later growth stages.




## Impact on plant growth

**Plants:** were stunted and remained 12 cm shorter at picking following exposure to the 50% rate of residual atrazine.

**Leaves:** residual atrazine was absorbed by the plant roots and affected early shoot development. Inter-veinal yellowing was apparent on some leaves during early growth. There was a 30% reduction in final leaf area, although differences were not apparent during the season.

**Squares**: there was no apparent effect on square production.

**Bolls:** there was no obvious effect on boll production, but some early fruit were lost, with 82% of bolls were retained between nodes 9 - 18, 2 nodes higher than the undamaged crop. There was also a 7% reduction in the number of bolls open at picking, but no delay in crop maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton fell below base grade with a staple length of 1.12" and lint yield was reduced by 15%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **atrazine** |
| **Nodes/plant** | 30.9 | 30.8 |
| **Leaves/m*** | 543 | 525 |
| **Leaf area (cm²/m)*** | 23764 | 16731 |
| **Reduction in leaf area*** | | 30% |
| **Bolls/m** | 132 | 150 |
| **Boll weight (g/open boll)** | 5.3 | 5.2 |
| **Retention in posit's 1-3^** | 95% | 98% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 9 - 18 |
| **Days to 50% open bolls** | 157 | 154 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 78% |
| **Lint yield/ha** | 2380 | 2032 |

Exposure to 50% of a typical field rate of residual atrazine caused inter-veinal yellowing of some early leaves and a reduction in plant height and leaf area.

Boll production was not affected, but some early bolls were lost on nodes 7 and 8. Later bolls were retained, but there was a reduction in fibre quality and a 15% reduction in lint yield. There was no delay in crop maturity.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** atrazine
**Rate:** 200 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 25th Nov
(5 weeks post-emergence)
**Growth stage at exposure:** 5 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | |

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by roots and translocated to shoots, absorbed by leaves
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may exceed 1-2 years depending on rate, soil moisture and temperature
**Soil half-life:** 60 days. Breakdown is slower in dry, alkaline soils and cold conditions.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

Mild inter-veinal yellowing was apparent on many of the older leaves 6 days after exposure. No damage could be seen on newly-emerged leaves.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

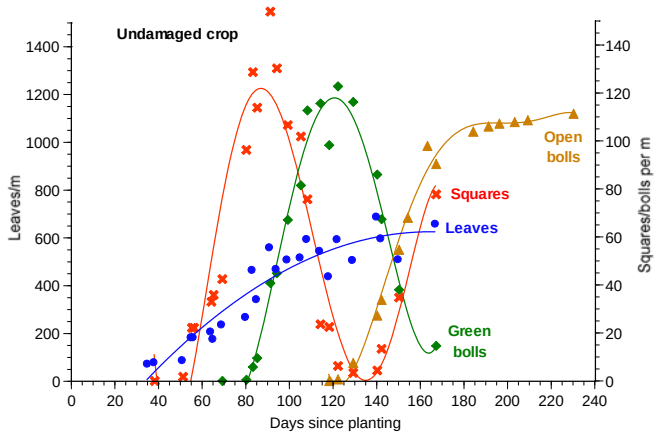
Most symptoms of atrazine damage had faded 20 days after exposure.

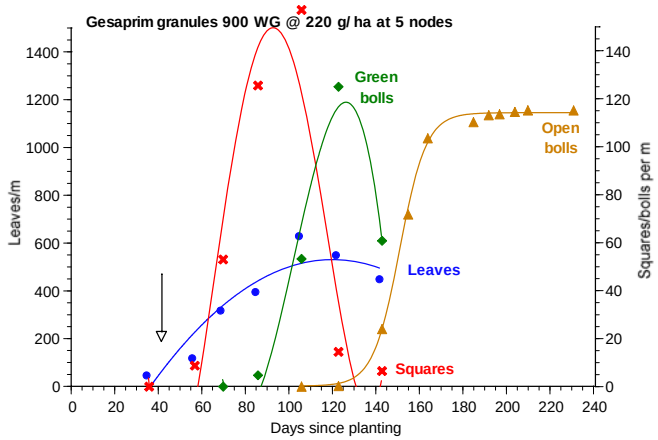
Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 5 node cotton. Photo taken on 23rd Dec, 28 days after exposure.

No herbicide damage symptoms could be seen 4-weeks after the herbicide exposure.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 5 node cotton. Photo taken on 14 Jan, 50 days after exposure.

No symptoms of atrazine damage were apparent on these plants at this or later growth stages.




## Impact on plant growth

**Plants:** exposure to the 10% rate of atrazine at 5 nodes had no effect on plant height, but plants were 15% smaller by weight at the final observation.

**Leaves:** the herbicide caused mild inter-veinal yellowing on some of the exposed leaves, but no other visible damage. Leaf production appeared to be unaffected during the early part of the season, but there was a reduction in leaf number and leaf area in the middle of the season, with plants having 25% fewer leaves and 30% less leaf area at the final observation.

**Squares**: there was no apparent effect on square production.

**Bolls:** there was no obvious effect on boll production or the pattern of boll retention, boll size, the proportion of open bolls or crop maturity.

**Lint:** there was no effect on ginning turnout, fibre quality or lint yield.

**Final plant count data**

| | undamaged | atrazine |
|---|---|---|
| **Nodes/plant** | 30.9 | 31.7 |
| **Leaves/m*** | 595 | 446 |
| **Leaf area (cm²/m)*** | 24900 | 17511 |
| **Reduction in leaf area*** | | 30% |
| **Bolls/m** | 132 | 124 |
| **Boll weight (g/open boll)** | 5.3 | 5.0 |
| **Retention in posit's 1-3^** | 95% | 99% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 17 |
| **Days to 50% open bolls** | 157 | 152 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 85% |
| **Lint yield/ha** | 2380 | 2352 |

Exposure to 10% of a typical field rate of atrazine at 5 nodes caused mild inter-veinal yellowing of some early leaves and a reduction in plant size, leaf number and leaf area.

Boll production, the pattern of boll retention, boll size, the proportion of open bolls and crop maturity were unaffected and there was no reduction in fibre quality or lint yield.

Note* These parameters were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **atrazine** |
| **Rate:** | **1 kg a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **25th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots, absorbed by leaves
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may exceed 1-2 years depending on rate, soil moisture and temperature
**Soil half-life:** 60 days. Breakdown is slower in dry, alkaline soils and cold conditions.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 5 node cotton. Photo taken on 4th Dec, 9 days after exposure.

There was no apparent damage on emerging leaves 9 days after exposure, but some of the older leaves had patches of inter-veinal yellowing.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

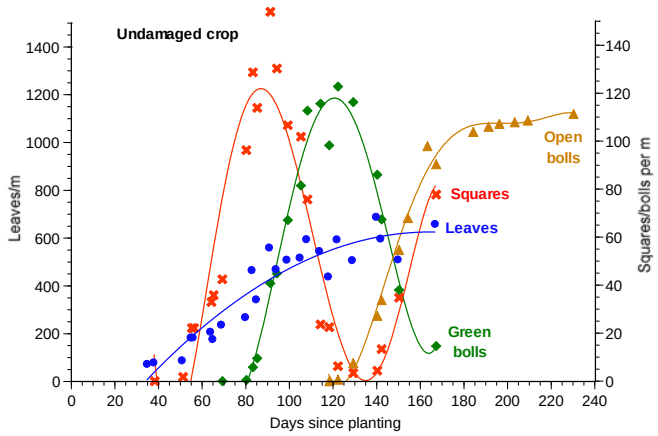
Symptoms of atrazine damage were still apparent on some of the older leaves 20 days after exposure, with patches of inter-veinal yellowing.

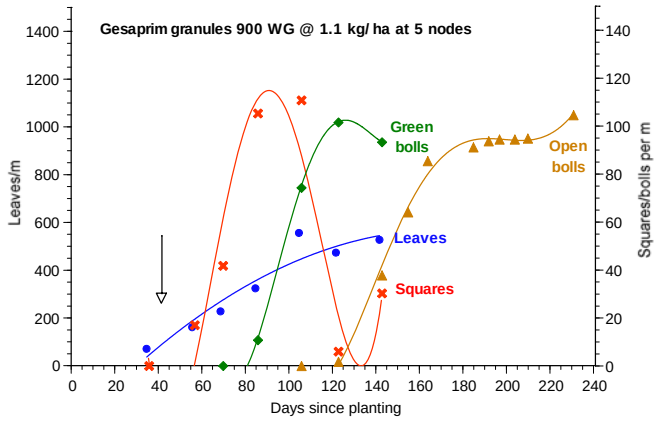
Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 5 node cotton. Photo taken on 23rd Dec, 28 days after exposure.

Symptoms of atrazine damage remain on some of the older leaves 28 days after exposure, with patches of inter-veinal yellowing. However, plants appear to be unaffected by this light damage, with no damage symptoms apparent on most of the plant.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 5 node cotton. Photo taken on 14 Jan, 50 days after exposure.

No symptoms of atrazine damage were apparent on these plants at this or later growth stages.




## Impact on plant growth

**Plants:** exposure to the 50% rate of atrazine at 5 nodes caused a 20% increase in tipping-out. There was a reduction in plant size of 2.4 nodes and 24 cm height and a 10% reduction in average plant weight.

**Leaves:** inter-veinal yellowing was apparent on some of the exposed leaves, but there was no other visible damage. However, leaf number was reduced by 12% and leaf area by 16% at the final observation.

**Squares**: there were no obvious effects on square production.

**Bolls:** the herbicide damage didn't affect the pattern of boll retention, but caused a 19% reduction in peak boll production and a 5% reduction in open bolls at picking. There was no reduction in the average weight of open bolls or delay in crop maturity.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide damage but lint yield was reduced by 15%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **atrazine** |
| **Nodes/plant** | 30.9 | 28.5 |
| **Leaves/m*** | 595 | 524 |
| **Leaf area (cm²/m)*** | 24900 | 20897 |
| **Reduction in leaf area*** | | 16% |
| **Bolls/m** | 132 | 130 |
| **Boll weight (g/open boll)** | 5.3 | 5.2 |
| **Retention in posit's 1-3^** | 95% | 96% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 18 |
| **Days to 50% open bolls** | 157 | 153 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 80% |
| **Lint yield/ha** | 2380 | 2033 |

Exposure to 50% of a typical field fate of atrazine at 5 nodes caused inter-veinal yellowing of some early leaves and a reduction in plant size, leaf number and leaf area.

Boll production, boll number, boll size, crop maturity and fibre quality were largely unaffected, but a number of small reductions combined to give a 15% reduction in lint yield.

Note* These parameters were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **atrazine** |
| **Rate:** | **200 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots, absorbed by leaves
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may exceed 1-2 years depending on rate, soil moisture and temperature
**Soil half-life:** 60 days. Breakdown is slower in dry, alkaline soils and cold conditions.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 9 node cotton. Photo taken on 15th Dec, 7 days after exposure.

There was no apparent damage on the plants 7 days after exposure.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 9 node cotton. Photo taken on 23rd Dec, 15 days after exposure.

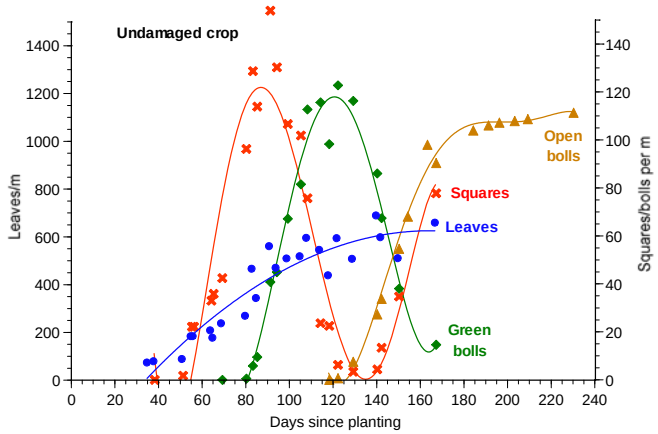
Mild symptoms of atrazine damage were apparent on some of the expanded leaves 15 days after exposure. Damaged leaves had a mottled appearance, with patches of inter-veinal yellowing between green veins.

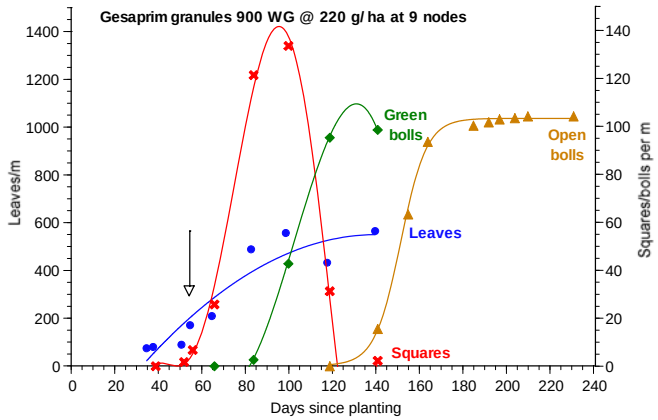
Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

Some symptoms of atrazine damage remain apparent on some of the older, lower leaves , with patches of inter-veinal yellowing 28 days after exposure. However, plants appear to be unaffected by this damage, with no damage symptoms apparent on most of the plant.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 9 node cotton. Photo taken on 14 Jan, 37 days after exposure.

Few symptoms of atrazine damage were still apparent on the lower leaves of these plants 37 days after exposure. Plants otherwise appeared to be unaffected by the atrazine.




## Impact on plant growth

**Plants:** exposed to the 10% rate of atrazine at 9 nodes were on average 2.2 nodes and 16 cm shorter than the undamaged plants at picking. There was also a doubling of the percentage of tipped-out plants.

**Leaves:** inter-veinal yellowing was apparent on some exposed leaves, but there was no other visible damage. Plants had18% fewer leaves and 12% less leaf area at the final observation.

**Squares**: there was no apparent effect on square production.

**Bolls:** there was no obvious effect on boll production, the pattern of boll retention or the average weight of open bolls but there were 8% fewer bolls at picking. Crop maturity was unaffected.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton fell below base grade with 11.1% short fibres and a staple length of 1.112". Lint yield was reduced by 7%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **atrazine** |
| **Nodes/plant** | 30.9 | 28.7 |
| **Leaves/m*** | 687 | 562 |
| **Leaf area (cm²/m)*** | 23830 | 21039 |
| **Reduction in leaf area*** | | 12% |
| **Bolls/m** | 132 | 121 |
| **Boll weight (g/open boll)** | 5.3 | 5.4 |
| **Retention in posit's 1-3^** | 95% | 96% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 0.59 |
| **Days to 50% open bolls** | 157 | 151 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 83% |
| **Lint yield/ha** | 2380 | 2206 |

Exposure to 10% of a typical field rate of atrazine at 9 nodes caused inter-veinal yellowing of some of the lower leaves. Interestingly, plants did not compensate for this minor damage, whereas the higher rate caused more damage, but plants compensated for the damage.

There was a reduction in plant height, leaf number and area, boll retention and fibre quality. Crop maturity was not delayed, but lint yield was reduced by 7%.

Note* These parameters were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **atrazine** |
| **Rate:** | **1 kg a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots, absorbed by leaves
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may exceed 1-2 years depending on rate, soil moisture and temperature
**Soil half-life:** 60 days. Breakdown is slower in dry, alkaline soils and cold conditions.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 9 node cotton. Photo taken on 15th Dec, 7 days after exposure.

There was no apparent damage on the plants 7 days after exposure.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 9 node cotton. Photo taken on 23rd Dec, 15 days after exposure.

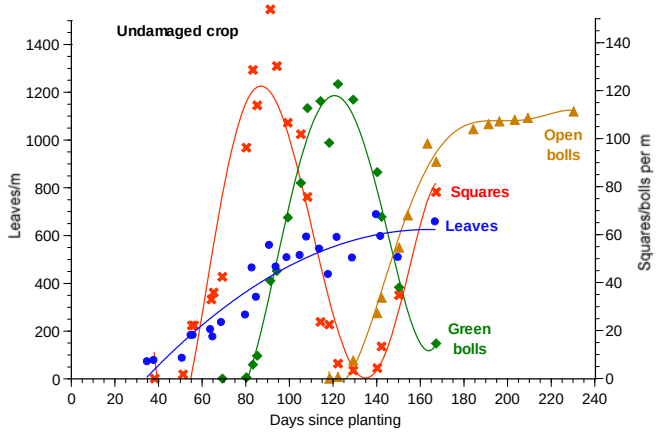
Symptoms of atrazine damage were apparent on many of the expanded leaves 15 days after exposure. Damaged leaves had a mottled appearance, with patches of inter-veinal yellowing between green veins.

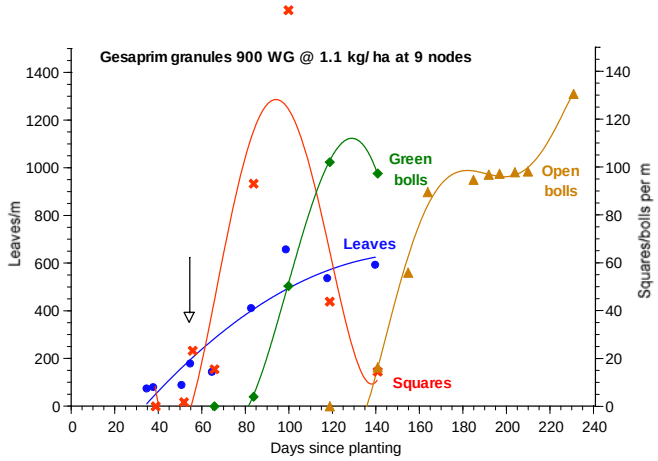
Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

Symptoms of atrazine damage remain apparent on many of the older, lower leaves, with patches of inter-veinal yellowing 28 days after exposure. However, plants appear to be unaffected by this damage, with no damage symptoms apparent on much of the plant.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 9 node cotton. Photo taken on 14 Jan, 37 days after exposure.

Symptoms of atrazine damage were still apparent on the lower leaves of these plants 37 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 50% rate of atrazine at 9 nodes had no adverse impact on plant size, with plants on average 1.7 nodes and 7 cm taller than the undamaged plants at picking. However, there was an 80% increase in the percentage of tipped-out plants.

**Leaves:** inter-veinal yellowing was apparent on many of the exposed leaves, but there was no other obvious damage. Leaf production was largely unaffected. Plants had 14% fewer leaves at the last observation but there was no reduction in leaf area.

**Squares**: there was no apparent effect on square production.

**Bolls:** there was no adverse effect on boll production, the pattern of boll retention, boll weight or crop maturity, but plants retained an additional 20% (26 bolls/m) at picking.

**Lint:** there was no effect on ginning turnout, fibre quality or lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **atrazine** |
| **Nodes/plant** | 30.9 | 32.4 |
| **Leaves/m*** | 687 | 590 |
| **Leaf area (cm²/m)*** | 23830 | 23282 |
| **Reduction in leaf area*** | | 2% |
| **Bolls/m** | 132 | 158 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 98% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 6 - 19 |
| **Days to 50% open bolls** | 157 | 156 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 83% |
| **Lint yield/ha** | 2380 | 2308 |

Exposure to 50% of a typical field rate of atrazine at 9 nodes caused extensive inter-veinal yellowing of many of the lower leaves and a small reduction in leaf area.

Plants compensated for this damage, with increased boll retention (the pattern of boll retention was unchanged). There was no delay in crop maturity or effect on boll size, lint quality or lint yield.

Note* These parameters were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **atrazine** |
| **Rate:** | **200 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Jan (12 weeks post-emergence)** |
| **Growth stage at exposure:** | **17 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots, absorbed by leaves
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may exceed 1-2 years depending on rate, soil moisture and temperature
**Soil half-life:** 60 days. Breakdown is slower in dry, alkaline soils and cold conditions.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 17 node cotton. Photo taken on 20th Jan, 7 days after exposure.

Mild symptoms of atrazine damage were apparent on many of the expanded leaves 7 days after exposure. Damaged leaves had a mottled appearance, with patches of inter-veinal yellowing between green veins.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 17 node cotton. Photo taken on 5th Feb, 23 days after exposure.

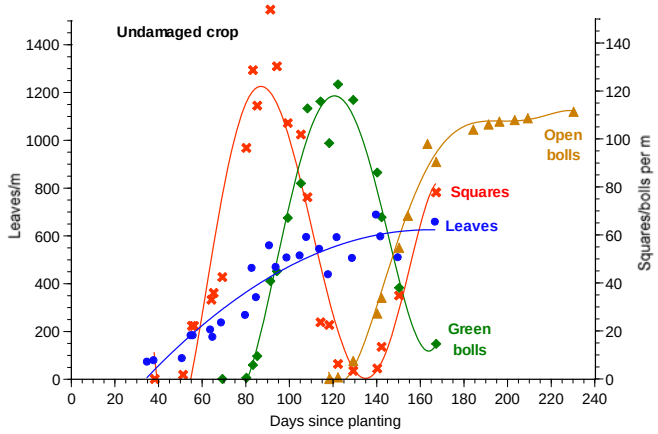
Mild symptoms of atrazine damage were still apparent on some of the outer leaves 23 days after exposure. Damaged leaves had a mottled appearance, with patches of inter-veinal yellowing between green veins.

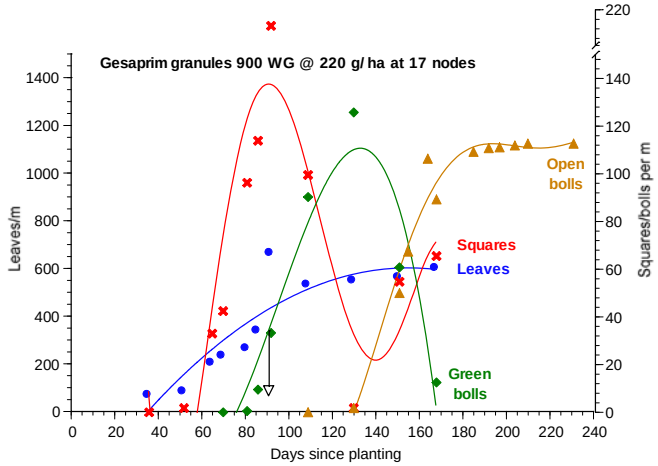
Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 17 node cotton. Photo taken on 10th Feb, 28 days after exposure.

Symptoms of atrazine damage remain apparent on some of the outer leaves, with patches of inter-veinal yellowing 28 days after exposure.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 220 g/ha to 17 node cotton. Photo taken on 11th Mar, 57 days after exposure.

A few symptoms of atrazine damage were still apparent on the lower leaves of these plants 57 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 10% rate of atrazine at 17 nodes caused some stunting, with plants 10 cm and 1.4 nodes shorter and 8% lighter by weight.

**Leaves:** the herbicide exposure caused mild inter-veinal yellowing on some of the exposed leaves, with symptoms remaining throughout the life of the crop. The damage resulted in an 8% reduction in leaf number and a 30% reduction in leaf area at the final observation.

**Squares**: there was no apparent adverse effect on square production.

**Bolls:** there were no obvious adverse effects on boll production, the pattern of boll retention or average crop maturity. Nevertheless, there was a 6% reduction in the proportion of bolls open at picking and the open bolls were 7% lighter compared to the undamaged crop.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton fell below base grade with a staple length of 1.114" and lint yield was reduced by 10%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **atrazine** |
| **Nodes/plant** | 30.9 | 29.5 |
| **Leaves/m*** | 657 | 603 |
| **Leaf area (cm²/m)*** | 21196 | 14865 |
| **Reduction in leaf area*** | | 30% |
| **Bolls/m** | 132 | 126 |
| **Boll weight (g/open boll)** | 5.3 | 4.9 |
| **Retention in posit's 1-3^** | 95% | 95% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 18 |
| **Days to 50% open bolls** | 157 | 153 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 80% |
| **Lint yield/ha** | 2380 | 2142 |

Exposure to 10% of a typical field rate of atrazine at 17 nodes caused mild plant damage, with mild inter-veinal yellowing of many of the outer leaves. Plants were slightly stunted, with fewer leaves and less leaf area.

Square and boll production and retention were less impacted, with no delay in crop maturity. Boll size and fibre quality were reduced and lint yield was reduced by 10%.

Note* These parameters were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **atrazine** |
| **Rate:** | **1 kg a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (12 weeks post-emergence)** |
| **Growth stage at exposure:** | **17 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots, absorbed by leaves
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may exceed 1-2 years depending on rate, soil moisture and temperature
**Soil half-life:** 60 days. Breakdown is slower in dry, alkaline soils and cold conditions.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 17 node cotton. Photo taken on 20th Jan, 7 days after exposure.

Mild symptoms of atrazine damage were becoming apparent on many of the expanded leaves 7 days after exposure. Damaged leaves had a mottled appearance, with patches of inter-veinal yellowing between green veins.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 17 node cotton. Photo taken on 5th Feb, 23 days after exposure.

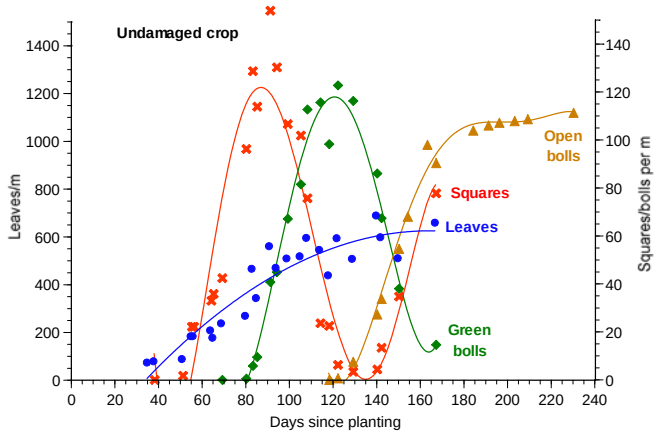
Symptoms of atrazine damage were readily apparent on some of the outer leaves 23 days after exposure. Damaged leaves had a mottled appearance, with patches of inter-veinal yellowing between green veins. Necrotic patches were apparent on some leaves.

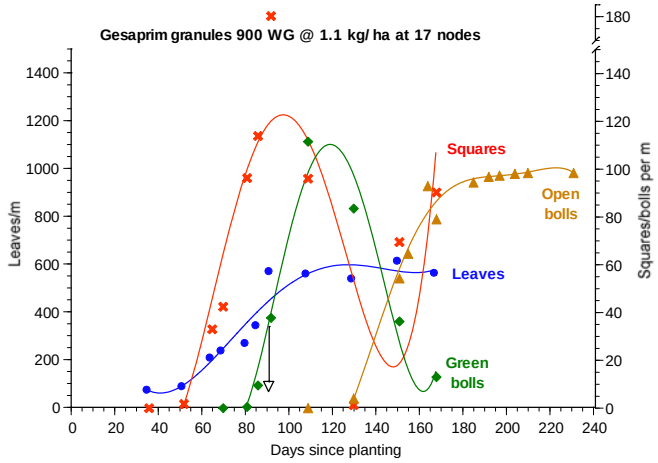
Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 17 node cotton. Photo taken on 10th Feb, 28 days after exposure.

Symptoms of atrazine damage remain apparent on some of the outer leaves 28 days after exposure, with patches of inter-veinal yellowing and necrotic patches on many leaves.

Gesaprim® granules 900 WG (atrazine) applied broadcast at 1.1 kg/ha to 17 node cotton. Photo taken on 11th Mar, 57 days after exposure.

Symptoms of atrazine damage were still readily apparent on many of the lower leaves of these plants 57 days after exposure.




## Impact on plant growth

**Plants:** exposed to the 50% rate of atrazine at 17 nodes were 1.9 nodes and 10 cm shorter and 11% lighter than undamaged plants at picking.

**Leaves:** the herbicide caused leaf damage to may of the outer leaves, with inter-veinal yellowing and necrotic patches. The plants had 15% fewer leaves and 18% less leaf area at the last observation.

**Squares**: there was no apparent effect on square production.

**Bolls:** the herbicide damage affected boll retention, with a higher proportion of bolls retained on the lower nodes. The final boll load was reduced by only 5%, but the average weight of open bolls was down by 9% and there were 13% fewer mature bolls open at picking.

**Lint:** ginning turnout and lint quality were unaffected by the herbicide damage, but lint yield was reduced by 16%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **atrazine** |
| **Nodes/plant** | 30.9 | 29.0 |
| **Leaves/m*** | 657 | 560 |
| **Leaf area (cm²/m)*** | 21196 | 17466 |
| **Reduction in leaf area*** | | 18% |
| **Bolls/m** | 132 | 125 |
| **Boll weight (g/open boll)** | 5.3 | 4.8 |
| **Retention in posit's 1-3^** | 95% | 94% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 16 |
| **Days to 50% open bolls** | 157 | 150 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 74% |
| **Lint yield/ha** | 2380 | 1999 |

Exposure to 50% of a field rate of atrazine at 17 nodes caused damage to many of the outer leaves. Plant height, weight and node number, leaf number and leaf area were all reduced.

Square and boll production were less impacted, with no delay in crop maturity or reduction in lint quality. However, some later bolls were shed, with fewer bolls were open at picking and lint yield was down by 16%.

Note* These parameters were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

**Herbicide:** bromoxynil
**Rate:** 30 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 12th Nov (6 weeks post-emergence)
**Growth stage at exposure:** 6 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by leaves but not translocated
**Mode of action:** inhibits photosynthesis
**Residual activity:** limited
**Soil half-life:** 7 days

Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

Few symptoms of bromoxynil damage were apparent at any stage. Some burned, necrotic patches and spots were apparent on the leaves 3 days after exposure.

Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

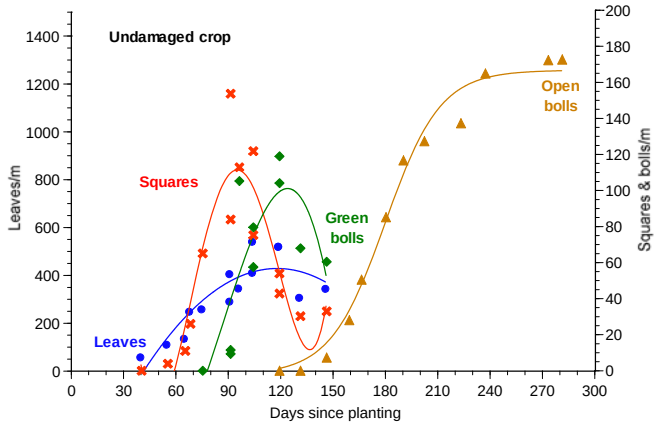
Few symptoms of bromoxynil damage were apparent at any stage. Some burned, necrotic patches and spots were still apparent on some of the lower leaves 10 days after exposure.

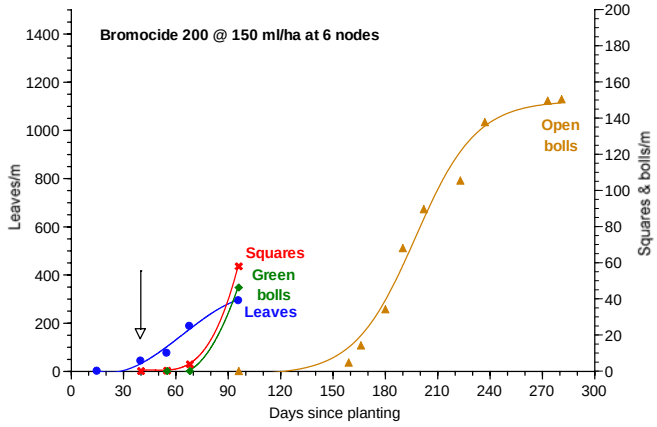
Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

No symptoms of bromoxynil damage remained 29 days after exposure.

Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 6 node cotton. Photo taken on 7th Jan, 56 days after exposure.

No symptoms of bromoxynil damage remained 56 days after exposure.




## Impact on plant growth

**Plants:** exposed to the lighter rate of bromoxynil at 6 nodes displayed few symptoms of damage. There was a 25% increase in tipping out and plant growth was delayed. Plants were stunted and remained 2 nodes shorter at picking.

**Leaves:** some necrotic spots were apparent on the leaves soon after the herbicide exposure. There was a reduction in leaf number and a large reduction in leaf area mid-season.

**Squares**: there was a short delay in square production following the exposure.

**Bolls:** were lost from the primary fruiting positions following the exposure, but additional bolls were retained on the outer positions and the lateral branches. Average crop maturity was delayed by 19 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature at picking, with low micronare (3.4) and lint yield was reduced by 34%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **bromoxynil** |
| **Nodes/plant** | 27.8 | 25.6 |
| **Leaves/m*** | 342 | 292 |
| **Leaf area (cm²/m)*** | 17713 | 10322 |
| **Reduction in leaf area*** | | 42% |
| **Bolls/m** | 200 | 180 |
| **Boll weight (g/boll)** | 4.2 | 4.0 |
| **Retention in posit's 1-3^** | 88% | 75% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 19 |
| **Days to 50% open** | 187 | 206 |
| **Maturity delay (days)** | | 19 |
| **% Open bolls at picking** | 86% | 84% |
| **Lint yield/ha** | 2246 | 1484 |

Exposure to 10% of a typical field rate of bromoxynil at 6 nodes caused minor damage to the leaves, with a few necrotic spots.

However, many plants were tipped-out and plant growth and development were delayed more than might have been expected. Plants were smaller, with fewer leaves and less leaf area. Plants retained fewer bolls on the primary positions with more bolls on the lateral branches. Crop maturity was delayed and yield was down 34%.

Note* These parameters were last recorded 96 days after exposure.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

**Herbicide:** bromoxynil
**Rate:** 150 g a.i./ha
**% of typical field rate** 50%
**Date of exposure:** 12th Nov (6 weeks post-emergence)
**Growth stage at exposure:** 6 nodes

| Damage key: | |
|---|---|
| Leaf loss | x |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by leaves but not translocated
**Mode of action:** inhibits photosynthesis
**Residual activity:** limited
**Soil half-life:** 7 days

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

Symptoms of bromoxynil damage were apparent within hours of exposure, with burning of the leaf and stem tissues and growing tips.

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

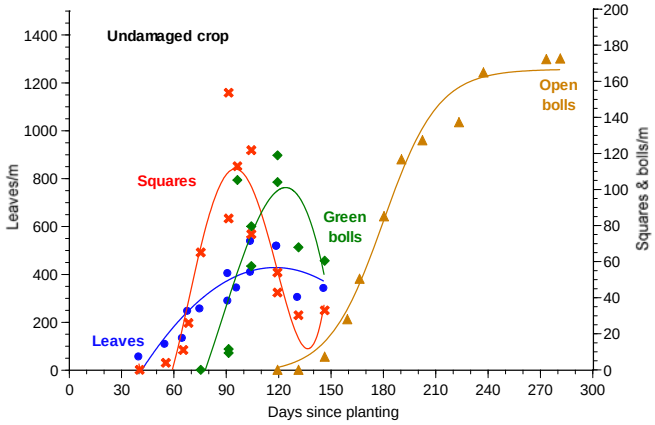
Plants were showing severe symptoms of damage 10 days after exposure, with necrotic patches evident on most leaves. Most plants retained some green leaf material and new leaves were emerging from the growing tips.

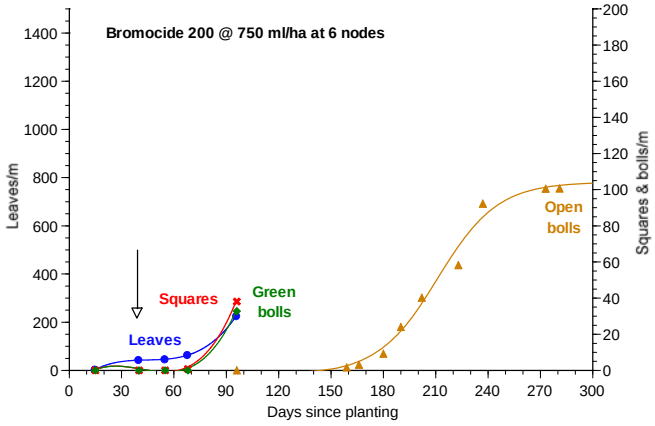
Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

The initial damage symptoms had largely disappeared 29 days after exposure, with the plants now covered in new growth.

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 6 node cotton. Photo taken on 7th Jan, 56 days after exposure.

No symptoms of damage remained 56 days after exposure, although there had been a delay in plant growth and development.




## Impact on plant growth

**Plants:** exposure to the heavier rate of bromoxynil at 6 nodes caused extensive damage, burning the leaves and growing tips. Tipping out increase by 43%, plants were 74% smaller by weight and remained 21 cm and 7 nodes shorter at picking.

**Leaves:** necrotic patches were apparent on the leaves soon after the herbicide exposure. Plants had 35% fewer leaves and 62% less leaf area mid-season.

**Squares**: many early squares were shed and there was a 30 day delay in square production following the exposure.

**Bolls:** were lost from the primary fruiting positions following the exposure, but some additional bolls were retained on the outer positions and the lateral branches. Plants retained 34% fewer bolls and boll weight was down 15% at picking. Average crop maturity was delayed by 35 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature at picking, with low micronare (3.15) and lint yield was reduced by 60%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **bromoxynil** |
| **Nodes/plant** | 27.8 | 21.2 |
| **Leaves/m*** | 342 | 222 |
| **Leaf area (cm²/m)*** | 17713 | 6681 |
| **Reduction in leaf area*** | | 62% |
| **Bolls/m** | 200 | 132 |
| **Boll weight (g/boll)** | 4.2 | 3.6 |
| **Retention in posit's 1-3^** | 88% | 71% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 16 |
| **Days to 50% open** | 187 | 222 |
| **Maturity delay (days)** | | 35 |
| **% Open bolls at picking** | 86% | 76% |
| **Lint yield/ha** | 2246 | 892 |

Exposure to 50% of a typical field rate of bromoxynil at 6 nodes caused extensive damage, burning the leaves and growing tips.

Many plants were tipped-out and plant growth and development were delayed. Plants were smaller, with fewer leaves and less leaf area mid-season. Plants retained fewer bolls on the primary positions with more bolls on the lateral branches. There was a reduction in boll number, boll size, boll maturity and fibre quality. Lint yield was reduced by 60%.

Note* These parameters were last recorded 96 days after exposure.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **bromoxynil** |
| **Rate:** | **30 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **5th Dec** (9 weeks post-emergence) |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by leaves but not translocated
**Mode of action:** inhibits photosynthesis
**Residual activity:** limited
**Soil half-life:** 7 days

Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Mild yellowing and bleaching of the leaves were the main symptoms of bromoxynil damage 6 days after exposure. A few necrotic spots and patches were visible on some leaves.

Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

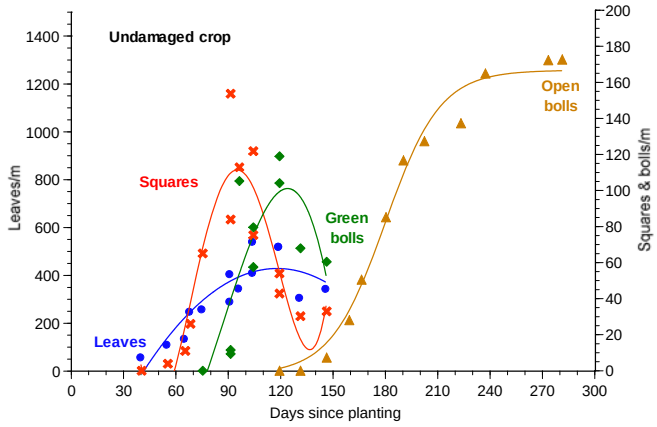
Bleached, yellowish or necrotic patches and spots were apparent on some leaves16 days after exposure. No symptoms of bromoxynil damage were apparent on most of the upper leaves.

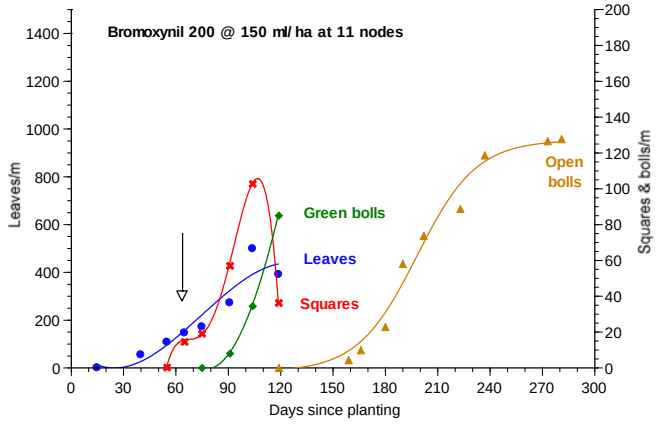
Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

No symptoms of bromoxynil damage remained visible 40 days after exposure.

Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 11 node cotton. Photo taken on 31st Jan, 57 days after exposure.

No symptoms of bromoxynil damage remained 57 days after exposure.




## Impact on plant growth

**Plants:** exposed to the lighter rate of bromoxynil at 11 nodes displayed mild symptoms of damage with some leaf discolouration and necrotic spots. There was a 16% increase in tipping out and plant growth was delayed. Plants were 42% small by weight, and 4 nodes and 3 cm shorter at picking.

**Leaves:** plants had 24% fewer leaves and 18% less leaf area mid-season.

**Squares**: many early squares were shed and there was a 20 day delay in square production following the exposure.

**Bolls:** were lost from the primary fruiting positions following the exposure, but additional bolls were retained on the lateral branches. Plants retained 21% fewer bolls, bolls were 19% lighter and fewer were mature at picking. Average boll maturity was delayed by 19 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature at picking, with low micronare (2.75) and lint yield was reduced by 57%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **bromoxynil** |
| **Nodes/plant** | 27.8 | 24.1 |
| **Leaves/m*** | 517 | 391 |
| **Leaf area (cm²/m)*** | 13541 | 11162 |
| **Reduction in leaf area*** | | 18% |
| **Bolls/m** | 200 | 158 |
| **Boll weight (g/boll)** | 4.2 | 3.4 |
| **Retention in posit's 1-3^** | 88% | 77% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 2 - 20 |
| **Days to 50% open** | 187 | 208 |
| **Maturity delay (days)** | | 21 |
| **% Open bolls at picking** | 86% | 81% |
| **Lint yield/ha** | 2246 | 957 |

Exposure to 10% of a typical field rate of bromoxynil at 11 nodes caused minor damage to the leaves, with yellowing and necrotic spots.

However, plants were tipped-out and plant growth and development were delayed more than might have been expected. Plants were smaller, with fewer leaves and less leaf area mid-season. Plants retained fewer bolls, bolls were lighter, and fewer bolls were open at picking. Crop maturity was delayed and yield was down 57%.

Note* These parameters were last recorded 119 days after exposure.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **bromoxynil** |
| **Rate:** | **150 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **5th Dec** |
| | **(9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by leaves but not translocated
**Mode of action:** inhibits photosynthesis
**Residual activity:** limited
**Soil half-life:** 7 days

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Mild yellowing and bleaching of the leaves, with some burned, necrotic spots and patches were the main symptoms of bromoxynil damage 6 days after exposure.

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

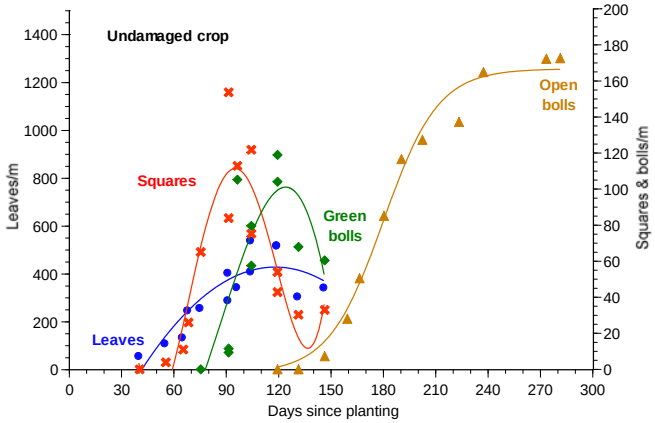
Much of the leaf yellowing had faded 16 days after exposure, but dead leaves and necrotic spots were still very obvious. Little damage was apparent on the newly expanded top leaves other than some mild yellowing.

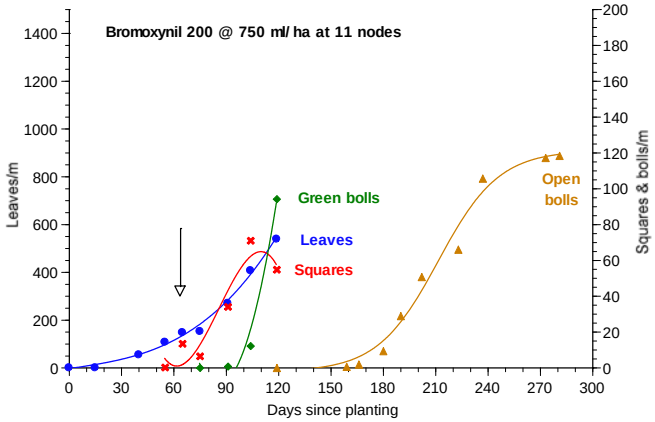
Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

Leaf damage persisted on the older leaves 28 days after exposure, with some yellowing and necrotic spots.

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 11 node cotton. Photo taken on 31st Jan, 57 days after exposure.

No symptoms of damage remained 57 days after exposure, although there had been a delay in plant growth and development.




## Impact on plant growth

**Plants:** exposure to the heavier rate of bromoxynil at 11 nodes caused leaf yellowing and some necrotic spots. Tipping out increase by 34%, plants were 23% smaller by weight and remained 20 cm shorter at picking.

**Leaves:** growth and development was delayed by the herbicide, delaying leaf production.

**Squares**: many early squares were shed following the exposure, reducing peak square production by 42%.

**Bolls:** were lost from the primary fruiting positions following the exposure, delaying boll set by about 20 days, but some additional bolls were retained on the outer positions and the lateral branches. Plants retained 21% fewer bolls and boll weight was down 18% at picking. Average crop maturity was delayed by 36 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature at picking, with low micronare (2.85) and 11.9% short fibres, and lint yield was reduced by 67%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **bromoxynil** |
| **Nodes/plant** | 27.8 | 26.3 |
| **Leaves/m*** | 517 | 538 |
| **Leaf area (cm²/m)*** | 13541 | 12199 |
| **Reduction in leaf area*** | | 10% |
| **Bolls/m** | 200 | 157 |
| **Boll weight (g/boll)** | 4.2 | 3.5 |
| **Retention in posit's 1-3^** | 88% | 54% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 3 - 21 |
| **Days to 50% open** | 187 | 223 |
| **Maturity delay (days)** | | 36 |
| **% Open bolls at picking** | 86% | 75% |
| **Lint yield/ha** | 2246 | 749 |

Exposure to 50% of a typical field rate of bromoxynil at 11 nodes caused leaf yellowing and some leaf burn and necrotic spots.

Many plants were tipped-out and plant growth and development were delayed. Plants were shorter and retained fewer bolls on the primary positions with more bolls on the lateral branches. There was a reduction in boll number, boll size, boll maturity and fibre quality. Crop maturity was delayed and lint yield was reduced by 60%.

Note* These parameters were last recorded 119 days after exposure.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **bromoxynil** |
| **Rate:** | **30 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **2nd Jan** |
| | **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by leaves but not translocated
**Mode of action:** inhibits photosynthesis
**Residual activity:** limited
**Soil half-life:** 7 days

Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 15 node cotton. Photo taken on 7th Jan, 5 days after exposure.

The only symptoms of bromoxynil damage apparent 6 days after exposure was very mild yellowing and a few small necrotic spots on the more exposed leaves.

Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 11 node cotton. Photo taken on 14th Jan, 12 days after exposure.

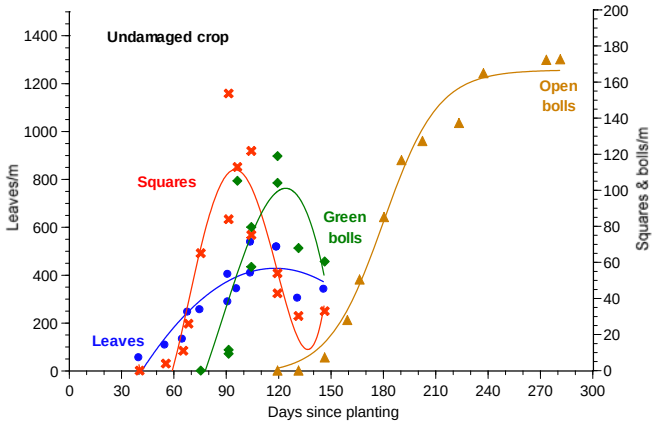
Bleached, yellowish and necrotic spots and patches were apparent on most exposed leaves12 days after exposure. No symptoms of bromoxynil damage were apparent on newly emerged leaves.

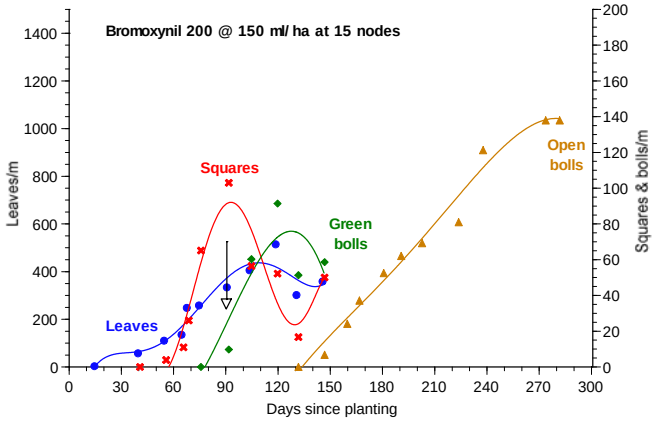
Bromicide® 200 (bromoxynil) applied broadcast at 150 ml/ha to 11 node cotton. Photo taken on 25th Jan, 23 days after exposure.

Bleached, yellowish and necrotic spots and patches were still very obvious on most exposed leaves 23 days after exposure. No symptoms of bromoxynil damage were apparent on newly emerged leaves.

Bromicide® 200 (bromoxynil) applied broadcast at 30 g a.i./ha to 11 node cotton. Photo taken on 31st Jan, 29 days after exposure.

Bleached, yellowish and necrotic spots and patches were still very obvious on most exposed leaves 29 days after exposure. However, the plants are now topped with fresh, undamaged growth




## Impact on plant growth

**Plants:** exposed to the lighter rate of bromoxynil at 15 nodes displayed few initial symptoms, with leaf discolouration and necrotic spots developing over time. The herbicide exposure caused a delay in plant growth and development.

**Leaves:** there was a reduction in effective leaf area caused by discolouration and burning following exposure.

**Squares**: squares were shed following the exposure and there was a 48% reduction in peak square production. Plants produced additional late squares.

**Bolls:** there was a delay in boll retention and a 16% reduction in final boll retention. Average crop maturity was delayed by 15 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature at picking, with low micronare (2.6) and lint yield was reduced by 10%.

**Final plant count data**

| | undamaged | bromoxynil |
|---|---|---|
| **Nodes/plant** | 27.8 | 28.3 |
| **Leaves/m*** | 341 | 355 |
| **Leaf area (cm²/m)*** | 22084 | 23817 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 200 | 168 |
| **Boll weight (g/boll)** | 4.2 | 4.0 |
| **Retention in posit's 1-3^** | 88% | 88% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 6 - 24 |
| **Days to 50% open** | 187 | 202 |
| **Maturity delay (days)** | | 15 |
| **% Open bolls at picking** | 86% | 85% |
| **Lint yield/ha** | 2246 | 2022 |

Exposure to 10% of a typical field rate of bromoxynil at 15 nodes caused some damage to the leaves, with yellowing and necrotic spots and patches. Crop growth and development were delayed.

There was a delay in square and boll production, and a decrease in fibre quality. Crop maturity was delayed and yield was reduced by 10%.

Note* These parameters were last recorded 146 days after exposure.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **bromoxynil** |
| **Rate:** | **150 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **2nd Jan (3 weeks post-emergence)** |
| **Growth stage at exposure:** | **13 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by leaves but not translocated
**Mode of action:** inhibits photosynthesis
**Residual activity:** limited
**Soil half-life:** 7 days

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 15 node cotton. Photo taken on 7th Jan, 5 days after exposure.

The main symptoms of bromoxynil damage 5 days after exposure were mild yellowing and bleaching of the leaves, and a large number of necrotic spots and burned patches were.

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 15 node cotton. Photo taken on 14th Jan, 12 days after exposure.

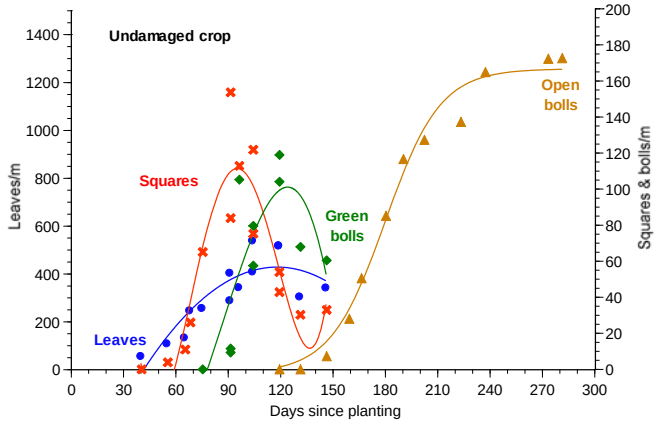
The bromoxynil damage was much more obvious 12 days after exposure, with areas of the yellowing and bleaching developing on the exposed leaves and necrotic spots and patches. Some leaves, such as the one in this photo, with largely desiccated and shrivelling up.

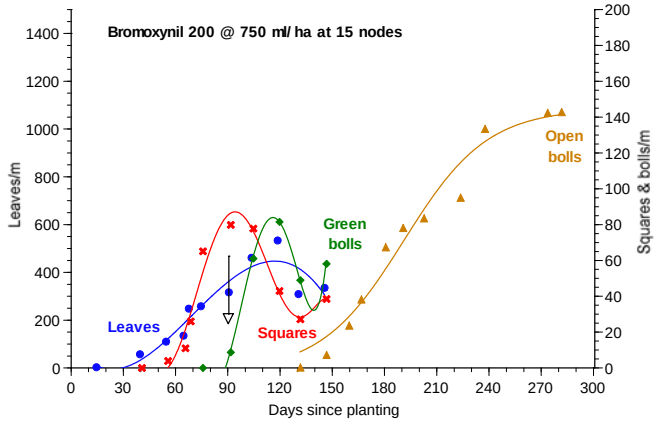
Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 15 node cotton. Photo taken on 25th Jan, 23 days after exposure.

Bleached, yellowish and necrotic spots and patches were still very obvious on most exposed leaves 23 days after exposure. However, new top-growth has developed which shows no damage symptoms and is beginning to overshadow the damage on the lower leaves.

Bromicide® (bromoxynil) applied broadcast at 750 ml/ha to 15 node cotton. Photo taken on 31st Jan, 29 days after exposure.

Bleached, yellowish and necrotic spots and patches were still very obvious on the middle and lower leaves 29 days after exposure.




## Impact on plant growth

**Plants:** exposure to the heavier rate of bromoxynil at 15 nodes caused leaf yellowing and bleaching, and some necrotic spots and patches. Plants were 18% smaller by weight mid-season and remained 2 nodes shorter at picking.

**Leaves:** growth and development was delayed by the herbicide. Plants had 26% less leaf area mid-season.

**Squares**: many early squares were shed following the exposure, reducing peak square production by 33%.

**Bolls:** there was a delay in boll retention and an 18% reduction in final boll retention. Average boll size was down 19% and average crop maturity was delayed by 24 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature at picking, with low micronare (2.8) and short fibres, and lint yield was reduced by 33%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **bromoxynil** |
| **Nodes/plant** | 27.8 | 25.7 |
| **Leaves/m*** | 341 | 332 |
| **Leaf area (cm²/m)*** | 22084 | 16409 |
| **Reduction in leaf area*** | | 26% |
| **Bolls/m** | 200 | 164 |
| **Boll weight (g/boll)** | 4.2 | 3.4 |
| **Retention in posit's 1-3^** | 88% | 85% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 6 - 24 |
| **Days to 50% open** | 187 | 211 |
| **Maturity delay (days)** | | 24 |
| **% Open bolls at picking** | 86% | 84% |
| **Lint yield/ha** | 2246 | 1504 |

Exposure to 50% of a typical field rate of bromoxynil at 15 nodes caused leaf yellowing and bleaching, with some leaf burn and necrotic spots. A few leaves were shed.

Plant growth and development were delayed. Plants retained fewer bolls at picking and there was a reduction in boll size and fibre quality. Crop maturity was delayed and lint yield was reduced by 33%.

Note* These parameters were last recorded 146 days after exposure.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** simazine
**Rate:** 300 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 14th Oct (pre-planting)
**Growth stage at exposure:**

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by roots and translocated to shoots
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may be up to 1 year depending on rate, soil moisture, soil Ph and temperature
**Soil half-life:** 55 - 186 days. Breakdown is slower in dry, alkaline and cold soils

Simazine granules 900 WG were applied broadcast at 330 g/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 330 g/ha and incorporated prior to planting cotton. Photo taken on 11th Dec, 49 days after emergence.

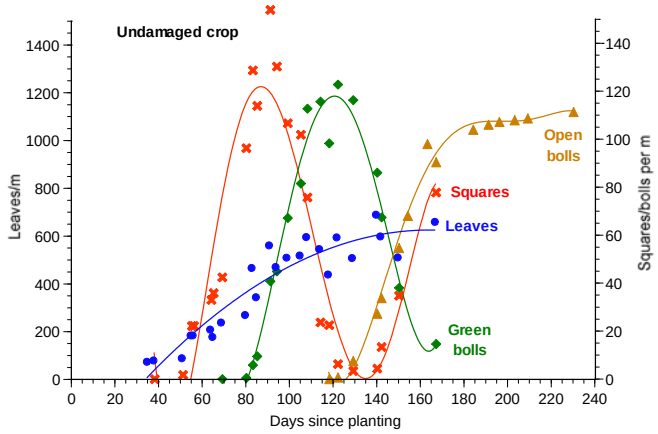
No symptoms of simazine damage were apparent at any stage.

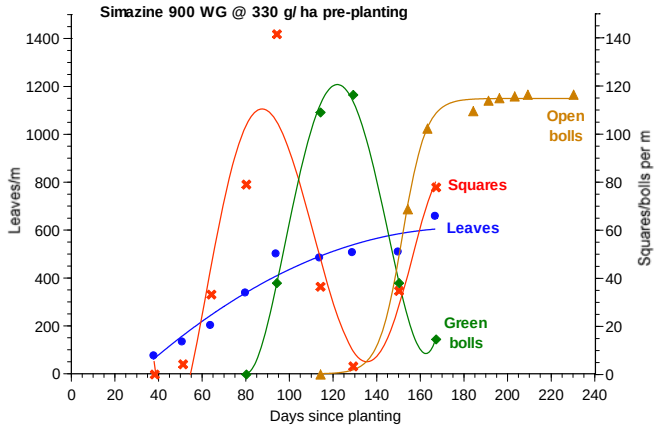
Simazine granules 900 WG were applied broadcast at 330 g/ha and incorporated prior to planting cotton. Photo taken on 31st Dec, 69 days after emergence.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 330 g/ha and incorporated prior to planting cotton. Photo taken on 14th Jan, 83 days after emergence.

No symptoms of simazine damage were apparent at any stage.




## Impact on plant growth

**Plants**: exposure to the 10% rate of residual simazine had no apparent effect on plant size, but caused a 20% increase in the proportion of tipped-out plants.

**Leaves:** the herbicide caused no observable damage to the foliage. However, plants had 11% fewer leaves and 7% less leaf area at the last observation.

**Squares**: there was no apparent effect on square production.

**Bolls:** there was no observable effect on boll production or the pattern of boll retention, but plants had 6% fewer bolls, proportionally 5% fewer of the bolls were open at picking and the open bolls were 11% lighter than the undamaged crop. There was no delay in crop maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton fell below base grade with 11.5 % short fibres. Lint yield was not affected.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **simazine** |
| **Nodes/plant** | 30.9 | 31.2 |
| **Leaves/m*** | 543 | 483 |
| **Leaf area (cm²/m)*** | 23764 | 22057 |
| **Reduction in leaf area*** | | 7% |
| **Bolls/m** | 132 | 124 |
| **Boll weight (g/open boll)** | 5.3 | 4.7 |
| **Retention in posit's 1-3^** | 95% | 97% |
| **Nodes carrying >80% bolls#** | 0.63 | 0.68 |
| **Days to 50% open bolls** | 157 | 153 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 80% |
| **Lint yield/ha** | 2380 | 2410 |

Exposure to 10% of a typical field rate of residual simazine caused no visibly detectable damage to the crop. However, leaf number and leaf area were reduced and boll retention was affected, although there was no delay in crop maturity or reduction in lint yield.

Nevertheless, the extent of damage from residual herbicides is influenced by seasonal conditions. More damage may have occurred in wetter and/or cooler conditions.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** simazine
**Rate:** 1.5 kg a.i./ha
**% of typical field rate** 50%
**Date of exposure:** 14th Oct (pre-planting)
**Growth stage at exposure:**

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | |

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by roots and translocated to shoots
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may be up to 1 year depending on rate, soil moisture, soil Ph and temperature
**Soil half-life:** 55 - 186 days. Breakdown is slower in dry, alkaline and cold soils

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha and incorporated prior to planting cotton. Photo taken on 15th Dec, 53 days after emergence.

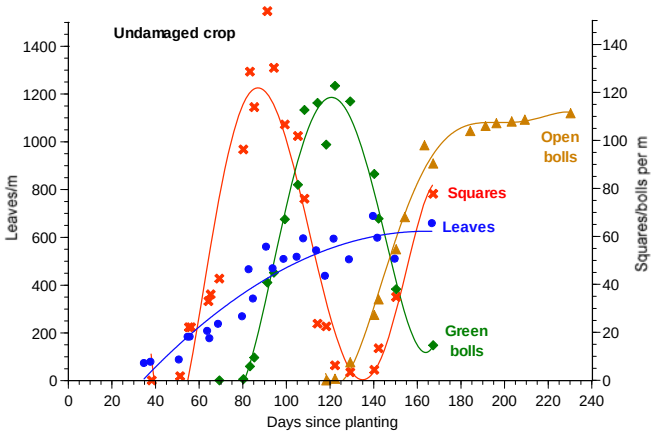
No symptoms of simazine damage were apparent at any stage.

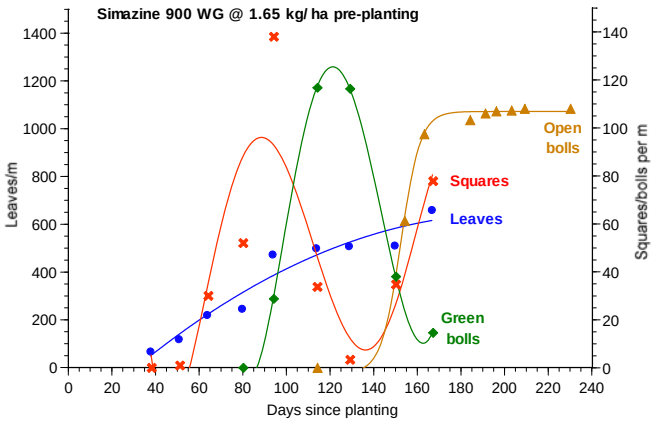
Simazine granules 900 WG were applied broadcast at 1.65 kg/ha and incorporated prior to planting cotton. Photo taken on 31st Dec, 69 days after emergence.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha and incorporated prior to planting cotton. Photo taken on 14th Jan, 83 days after emergence.

No symptoms of simazine damage were apparent at any stage.




## Impact on plant growth

**Plants:** exposure to the 50% rate of residual simazine caused some stunting. Plants were 15cm and 2.6 nodes shorter at picking.

**Leaves:** the herbicide had no obvious effect on the foliage. However, plant had 8% fewer leaves and 20% less leaf area at the last observation.

**Squares**: there were no noticeable effects on square production.

**Bolls:** there were no obvious effects on boll production, the pattern of boll retention, or boll weight, although plants retained 16% fewer bolls at picking. There was no delay in crop maturity.

**Lint:** ginning turnout, lint quality and lint yield were unaffected by the herbicide damage.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **simazine** |
| **Nodes/plant** | 30.9 | 28.3 |
| **Leaves/m*** | 543 | 497 |
| **Leaf area (cm²/m)*** | 23764 | 19029 |
| **Reduction in leaf area*** | | 20% |
| **Bolls/m** | 132 | 110 |
| **Boll weight (g/open boll)** | 5.3 | 5.0 |
| **Retention in posit's 1-3^** | 95% | 100% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 17 |
| **Days to 50% open bolls** | 157 | 154 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 83% |
| **Lint yield/ha** | 2380 | 2263 |

Exposure to 50% of a typical field rate of residual simazine had no observable effect on the plants, but caused a reduction in plant size, leaf number and leaf area.

There no obvious effects on boll production, the pattern of boll retention, boll weight, crop maturity, the proportion of bolls open at picking, fibre quality or lint yield, although plants retained fewer bolls at picking.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **simazine** |
| **Rate:** | **300 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **25th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may be up to 1 year depending on rate, soil moisture, soil Ph and temperature
**Soil half-life:** 55 - 186 days. Breakdown is slower in dry, alkaline and cold soils

Simazine granules 900 WG were applied broadcast at 330 g/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

No symptoms of simazine damage were apparent at this stage, 6 days after exposure.

Simazine granules 900 WG were applied broadcast at 330 g/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

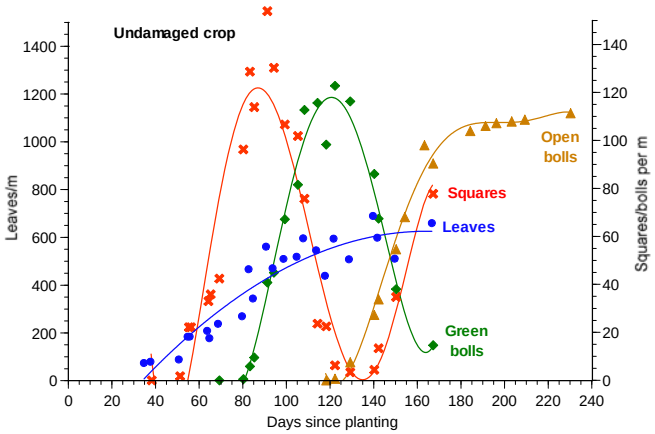
Symptoms of simazine damage were obvious 20 days after exposure. Damaged leaves had areas of inter-veinal yellowing. No damage was apparent on the upper leaves.

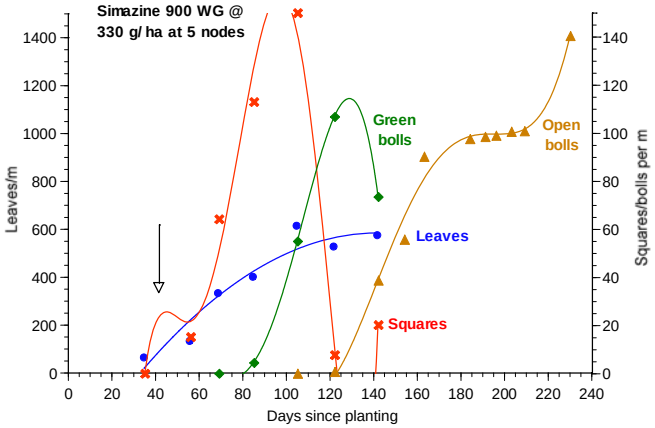
Simazine granules 900 WG were applied broadcast at 330 g/ha to 5 node cotton. Photo taken on 23rd Dec, 28 days after exposure.

Symptoms of simazine damage were no longer obvious 28 days after exposure.

Simazine granules 900 WG were applied broadcast at 330 g/ha to 5 node cotton. Photo taken on 14th Jan, 50 days after exposure.

No symptoms of simazine damage were apparent 50 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 10% rate of simazine at 5 nodes caused a 20% increase in tipping out. Plants were also 12 cm shorter than undamaged plants at picking, but there was no reduction in node number or plant weight.

**Leaves:** the herbicide damage caused mild leaf damage, with inter-veinal yellowing of the lower leaves. This damage had little effect on the plants, although it did result in a 13% reduction in leaf area.

**Squares**: there was no apparent effect on square production, although some early squares were shed following the exposure.

**Bolls:** there was no effect on boll production, the pattern of boll retention or the proportion of open bolls at picking but plants were holding an additional 34 bolls/m (26%) at picking. There was no delay in crop maturity.

**Lint:** ginning turnout and lint quality were unaffected by the herbicide damage. Lint yield was reduced by 7%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **simazine** |
| **Nodes/plant** | 30.9 | 31.8 |
| **Leaves/m*** | 595 | 572 |
| **Leaf area (cm²/m)*** | 24900 | 21559 |
| **Reduction in leaf area*** | | 13% |
| **Bolls/m** | 132 | 166 |
| **Boll weight (g/open boll)** | 5.3 | 5.2 |
| **Retention in posit's 1-3^** | 95% | 97% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 18 |
| **Days to 50% open bolls** | 157 | 156 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 85% |
| **Lint yield/ha** | 2380 | 2217 |

Exposure to 10% of a typical field rate of simazine at 5 nodes caused tipping out, some leaf damage to the lower leaves and a reduction in leaf area.

This damage had no apparent affect on total boll retention, the pattern of boll retention, boll size, crop maturity or fibre quality, but lint yield was reduced by 7%.

Note* These parameters were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** simazine
**Rate:** 1.5 kg a.i./ha
**% of typical field rate** 50%
**Date of exposure:** 25th Nov
(5 weeks post-emergence)
**Growth stage at exposure:** 5 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | |

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by roots and translocated to shoots
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may be up to 1 year depending on rate, soil moisture, soil Ph and temperature
**Soil half-life:** 55 - 186 days. Breakdown is slower in dry, alkaline and cold soils

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

No symptoms of simazine damage were apparent 6 days after exposure.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

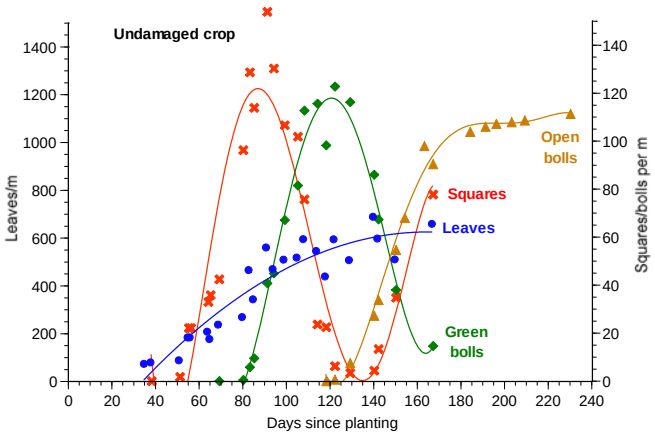
Some symptoms of simazine damage were apparent 20 days after exposure. Mild inter-veinal yellowing was apparent on a few of the older leaves.

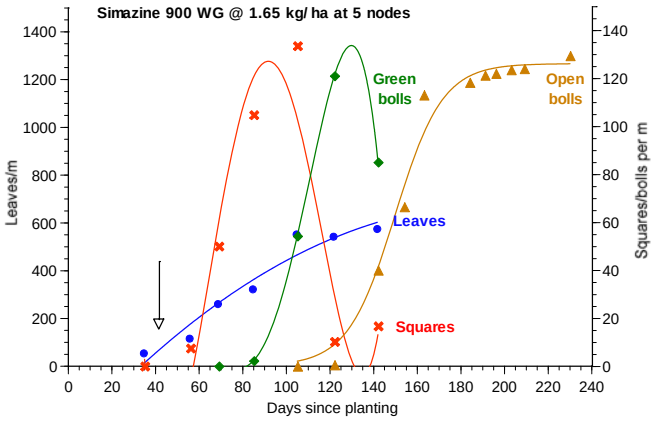
Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 5 node cotton. Photo taken on 23rd Dec, 28 days after exposure.

Some symptoms of simazine damage were still apparent 28 days after exposure. Mild inter-veinal yellowing was apparent on a few of the older leaves at the base of the plant.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 5 node cotton. Photo taken on 14th Jan, 50 days after exposure.

No visible symptoms of simazine damage remained 50 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 50% rate of simazine at 5 nodes caused a 40% increase in the percentage of tipped-out plants. Plants were also 14 cm and 1 node shorter than undamaged plants at picking but there was no reduction in plant weight.

**Leaves:** the herbicide caused a small amount of leaf damage on the exposed leaves. This had no effect on leaf number or leaf area at the last observation.

**Squares**: there was no noticeable effect on square production.

**Bolls:** the herbicide damage had no obvious effect on boll production, the pattern of boll retention, the proportion of bolls open at picking, the average weight of the open bolls or crop maturity.

**Lint:** ginning turnout, lint quality and lint yield were unaffected by the herbicide damage.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **simazine** |
| **Nodes/plant** | 30.9 | 29.9 |
| **Leaves/m*** | 595 | 572 |
| **Leaf area (cm²/m)*** | 24900 | 25316 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 146 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 93% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 16 |
| **Days to 50% open bolls** | 157 | 151 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 88% |
| **Lint yield/ha** | 2380 | 2356 |

Exposure to 50% of a typical field rate of simazine at 5 nodes caused a small amount of leaf damage and tipping-out and a reduction in plant height.

There were no obvious effects on boll production, the pattern of boll retention, the proportion of bolls open at picking, crop maturity, fibre quality or lint yield.

Note* These parameters were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **simazine** |
| **Rate:** | **300 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may be up to 1 year depending on rate, soil moisture, soil Ph and temperature
**Soil half-life:** 55 - 186 days. Breakdown is slower in dry, alkaline and cold soils

Simazine granules 900 WG were applied broadcast at 330 g/ha to 9 node cotton. Photo taken on 15th Dec, 7 days after exposure.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 330 g/ha to 9 node cotton. Photo taken on 23rd Dec, 15 days after exposure.

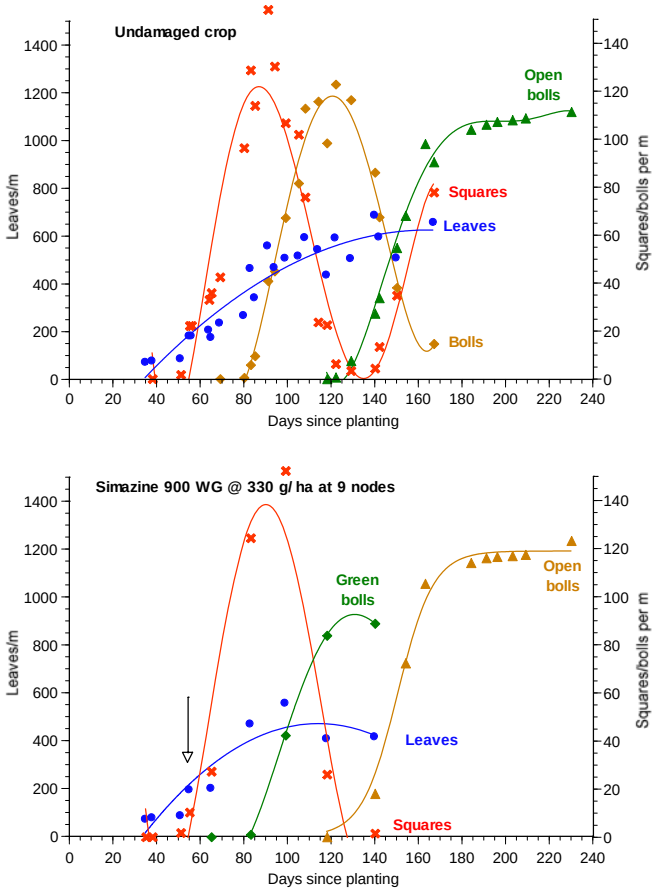
No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 330 g/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 330 g/ha to 9 node cotton. Photo taken on 14th Jan, 37 days after exposure.

No symptoms of simazine damage were apparent at any stage.




## Impact on plant growth

**Plants:** exposed to the 10% rate of simazine at 9 nodes were 10 cm and 1.3 nodes shorter at picking and 5% smaller by weight. A large proportion of plants (65%) were tipped out.

**Leaves:** caused no detectable leaf damage on the exposed leaves, but caused a disproportionately large amount of damage to the plant, reducing final leaf number by 40% and leaf area by 38%.

**Squares**: the herbicide exposure had no noticeable affect on square production.

**Bolls:** the herbicide damage caused the loss of some bolls mid-season, delaying peak boll production but didn't affect final boll retention, the pattern of boll retention or boll weight. There was no delay in crop maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton fell below base grade with 12% short fibres and a staple length of 1.108". Lint yield was unaffected.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **simazine** |
| **Nodes/plant** | 30.9 | 29.6 |
| **Leaves/m*** | 687 | 415 |
| **Leaf area (cm²/m)*** | 23830 | 14774 |
| **Reduction in leaf area*** | | 38% |
| **Bolls/m** | 132 | 143 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 97% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 17 |
| **Days to 50% open bolls** | 157 | 151 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 86% |
| **Lint yield/ha** | 2380 | 2421 |

Exposure to 10% of a typical field rate of simazine at 9 nodes caused no observable leaf damage but delayed crop growth, and reducing plant size, leaf number and leaf area.

The herbicide exposure affected mid-season boll retention but caused no reduction in final boll retention, boll size or crop maturity. Fibre quality was affected but there was no reduction in lint yield.

Note* These parameters were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **simazine** |
| **Rate:** | **1.5 kg a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may be up to 1 year depending on rate, soil moisture, soil Ph and temperature
**Soil half-life:** 55 - 186 days. Breakdown is slower in dry, alkaline and cold soils

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 9 node cotton. Photo taken on 15th Dec, 7 days after exposure.

No symptoms of simazine damage were apparent at this stage, 7 days after exposure.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 9 node cotton. Photo taken on 23rd Dec, 15 days after exposure.

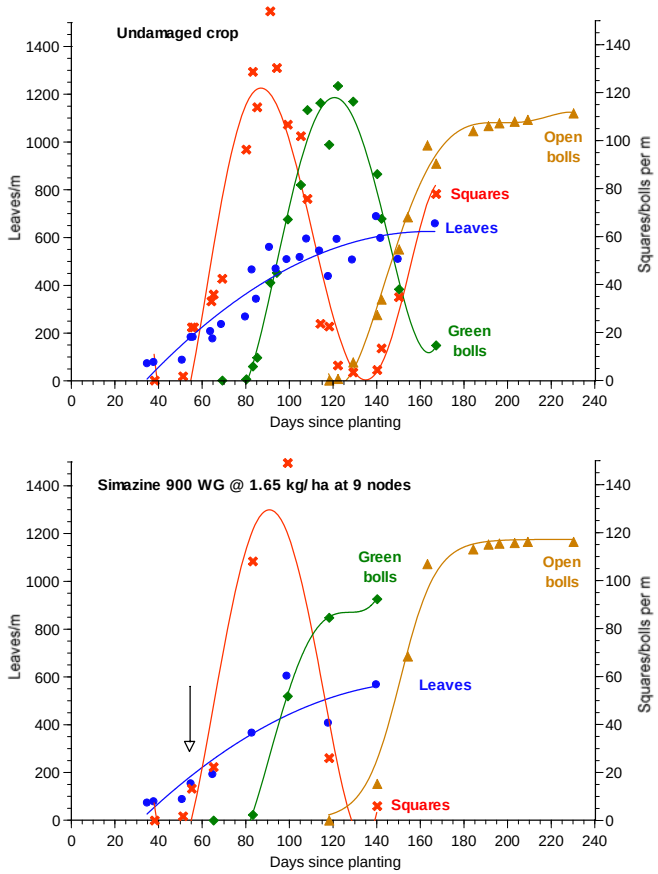
Symptoms of simazine damage were apparent 15 days after exposure, with mild inter-veinal yellowing apparent on some leaves.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

Symptoms of simazine damage were still apparent on some leaves 28 days after exposure, with mild inter-veinal yellowing.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

This photo, taken at the same time as the previous photo, shows how few symptoms of simazine damage were apparent on the plant at this stage, 28 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 50% rate of simazine at 9 nodes reduced the plant stand by 20%. The remaining plants were 5 cm and 2.3 nodes shorter at picking.

**Leaves:** caused a small amount of leaf damage on the exposed leaves. This affected plant development, with an 18% reduction in leaf number at the final observation.

**Squares**: there was no noticeable effect on square production.

**Bolls:** the herbicide exposure did not effect early bolls, but resulted in the loss of some mid- and late-season bolls, delaying and reducing peak boll set and resulting in a higher proportion of pickable bolls coming from the bottom branches than was the case for undamaged plants. There was no delay in crop maturity.

**Lint:** ginning turnout, fibre quality and lint yield were not affected by the herbicide damage.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **simazine** |
| **Nodes/plant** | 30.9 | 28.6 |
| **Leaves/m*** | 687 | 566 |
| **Leaf area (cm²/m)*** | 23830 | 23180 |
| **Reduction in leaf area*** | | 3% |
| **Bolls/m** | 132 | 125 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 97% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 15 |
| **Days to 50% open bolls** | 157 | 149 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 88% |
| **Lint yield/ha** | 2380 | 2382 |

Exposure to 50% of a typical field rate of simazine at 9 nodes caused a small amount of leaf damage and a reduction in leaf number and plant size mid-season.

The herbicide affected the pattern of boll retention but did not reduce the final boll retention or boll size, delay crop maturity or reduce boll size, fibre quality or lint yield.

Note* These parameters were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** simazine
**Rate:** 300 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 13th Jan (12 weeks post-emergence)
**Growth stage at exposure:** 17 nodes

**Damage key:**
- Leaf loss
- Leaf distortion
- Petiole distortion
- Plant stunting
- Square shedding
- Boll shedding

## Herbicidal action

**Herbicide group:** C
**Translocation:** readily absorbed by roots and translocated to shoots
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may be up to 1 year depending on rate, soil moisture, soil Ph and temperature
**Soil half-life:** 55 - 186 days. Breakdown is slower in dry, alkaline and cold soils

Simazine granules 900 WG were applied broadcast at 330 g/ha to 17 node cotton. Photo taken on 20th Jan, 7 days after exposure.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 330 g/ha to 17 node cotton. Photo taken on 5th Feb, 23 days after exposure.

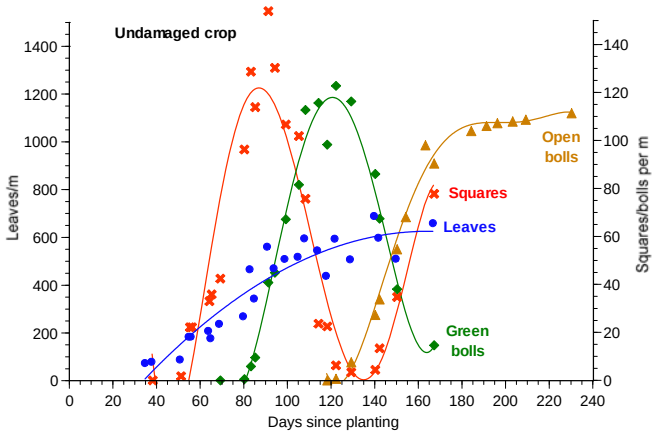
No symptoms of simazine damage were apparent at any stage.

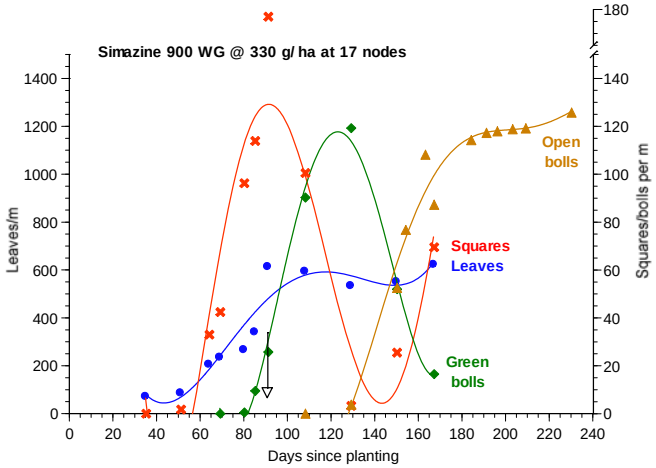
Simazine granules 900 WG were applied broadcast at 330 g/ha to 10 node cotton. Photo taken on 10th Feb, 28 days after exposure.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 330 g/ha to 5 node cotton. Photo taken on 11th Mar, 57 days after exposure.

No symptoms of simazine damage were apparent at any stage.




## Impact on plant growth

**Plants:** exposure to the 10% rate of simazine at 17 nodes caused no effect on plant height but plants were 8% smaller by weight at the final observation.

**Leaves:** the herbicide caused no obvious damage to the foliage but had an effect on plant growth and development, affecting leaf production. Plants had 21% less leaf area at the final observation.

**Squares**: there was no noticeable effect on square production.

**Bolls:** there were no obvious affects on boll retention, but plants produced an additional late flush of bolls, with 16% more bolls at picking. These additional small bolls were not pickable but there was no reduction in the average weight of open bolls at picking and average crop maturity was unaffected.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide damage, but lint yield was reduced by 8%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **simazine** |
| **Nodes/plant** | 30.9 | 31.4 |
| **Leaves/m*** | 657 | 623 |
| **Leaf area (cm²/m)*** | 21196 | 16677 |
| **Reduction in leaf area*** | | 21% |
| **Bolls/m** | 132 | 153 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 98% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 18 |
| **Days to 50% open bolls** | 157 | 154 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 82% |
| **Lint yield/ha** | 2380 | 2188 |

Exposure to 10% of a typical field rate of simazine at 17 nodes caused no obvious damage to the cotton, but caused a reduction in leaf area mid-season

There were no obvious affects on boll retention, but plants produced an additional late flush of bolls. There were no reductions in boll size, crop maturity or fibre quality. Lint yield was reduced by 8%.

Note* These parameters were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **simazine** |
| **Rate:** | **1.5 kg a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (12 weeks post-emergence)** |
| **Growth stage at exposure:** | **17 nodes** |

**Damage key:**
- **Leaf loss**
- **Leaf distortion**
- **Petiole distortion**
- **Plant stunting**
- **Square shedding**
- **Boll shedding**

## Herbicidal action

**Herbicide group:** **C**
**Translocation:** readily absorbed by roots and translocated to shoots
**Mode of action:** inhibits photosynthesis
**Residual activity:** prolonged residual activity. Plant-back period may be up to 1 year depending on rate, soil moisture, soil Ph and temperature
**Soil half-life:** 55 - 186 days. Breakdown is slower in dry, alkaline and cold soils

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 17 node cotton. Photo taken on 20th Jan, 7 days after exposure.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 17 node cotton. Photo taken on 5th Feb, 23 days after exposure.

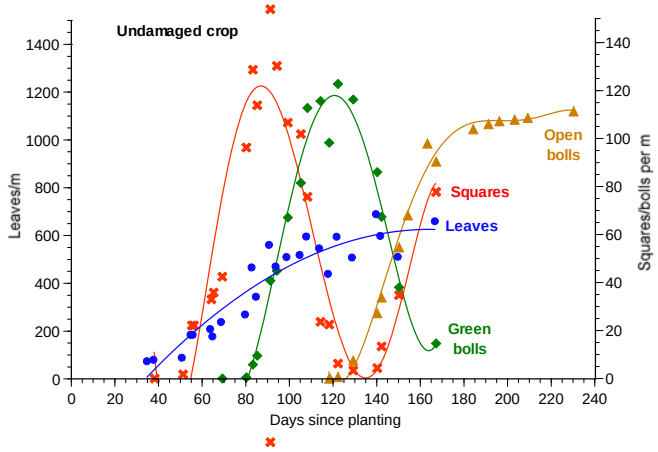
No symptoms of simazine damage were apparent at any stage.

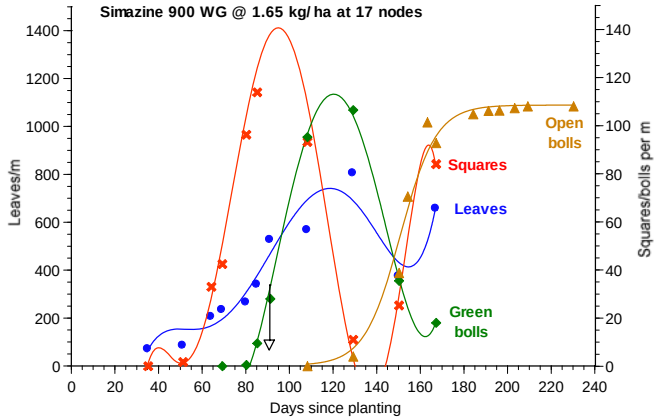
Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 17 node cotton. Photo taken on 10th Feb, 28 days after exposure.

No symptoms of simazine damage were apparent at any stage.

Simazine granules 900 WG were applied broadcast at 1.65 kg/ha to 17 node cotton. Photo taken on 11th Mar, 57 days after exposure.

No symptoms of simazine damage were apparent at any stage.




## Impact on plant growth

**Plants:** exposure to simazine at 17 nodes caused no reduction in plant size.

**Leaves:** there was no obvious damage to the foliage and no effect on the number of leaves or leaf area as the last observation.

**Squares**: there was no noticeable effect on square production.

**Bolls:** the herbicide exposure had no obvious effect on boll production, the pattern of boll retention, the average weight of the open bolls or average crop maturity. There was a 5% reduction in the proportion of bolls open at picking.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton fell below base grade with 11.4% short fibres and a staple length of 1.112". Lint yield was reduced by 11%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **simazine** |
| **Nodes/plant** | 30.9 | 31.3 |
| **Leaves/m*** | 657 | 658 |
| **Leaf area (cm²/m)*** | 21196 | 20459 |
| **Reduction in leaf area*** | | 3% |
| **Bolls/m** | 132 | 130 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 96% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 18 |
| **Days to 50% open bolls** | 157 | 151 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 80% |
| **Lint yield/ha** | 2380 | 2123 |

Exposure to 50% of a typical field rate of simazine at 17 nodes caused no obvious damage to the plants.

The herbicide exposure did not affect the number of retained bolls, the pattern of boll retention, boll size or crop maturity, but reduced the proportion of bolls open at picking and fibre quality. Lint yield was reduced by 11%.

Note* These parameters were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **F**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** limited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 10 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 9 days after crop emergence.

Initial symptoms of isoxaflutole damage were mild, with slight yellowing of the cotyledons.

Balance® (isoxaflutole) applied broadcast at 10 g/ha and incorporated prior to planting cotton. Photo taken on 12th Nov, 17 days after crop emergence.

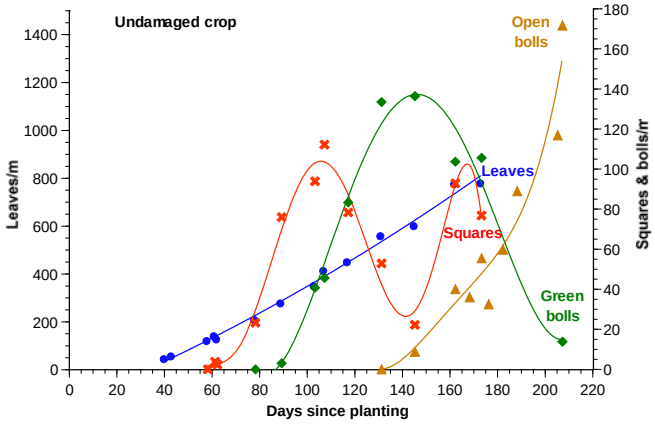
Symptoms of isoxaflutole damage were more obvious on some cotyledons 17 days after emergence, with inter-vienal discolouration and some chlorosis. Some seedlings had few or no symptoms. However, the seedlings appeared to develop normally and there were no signs of damage on the newly emerged true leaves.

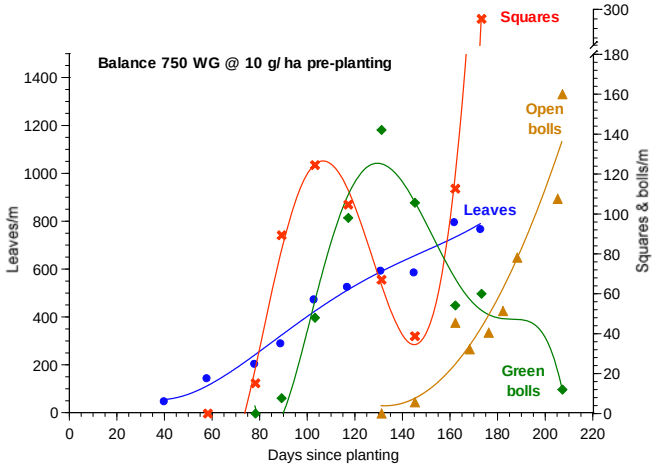
Balance® (isoxaflutole) applied broadcast at 10 g/ha and incorporated prior to planting cotton. Photo taken on 9th Dec, 44 days after crop emergence.

Symptoms of isoxaflutole damage developed on many of the lower leaves by 44 days after crop emergence, with inter-vienal yellowing and necrotic spots.

Balance® (isoxaflutole) applied broadcast at 10 g/ha and incorporated prior to planting cotton. Photo taken on 7th Jan, 73 days after crop emergence.

No symptoms of isoxaflutole damage remained 73 days after emergence.




## Impact on plant growth

**Plants**: exposure to the lighter rate of residual isoxaflutole affected many cotyledons and early plant growth and development. The plant stand was reduced by 13%, 1.5 times more seedlings were tipped-out, plants were 8 cm and 2.9 nodes shorter, and were 10% smaller by weight.

**Leaves:** the herbicide exposure caused early-season damage, with some discolouration and necrosis. Plants largely compensated for the damage and had 13% more leaf area at the final observation.

**Squares**: there was no obvious affect on square production until late in the season, when the damaged plants put on a mass of new squares.

**Bolls:** boll retention followed a similar pattern to the undamaged plants for the early part of the season, but a proportion of bolls were shed mid-season, triggering a flush in square production and some late bolls, few of which were retained. There was no delay in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **isoxaflutole 10% pre-plant** |
| **Nodes/plant** | 26.9 | 25.4 |
| **Leaves/m*** | 775 | 764 |
| **Leaf area (cm²/m)*** | 30138 | 34194 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 172 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention posit's 1-3^** | 91% | 90% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 – 18 |
| **Days to 50% open** | 193 | 193 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 93% |
| **Lint yield (kg/ha)** | 2099 | 2007 |


## Summary

Exposure to 10% of a typical field rate of residual isoxaflutole caused damage to the cotyledons and lower leaves, reduced the plant stand, increased tipping-out and affected plant growth and development.

Some bolls were shed mid-season, followed by a flush of late squares. There was a small reduction in the number of open bolls at picking, but no reduction in boll size, average boll maturity, fibre quality or lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **37.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **F**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** liomited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 50 g/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 9 days after crop emergence.

Strong initial symptoms of isoxaflutole damage were apparent on most seedlings soon after emergence. Seedlings generally had some degree of inter-vienal bleaching, with strongly bleached and necrotic patches on some cotyledons.

Balance® (isoxaflutole) applied broadcast at 50 g/ha and incorporated prior to planting cotton. Photo taken on 12th Nov, 17 days after crop emergence.

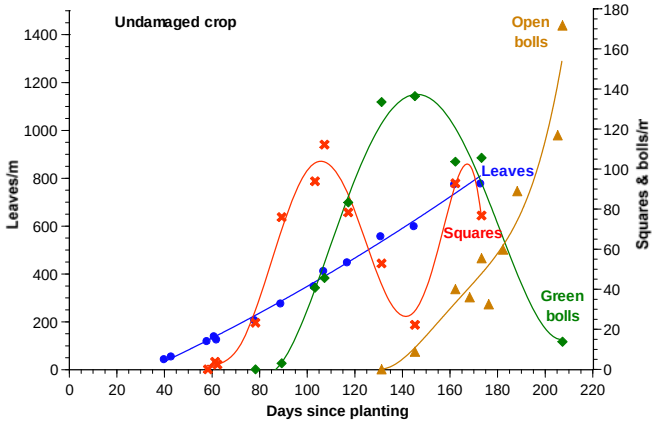
Symptoms of isoxaflutole damage were obvious on most cotyledons 17 days after emergence, with inter-vienal bleaching and some necrosis. However, the seedlings appeared to develop normally following this initial damage and there were no signs of damage on the newly emerged true leaves.

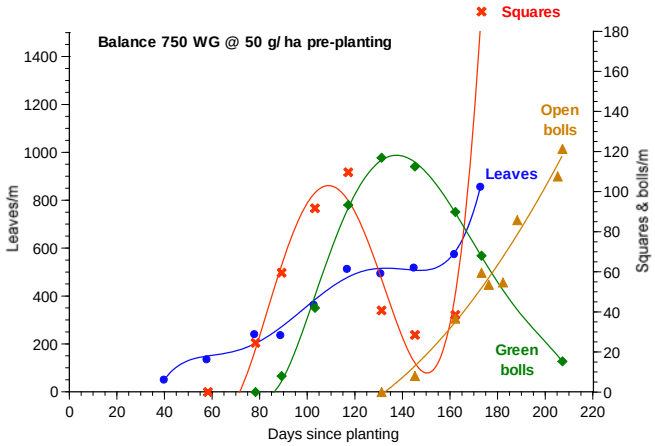
Balance® (isoxaflutole) applied broadcast at 50 g/ha and incorporated prior to planting cotton. Photo taken on 9th Dec, 44 days after crop emergence.

Symptoms of isoxaflutole damage developed on many of the lower leaves by 44 days after crop emergence, with inter-vienal yellowing and necrotic spots.

Balance® (isoxaflutole) applied broadcast at 50 g/ha and incorporated prior to planting cotton. Photo taken on 7th Jan, 73 days after crop emergence.

No symptoms of isoxaflutole damage remained 73 days after emergence.




## Impact on plant growth

**Plants**: exposure to residual isoxaflutole affected early-season growth and development. The plant stand was reduced by 13% and nearly 3-times as many seedlings were tipped-out.

**Leaves:** the herbicide exposure caused extensive early-season damage to the cotyledons and the lower leaves, with bleaching and some necrosis. Plants compensated for the damage and had 10% more leaves late in the season.

**Squares**: there was no obvious affect on square production until the final observation, when the damaged plants put on a mass of new squares.

**Bolls:** boll retention followed a similar pattern to the undamaged plants for the early part of the season, but a proportion of bolls were shed mid-season, triggering the flush of squares. There was a 29% reduction in the number open bolls at picking, but no change in average boll size or maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **isoxaflutole 50% pre-plant** |
| **Nodes/plant** | 26.9 | 26.5 |
| **Leaves/m*** | 775 | 853 |
| **Leaf area (cm²/m)*** | 30138 | 29708 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 137 |
| **Boll weight (g/open boll)** | 4.2 | 4.1 |
| **Retention posit's 1-3^** | 91% | 91% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 – 18 |
| **Days to 50% open** | 193 | 183 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 88% |
| **Lint yield (kg/ha)** | 2099 | 2050 |


## Summary

Exposure to 50% of a typical field rate of residual isoxaflutole damaged the cotyledons and lower leaves with bleaching and some necrosis, reduced the plant stand, increased tipping-out and affected plant growth and development.

Some bolls were shed mid-season, followed by a flush of late squares. There was a reduction in the number of open bolls at picking, but no reduction in boll size, average boll maturity, fibre quality or lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **25th Nov** |
| | **(4 weeks post-emergence)** |
| **Growth stage at exposure:** | **4 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **F**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** limited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 4 node cotton. Photo taken on 9th Dec, 14 days after exposure.

No symptoms of isoxaflutole damage were apparent 14 days after exposure other than stunting and petiole reddening.

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 4 node cotton. Photo taken on 14th Dec, 19 days after exposure.

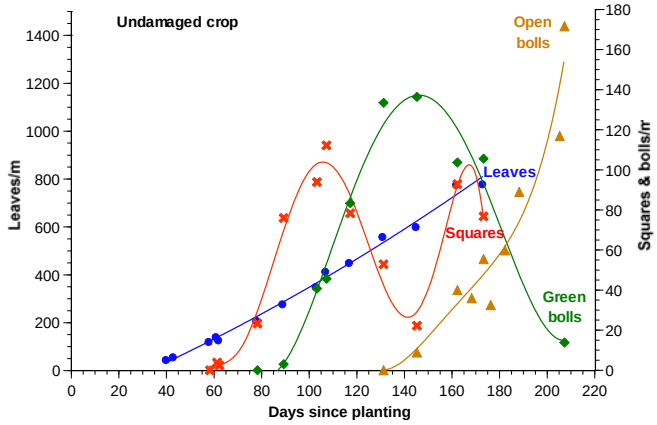
No symptoms of isoxaflutole damage were obvious 19 days after exposure, other than reddening of the petioles.

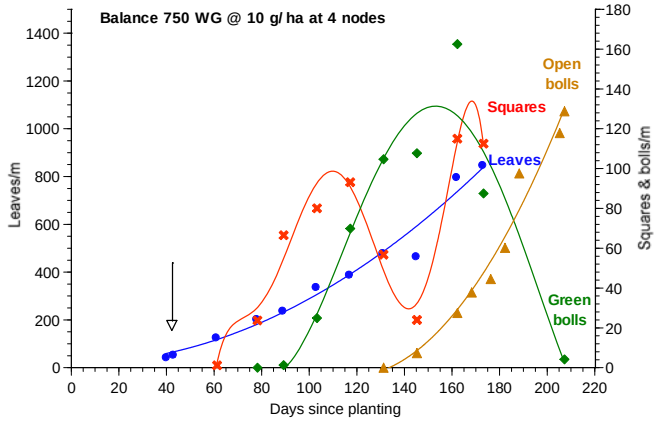
Balance® (isoxaflutole) applied broadcast at 10 g/ha to 4 node cotton. Photo taken on 22nd Dec, 27 days after exposure.

No symptoms of isoxaflutole damage were obvious 27 days after exposure, other than slight yellowing of the plants and reddening of the petioles.

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 4 node cotton. Photo taken on 29th Dec, 34 days after exposure.

No symptoms of isoxaflutole damage were apparent 34 days after exposure.




## Impact on plant growth

**Plants**: exposure to the light rate of isoxaflutole at 4 nodes appeared to cause minimal damage to the plants. Petiole reddening was apparent soon after exposure and there appeared to be some stunting, but there was no longer-term reduction in plant size.

**Leaves:** the herbicide exposure caused minimal damage to the foliage. There was no reduction in leaf number or leaf area at the final observation.

**Squares**: there was no obvious affect on square initiation or production.

**Bolls:** boll retention and opening appeared to be unaffected by the herbicide exposure, following a similar pattern to the undamaged plants. However, plants lost some late bolls, retaining 25% fewer open bolls at picking. There was no reduction in boll weight or delay in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide.

**Final plant count data**

| | undamaged comparison | isoxaflutole 10% @ 4 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 25.0 |
| **Leaves/m*** | 775 | 845 |
| **Leaf area (cm²/m)*** | 30138 | 33970 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 133 |
| **Boll weight (g/open boll)** | 4.2 | 4.4 |
| **Retention posit's 1-3^** | 91% | 94% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 – 18 |
| **Days to 50% open** | 193 | 193 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 97% |
| **Lint yield (kg/ha)** | 2099 | 1996 |

## Summary

Exposure to 10% of a typical field rate of isoxaflutole at 4 nodes caused little apparent damage to the plants. There was some transient reddening and stunting, but no long-term reduction in plant size, leaf number or leaf area.

The herbicide exposure had no apparent affect on square and boll initiation or retention, but plants lost some late-season bolls. There was no reduction in boll weight, delay in average boll maturity, loss of fibre quality or yield reduction.

**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **15th Dec** |
| | **(7 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **H**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** limited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 9 node cotton. Photo taken on 22nd Dec, 7 days after exposure.

Symptoms of isoxaflutole damage apparent 7 days after exposure included necrotic spots and patches, areas of inter-vienal yellowing on newly emerged leaves and yellowing of the main veins.

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 9 node cotton. Photo taken on 29th Dec, 14 days after exposure.

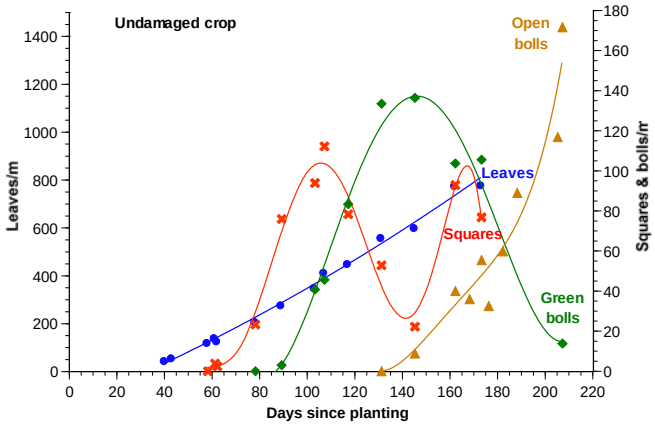
Most leaves show no symptoms of isoxaflutole damage 14 days after exposure. However, damage symptoms are readily apparent on what were the emerging leaves at the time of exposure, with patches of inter-vienal yellowing, often towards the edges of the leaves. The yellowing of the veins is no longer apparent.

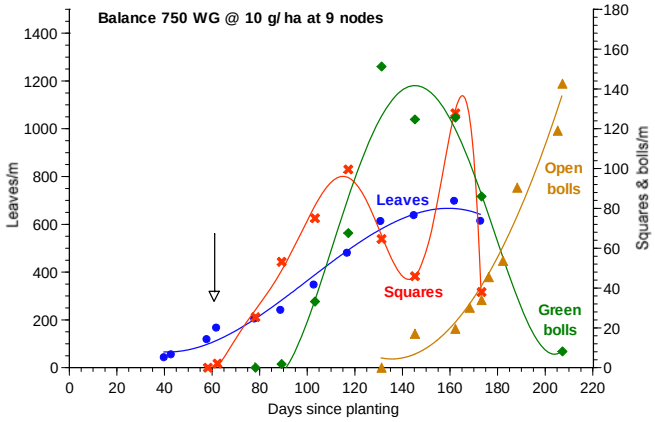
Balance® (isoxaflutole) applied broadcast at 10 g/ha to 9 node cotton. Photo taken on 7th Jan, 23 days after exposure.

By 23 days after exposure, the yellowish areas on the damaged leaves have largely faded to white or have become necrotic. All other leaves remain unaffected.

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 9 node cotton. Photo taken on 17th Jan, 33 days after exposure.

Isoxaflutole damage remains apparent on the damaged leaves, which are now towards the bottom of the plants. By 44 days after exposure, these damaged leaves are difficult to find among the mass of the growing plant.




## Impact on plant growth

**Plants**: exposure to the lighter rate of isoxaflutole at 9 nodes caused some damage to the emerging leaves and stunted the plants. Plants remained 26% smaller by weight at the last observation.

**Leaves:** the herbicide exposure caused yellowing, bleaching and some necrotic spots on the emerging leaves. Plants had 21% fewer leaves and 25% less leaf area at the last observation, with a large number of leaves shed late in the season.

**Squares**: the herbicide exposure caused some loss of early squares, delaying peak squaring by 20 days. Squares were also shed late in the season, but this loss had no implications for lint yield.

**Bolls:** boll retention followed a similar pattern to the undamaged plants, but some late bolls were shed, with 17% fewer open bolls retained at picking. There was no reduction in boll size or delay in crop maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide.

**Final plant count data**

| | undamaged comparison | isoxaflutole 10% @ 9 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 25.9 |
| **Leaves/m*** | 775 | 612 |
| **Leaf area (cm²/m)*** | 30138 | 22554 |
| **Reduction in leaf area*** | | 25% |
| **Bolls/m** | 186 | 151 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention posit's 1-3^** | 91% | 95% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 – 20 |
| **Days to 50% open** | 193 | 188 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 94% |
| **Lint yield (kg/ha)** | 2099 | 2216 |


## Summary

Exposure to 10% of a typical field rate of isoxaflutole at 9 nodes damaged the newly emerging leaves, with yellowing, bleaching and some necrotic spots. There was a reduction in plant size, leaf area and leaf number.

Plants shed some squares after exposure and again late in the season, and also some late-season bolls. However, there was no reduction in boll weight, delay in boll maturity, loss of fibre quality or reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **37.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **15th Dec (7 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **F**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** limited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 9 node cotton. Photo taken on 22nd Dec, 7 days after exposure.

Symptoms of isoxaflutole damage apparent 7 days after exposure included necrotic spots and patches, areas of inter-vienal yellowing on newly emerged leaves and yellowing of the main veins. Red streaks radiate from the petioles part-way along the veins of some leaves.

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 9 node cotton. Photo taken on 29th Dec, 14 days after exposure.

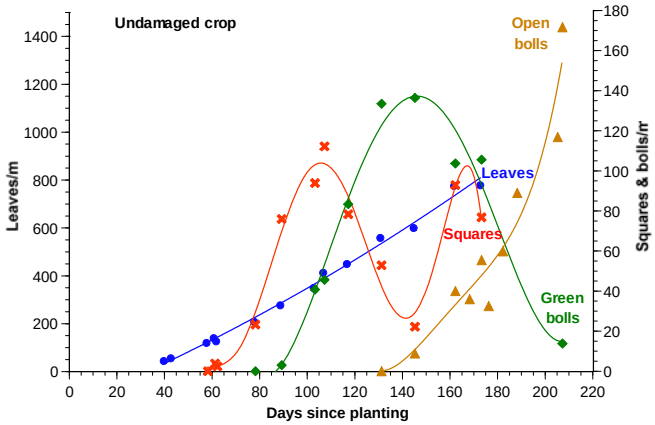
Most leaves show no symptoms of isoxaflutole damage 14 days after exposure. However, damage symptoms are readily apparent on what were the emerging leaves at the time of exposure, with patches of inter-vienal yellowing or bleaching, often towards the edges of the leaves. The yellowing of the veins is no longer apparent, but some red streaks remain.

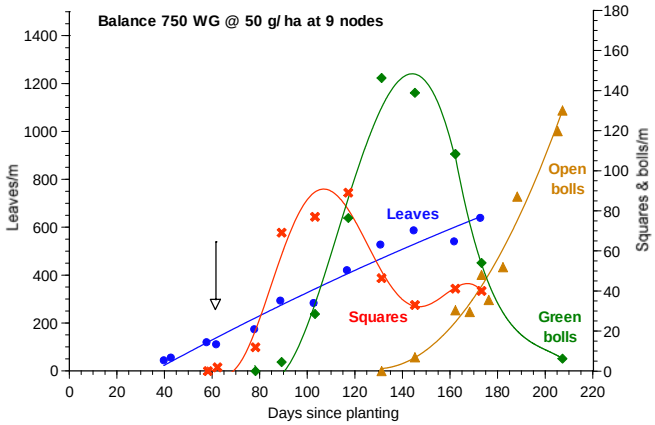
Balance® (isoxaflutole) applied broadcast at 50 g/ha to 9 node cotton. Photo taken on 7th Jan, 23 days after exposure.

By 23 days after exposure, the yellowish areas on the damaged leaves have largely faded to white or have become necrotic. All other leaves remain unaffected.

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 9 node cotton. Photo taken on 17th Jan, 33 days after exposure.

Isoxaflutole damage remains apparent on the damaged leaves, which are now towards the bottom of the plants. By 44 days after exposure, these damaged leaves are difficult to find among the mass of the growing plant.




## Impact on plant growth

**Plants**: exposure to isoxaflutole at 9 nodes caused some damage to the emerging leaves and stunted the plants. Plants remained 6 cm and 2 nodes shorter at the end of the season.

**Leaves:** the herbicide damaged newly emerging leaves and slowed plant growth and development. Plants had 18% fewer leaves and 16% less leaf area at the last observation.

**Squares**: there was a 10 day delay in square initiation and peak squaring was reduced by 25%. The normal flush of late squares was also greatly reduced.

**Bolls:** boll retention followed a similar pattern to the undamaged plants until later in the season when some bolls were shed. Plants retained 33% fewer open bolls at picking, but there was no reduction in average boll weight or delay in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **isoxaflutole 50% @ 9 nodes** |
| **Nodes/plant** | 26.9 | 25.6 |
| **Leaves/m*** | 775 | 636 |
| **Leaf area (cm²/m)*** | 30138 | 25250 |
| **Reduction in leaf area*** | | 16% |
| **Bolls/m** | 186 | 136 |
| **Boll weight (g/open boll)** | 4.2 | 4.3 |
| **Retention posit's 1-3^** | 91% | 94% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 – 18 |
| **Days to 50% open** | 193 | 186 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 95% |
| **Lint yield (kg/ha)** | 2099 | 2212 |


## Summary

Exposure to 50% of a typical field rate of isoxaflutole at 9 nodes caused damage to the newly emerging leaves, with yellowing, bleaching and necrosis. Plant growth and development were delayed, with reduction in plant size, leaf number and leaf area.

Plants shed some squares after the exposure and again late in the season, and also some late-season bolls. However, there was no reduction in boll weight, delay in boll maturity, loss of fibre quality or reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **F**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** limited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 21st Jan, 8 days after exposure.

Symptoms of isoxaflutole damage apparent 8 days after exposure included yellowish and bleached spots and patches, and areas of inter-vienal yellowing on newly emerged leaves.

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 28th Jan, 15 days after exposure.

Areas of inter-vienal yellowing had become more intense15 days after exposure, with some necrotic spots. Some of the more heavily affected leaves were completely desiccated.

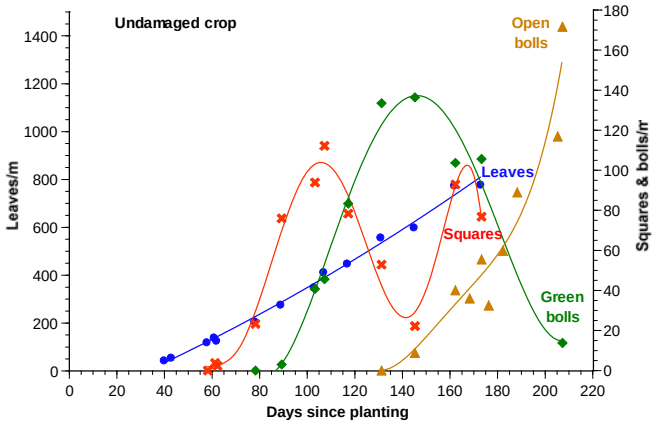
Balance® (isoxaflutole) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 7th Feb, 25 days after exposure.

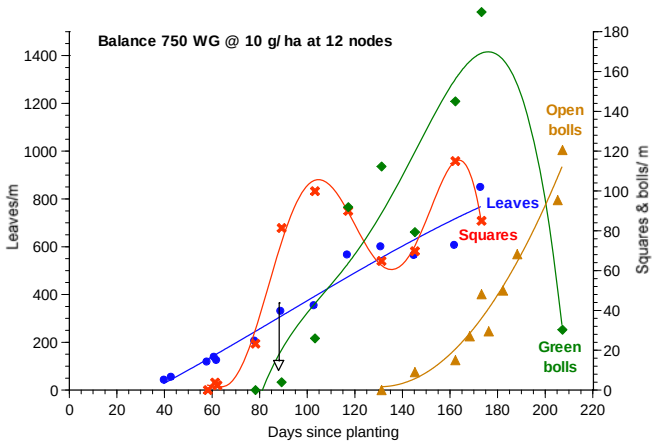
Yellow and necrotic spots and patches were still obvious on the damaged leaves 25 days after exposure. All other leaves remained unaffected. New leaves were emerging above the damaged leaves.

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 3rd Mar, 49 days after exposure.

Isoxaflutole damage remained apparent on the damaged leaves, which are now in the middle of the crop 49 days after exposure.

By 60 days after exposure, these damaged leaves were difficult to find among the mass of the growing plants.




## Impact on plant growth

**Plants**: exposure to the lighter rate of isoxaflutole at 12 nodes damaged the top leaves but appeared to have no other affect on the crop. There was no reduction in plant size later in the season.

**Leaves:** the herbicide exposure caused yellowing, bleaching and necrotic patches on the upper leaves, resulting in some leaf loss. Plants compensated for this damage, with no reduction in leaf number or leaf area at the last observation.

**Squares**: there was an 11% reduction in peak squaring, with additional squares produced mid-season.

**Bolls:** plants shed bolls following the herbicide exposure, delaying peak boll production by 30 days. This led to a delay in the development of the later bolls, with 30% fewer bolls open at picking.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but there was an increase in the proportion of short fibres and lint yield was reduced by 36%.

**Final plant count data**

| | undamaged comparison | isoxaflutole 10% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 27.1 |
| **Leaves/m*** | 775 | 847 |
| **Leaf area (cm²/m)*** | 30138 | 32904 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 186 | 151 |
| **Boll weight (g/open boll)** | 4.2 | 4.1 |
| **Retention posit's 1-3^** | 91% | 89% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 7 – 18 |
| **Days to 50% open** | 193 | 193 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 80% |
| **Lint yield (kg/ha)** | 2099 | 1340 |


### Summary

Exposure to 10% of a typical field rate of isoxaflutole at 12 nodes caused damage to the newly emerging leaves, with yellowing, bleaching and necrotic patches. Some leaves were shed.

Plants also shed squares and bolls following the herbicide exposure, delaying peak boll production and reducing the number of open bolls at picking. There was no reduction in boll weight, but fibre quality was reduced and there was a 36% reduction in lint yield.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **37.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **F**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** limited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 12 node cotton. Photo taken on 21st Jan, 8 days after exposure.

Symptoms of isoxaflutole damage could be seen on many of the top leaves as yellowish and bleached spots and patches and areas of inter-vienal yellowing, often covering the entire leaf. Pint and reddish areas were also apparent on some newly emerged leaves, 8 days after exposure.

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 12 node cotton. Photo taken on 28th Jan, 15 days after exposure.

Areas of yellowing and bleaching had become more intense on the top leaves 15 days after exposure, with necrotic spots and some dead leaves. Much of the yellowing was inter-vienal, with the veins remaining green.

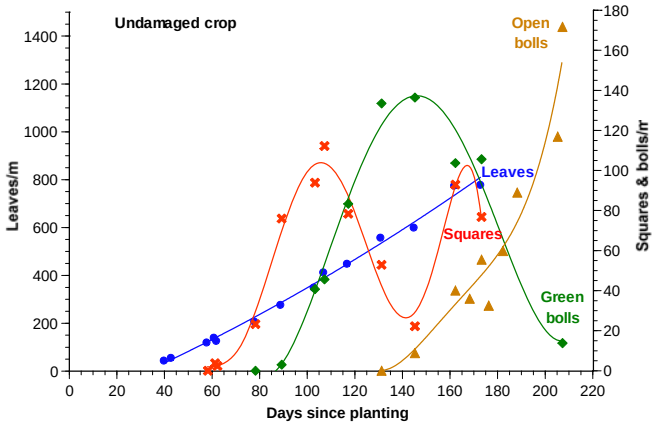
Balance® (isoxaflutole) applied broadcast at 50 g/ha to 12 node cotton. Photo taken on 7th Feb, 25 days after exposure.

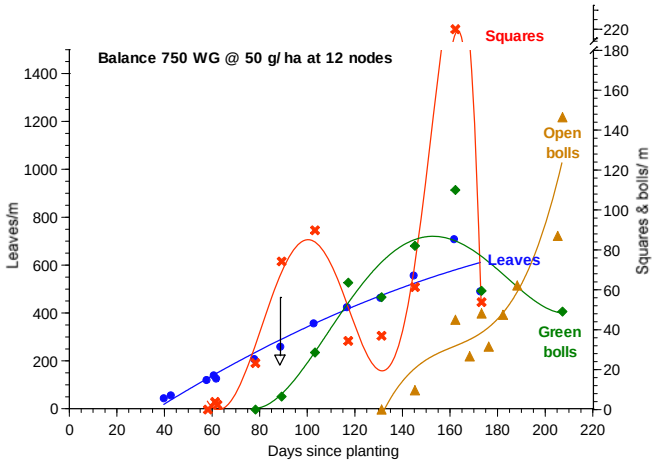
Yellow and necrotic spots and patches were still obvious on the damaged leaves 25 days after exposure. All other leaves remained unaffected and new leaves were emerging above the damaged foliage.

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 12 node cotton. Photo taken on 3rd Mar, 49 days after exposure.

Isoxaflutole damage remained apparent on the damaged leaves, which are now in the middle of the crop, surrounded by normal growth 49 days after exposure.

By 60 days after exposure, these damaged leaves were difficult to find among the mass of the growing plants.




## Impact on plant growth

**Plants**: exposure to isoxaflutole at 12 nodes damaged the top leaves but had no other obvious affect on the crop. However, plant growth and development was delayed. Plants were 6 cm shorter and 34% lighter at the final observations.

**Leaves:** there were reddish, yellowish and bleached patches on the upper leaves, with some leaves dying. Plants had 37% fewer leaves and 36% less leaf area at the last observation.

**Squares**: there was a 20% reduction in peak squaring, but plants produced a mass of late-season squares.

**Bolls:** plants shed many bolls following the herbicide exposure, with 15% fewer open bolls retained at picking. There were 6% fewer bolls retained in positions 1 – 3, and bolls retained to node 23. There was a 9% reduction in boll weight and an 8 day delay in average boll maturity.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but there was an increase in the proportion of short fibres and lint yield was reduced by 43%.

**Final plant count data**

| | undamaged comparison | isoxaflutole 50% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 27.6 |
| **Leaves/m*** | 775 | 487 |
| **Leaf area (cm²/m)*** | 30138 | 19349 |
| **Reduction in leaf area*** | | 36% |
| **Bolls/m** | 186 | 196 |
| **Boll weight (g/open boll)** | 4.2 | 3.8 |
| **Retention posit's 1-3^** | 91% | 84% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 9 – 23 |
| **Days to 50% open** | 193 | 201 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 92% | 74% |
| **Lint yield (kg/ha)** | 2099 | 1197 |


## Summary

Exposure to 50% of a typical field rate of isoxaflutole at 12 nodes caused damage to the newly emerging leaves, with reddish, yellowish and bleached patches, and some leaf necrosis.

Plants shed and then retained a mass of squares. Bolls were shed, with fewer bolls retained on positions 1 – 3, but extra bolls were retained higher up the plants. There was a reduction in boll weight, a delay in boll maturity, a reduction in fibre quality and a 43% yield loss.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **7.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **31st Jan** |
| | **(14 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **F**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** limited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 16 node cotton. Photo taken on 7th Feb, 7 days after exposure.

Symptoms of isoxaflutole damage 7 days after exposure included yellowish and bleached patches on the terminal leaves, areas of inter-vienal yellowing on some leaves and more general yellowing on other leaves.

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 16 node cotton. Photo taken on 18th Feb, 18 days after exposure.

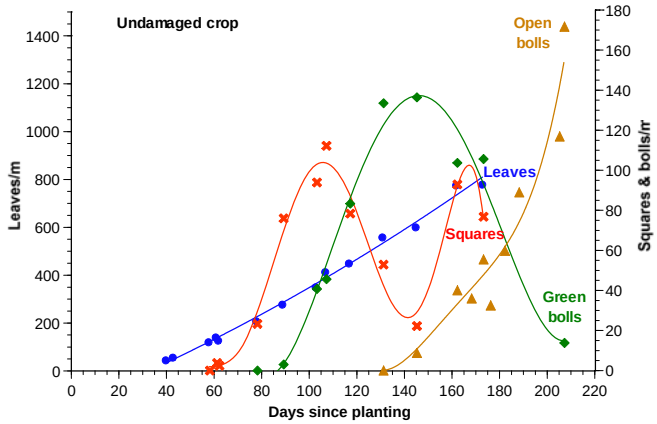
Areas of yellowing remained visible on the terminal leaves 18 days after exposure, with some necrotic spots. Some of the more heavily affected leaves were completely desiccated.

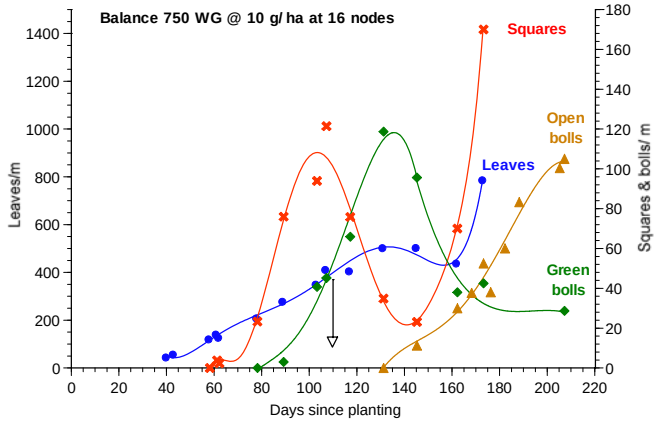
Balance® (isoxaflutole) applied broadcast at 10 g/ha to 16 node cotton. Photo taken on 3rd Mar, 31 days after exposure.

Yellow and necrotic spots and patches were still obvious on the damaged leaves 31 days after exposure, but were becoming less visible as new leaves emerged above the damaged leaves.

Balance® (isoxaflutole) applied broadcast at 10 g/ha to 16 node cotton. Photo taken on 14th Mar, 42 days after exposure.

Isoxaflutole damage remained apparent on the damaged terminals 42 days after exposure, but was becoming more difficult to find as fresh growth developed on undamaged branches.




## Impact on plant growth

**Plants**: exposure to the lighter rate of isoxaflutole at 16 nodes damaged the growing tips and newly emerging upper leaves, reducing the crop height by 9 cm and plant weight by 24% compared to the undamaged crop.

**Leaves:** the herbicide exposure caused leaf yellowing and bleaching and some necrosis. Plants produced small leaves late in the season. Leaf number was no affected but plants had 8% less leaf area at the final observation.

**Squares**: there was no obvious impact on squaring until late in the season when plants produced a flush of new squares.

**Bolls:** boll retention followed a similar pattern as the undamaged plants but many bolls were shed, with 13% fewer bolls at peak boll production and 39% fewer open bolls at picking. There was no delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but lint yield was reduced by 22%.

**Final plant count data**

| | undamaged comparison | isoxaflutole 10% @ 16 nodes |
|---|---|---|
| **Nodes/plant** | 26.9 | 25.5 |
| **Leaves/m*** | 775 | 783 |
| **Leaf area (cm²/m)*** | 30138 | 27833 |
| **Reduction in leaf area*** | | 8% |
| **Bolls/m** | 186 | 134 |
| **Boll weight (g/open boll)** | 4.2 | 4.4 |
| **Retention posit's 1-3^** | 91% | 95% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 8 – 18 |
| **Days to 50% open** | 193 | 184 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 78% |
| **Lint yield (kg/ha)** | 2099 | 1635 |

## Summary

Exposure to 10% of a typical field rate of isoxaflutole at 16 nodes caused damage to the newly emerging leaves, with yellowish and bleached patches, and some necrotic leaves. Plant size and leaf area was reduced.

Plants retained a mass of late squares. Bolls were shed. Peak boll retention was down and plants had fewer open bolls at picking. There was no reduction in boll weight, delay in boll maturity, or reduction in fibre quality, but lint yield was reduced by 22%.

**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of bolls retained in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **isoxaflutole** |
| **Rate:** | **37.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **31st Jan (14 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **F**
**Translocation:** absorbed and translocated by roots and leaves
**Mode of action:** inhibits plastoquinone biosynthesis, destroying plant chlorophyll
**Residual activity:** limited residual activity
**Soil half-life:** 1 - 2 days, but has a minimum 7 month plant-back to cotton

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 16 node cotton. Photo taken on 7th Feb, 7 days after exposure.

Symptoms of isoxaflutole damage 7 days after exposure included yellowish and bleached patches on the terminal leaves, areas of inter-vienal yellowing on some leaves and more general yellowing on other leaves.

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 16 node cotton. Photo taken on 18th Feb, 18 days after exposure.

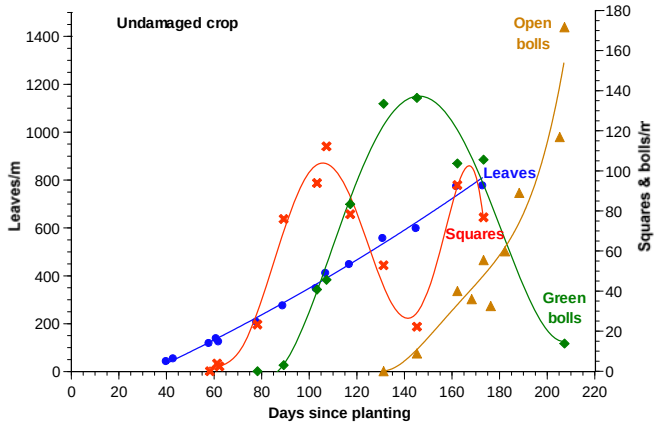
Areas of yellowing and bleaching remained visible on the terminal leaves, with necrotic spots 18 days after exposure. Some of the more heavily affected leaves were completely desiccated.

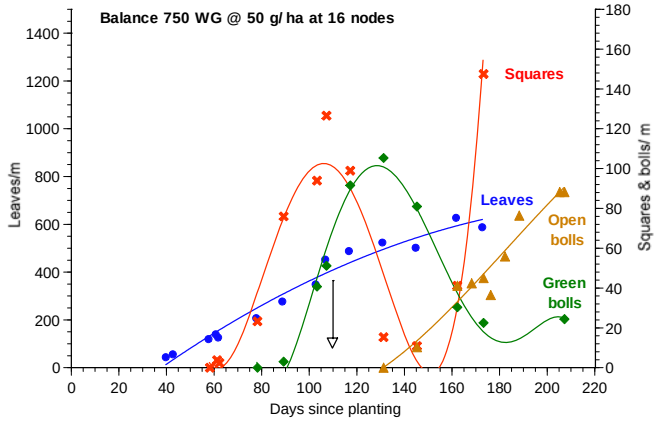
Balance® (isoxaflutole) applied broadcast at 50 g/ha to 16 node cotton. Photo taken on 3rd Mar, 31 days after exposure.

Yellow, bleached and necrotic spots and patches were still obvious on the damaged leaves 31 days after exposure, but new leaves were emerging above the damaged leaves.

Balance® (isoxaflutole) applied broadcast at 50 g/ha to 16 node cotton. Photo taken on 14th Mar, 42 days after exposure.

Isoxaflutole damage remained apparent on the damaged terminals 42 days after exposure, but was becoming more difficult to find as fresh growth developed on undamaged branches.




## Impact on plant growth

**Plants**: exposure to isoxaflutole at 16 nodes damaged the top leaves, reducing the crop height by 12 cm and 2 nodes, and plant weight by 53% compared to the undamaged crop.

**Leaves:** the herbicide exposure caused damage to the newly emerging leaves, with yellowing, bleaching and necrosis. Plants had 25% fewer leaves and 23% less leaf area at the last observation.

**Squares**: plants shed a large proportion of squares 3 weeks after exposure and then produced a flush of new squares late in the season. These squares didn't contribute to lint yield.

**Bolls:** the herbicide initially appeared not to affect boll retention, but bolls were shed and there was 21% reduction in peak boll load, with few bolls retained above node 15. Plants retained 49% fewer open bolls at picking.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but lint yield was reduced by 42%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **isoxaflutole 50% @ 16 nodes** |
| **Nodes/plant** | 26.9 | 24.7 |
| **Leaves/m*** | 775 | 585 |
| **Leaf area (cm²/m)*** | 30138 | 23060 |
| **Reduction in leaf area*** | | 23% |
| **Bolls/m** | 186 | 113 |
| **Boll weight (g/open boll)** | 4.2 | 4.1 |
| **Retention posit's 1-3^** | 91% | 93% |
| **Nodes carrying >80% bolls#** | 8 – 19 | 8 – 15 |
| **Days to 50% open** | 193 | 180 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 92% | 71% |
| **Lint yield (kg/ha)** | 2099 | 1221 |


## Summary

Exposure to 50% of a typical field rate of isoxaflutole at 16 nodes caused damage to the newly emerging leaves, with yellowish and bleached patches, and some necrotic leaves. Plant size, leaf number and leaf area was reduced.

Plants retained a mass of late squares. Bolls were shed. Peak boll retention was down and plants had fewer open bolls at picking. There was no reduction in boll weight, delay in average boll maturity, or reduction in fibre quality, but lint yield was reduced by 42%.


**Note*** These parameters were last recorded 173 days after planting.
**Note^** Percentage of bolls retained in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine** |
| **Rate:** | **8 g a.i./ha** |
| **% of typical field rate** | **1%** |
| **Date of exposure:** | **12 Dec (4 weeks post-emergence)** |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** A phenoxy (auxin-type) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein synthesis, resulting in uncontrolled cell division & growth.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Baton (2,4-D amine) applied broadcast at 10 g/ha to 6 node cotton. Photo taken on 5 Jan, 24 days after exposure.

Leaves on the main stem were affected by the herbicide, with leaf distortion on all subsequent growth. Leaf damage was less extreme than occurred at the 80 g a.i./ha rate.

Baton (2,4-D amine) applied broadcast at 10 g/ha to 6 node cotton. Photo taken on 5 Jan, 24 days after exposure.

The new leaves on the main stem were distorted by the herbicide. Leaves were cupped and twisted with distorted edges. These symptoms are typical of 2,4-D damage.

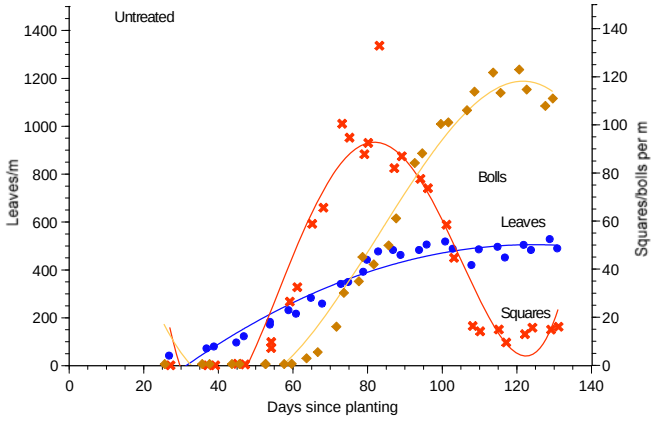
Baton (2,4-D amine) applied broadcast at 10 g/ha to 6 node cotton. Photo taken on 24 Mar, 102 days after exposure.

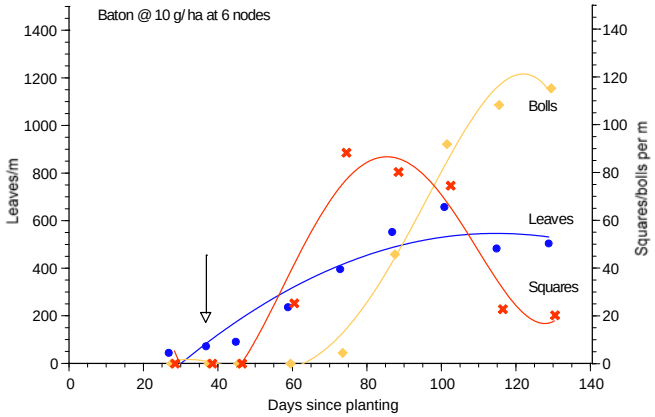
The main stem continued to produce distorted leaves throughout the season, but the growth on the vegetative branches was unaffected by the 2,4-D application.

Baton (2,4-D amine) applied broadcast at 10 g/ha to 6 node cotton. Photo taken on 24 Mar, 102 days after exposure.

This plate shows a close-up of the centre of the plants in the previous photo.

Vegetative branches that developed after the herbicide exposure were not affected by the 2,4-D, with no distorted leaves, and produced normal squares, flowers and bolls.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused some bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves on the main stem that developed following the herbicide exposure, causing an increase in leaf production, mainly through the production of small, distorted leaves.

**Squares**: the1% rate of 2,4-D has little effect on squares production, although peak squaring was delayed for about 5 days.

**Bolls:** some early bolls were shed, but later bolls were retained and developed on the vegetative branches. 2,4-D had little impact on boll production but did delay crop maturity by 23 days.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Nodes/plant** | 21.5 | 22.5 |
| **Leaves/m** | 502 | 501 |
| **Light interception** | 87% | 79% |
| **Leaf area (cm²/m)** | 22921 | 21274 |
| **Bolls/m** | 114 | 104 |
| **Boll weight (g/boll)** | 4.4 | 3.9 |
| **Days to 50% open** | 154 | 177 |
| **% Open bolls at picking** | 82% | 64% |
| **Lint yield/ha** | 1649 | 1474 |

2,4-D exposure at 6 nodes caused leaf deformation on the main stem and a loss of fruit from the main stem.

The plant compensated for this damage, setting bolls on the vegetative branches, producing a late crop, with a delay in crop maturity.

In this instance the damage only caused a small (11%) reduction in lint yield.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine** |
| **Rate:** | **80 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **12 Dec (4 weeks post-emergence)** |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** A phenoxy (auxin-type) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein synthesis, resulting in uncontrolled cell division & growth.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Baton (2,4-D amine) applied broadcast at 100 g/ha to 6 node cotton. Photo taken on 5 Jan, 24 days after exposure.

Leaves on the main stem were severely affected by the herbicide, with severe leaf distortion on all subsequent growth.

Baton (2,4-D amine) applied broadcast at 100 g/ha to 6 node cotton. Photo taken on 5 Jan, 24 days after exposure.

The new leaves on the main stem were severely distorted by the herbicide. Leaves were short, narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

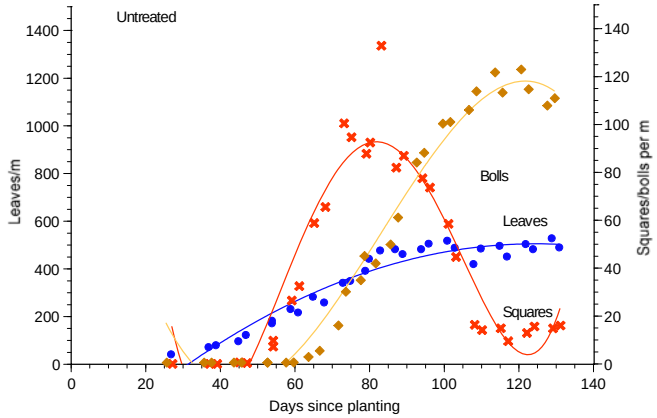
Baton (2,4-D amine) applied broadcast at 100 g/ha to 6 node cotton. Photo taken on 8 Mar, 86 days after exposure.

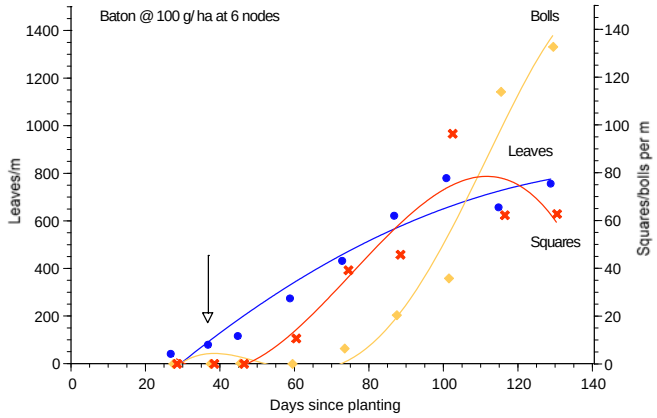
This plate shows a close-up of the centre of the plants in the following photo.

The main stem continued to produce distorted leaves throughout the season, but the growth on the vegetative branches was unaffected by the 2,4-D application.

Baton (2,4-D amine) applied broadcast at 100 g/ha to 6 node cotton. Photo taken on 8 Mar, 86 days after exposure.

Vegetative branches that developed after the herbicide exposure were not affected by the 2,4-D, with no distorted leaves, and produced normal squares, flowers and bolls.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing an increase in leaf production, mainly through the production of small, distorted leaves on the main stem.

**Squares**: many of the early squares were shed, but later squares were retained and developed.

**Bolls:** some early bolls were shed, but later bolls were retained and developed. The plant produced a large number of late bolls, the majority of which didn't reach maturity.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Nodes/plant** | 21.5 | 23.9 |
| **Leaves/m** | 502 | 753 |
| **Light interception** | 87% | 90% |
| **Leaf area (cm²/m)** | 22921 | 19737 |
| **Bolls/m** | 114 | 133 |
| **Boll weight (g/boll)** | 4.4 | 2.6 |
| **Days to 50% open** | 154 | - |
| **% Open bolls at picking** | 82% | 26% |
| **Lint yield/ha** | 1649 | 1471 |

Heavy 2,4-D exposure at 6 nodes caused extensive leaf deformation on the main stem and a loss of fruit from the main stem.

The plant compensated for this damage, setting the crop on the vegetative branches, producing a late crop, with a delay in crop maturity. Many of these bolls were still green at harvest.

In this instance the damage only caused a small (11%) reduction in lint yield. This yield loss would have been reduced had picking been delayed.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine** |
| **Rate:** | **8 g a.i./ha** |
| **% of typical field rate** | **1%** |
| **Date of exposure:** | **21 Dec (5½ weeks post-emergence)** |
| **Growth stage at exposure:** | **8 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** A phenoxy (auxin-type) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein synthesis, resulting in uncontrolled cell division & growth.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Baton (2,4-D amine) applied broadcast at 10 g/ha to 8 node cotton. Photo taken on 5 Jan, 15 days after exposure.

All eaves were severely affected by the herbicide, with severe leaf distortion on subsequent growth.

Baton (2,4-D amine) applied broadcast at 10 g/ha to 8 node cotton. Photo taken on 5 Jan, 15 days after exposure.

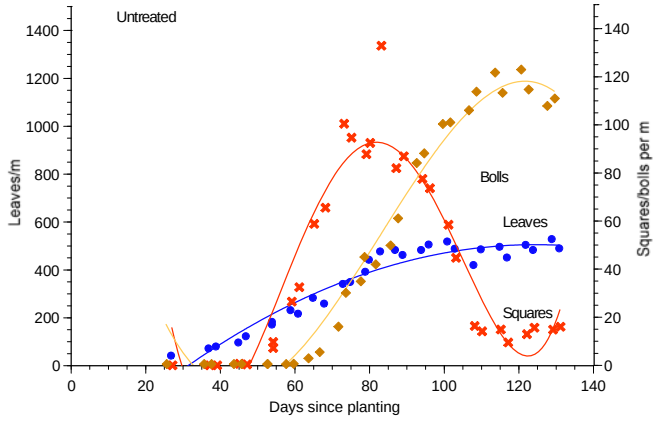
All new leaves were distorted by the herbicide. Leaves were cupped and twisted, with distorted edges. These symptoms are typical of 2,4-D damage.

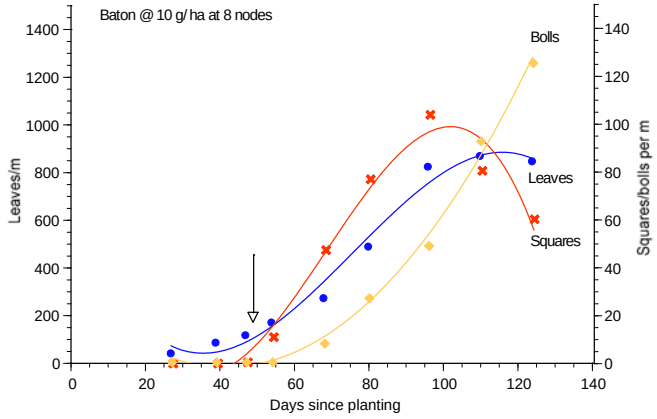
Baton (2,4-D amine) applied broadcast at 100 g/ha to 8 node cotton. Photo taken on 24 Mar, 93 days after exposure.

The main stem and most vegetative branches produced distorted leaves throughout the season. These branches produced few squares and few of these squares developed.

Baton (2,4-D amine) applied broadcast at 100 g/ha to 8 node cotton. Photo taken on 24 Mar, 93 days after exposure.

Some of the late vegetative branches did develop normally, producing some late squares, flowers and bolls, but few of these bolls opened before harvest.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused some bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the herbicide exposure, causing cupping and distortion of these leaves and an increase in leaf number, mainly through the production of smaller, distorted leaves.

**Squares**: the 1% rate of 2,4-D caused a delay in the production of squares, with peak squaring delayed by about 19 days.

**Bolls:** some early bolls were shed, but most later bolls were retained and developed on the vegetative branches. However, most of these bolls were small and few developed through to maturity on the upper branches following the 2,4-D exposure.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Nodes/plant** | 21.5 | 25.3 |
| **Leaves/m** | 502 | 844 |
| **Light interception** | 87% | 91% |
| **Leaf area (cm²/m)** | 22921 | 17210 |
| **Bolls/m** | 114 | 125 |
| **Boll weight (g/boll)** | 4.4 | 1.9 |
| **Days to 50% open** | 154 | - |
| **% Open bolls at picking** | 82% | 36% |
| **Lint yield/ha** | 1649 | 1383 |

2,4-D exposure at 8 nodes caused leaf deformation on the main stem.

There was an increase in leaf number, but most leaves were smaller and distorted, giving a reduction in total leaf area. Light interception was not reduced by this level of 2,4-D exposure at 8 nodes.

The plant retained most early bolls and retained a large number of late bolls, most of which didn't open, resulting in a 16% reduction in yield.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine** |
| **Rate:** | **80 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **21 Dec (5½ weeks post-emergence)** |
| **Growth stage at exposure:** | **8 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** A phenoxy (auxin-type) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein synthesis, resulting in uncontrolled cell division & growth.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Baton (2,4-D amine) applied broadcast at 100 g/ha to 8 node cotton. Photo taken on 5 Jan, 15 days after exposure.

All leaves were severely affected by the herbicide, with severe leaf distortion on subsequent growth.

Baton (2,4-D amine) applied broadcast at 100 g/ha to 8 node cotton. Photo taken on 5 Jan, 15 days after exposure.

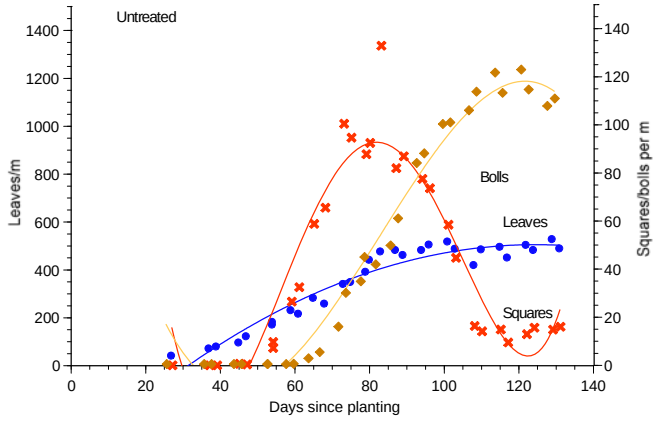
All new leaves were severely distorted by the herbicide. Leaves were short, narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

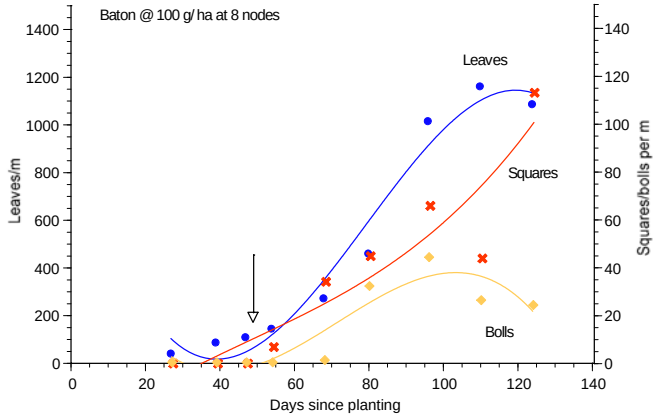
Baton (2,4-D amine) applied broadcast at 100 g/ha to 8 node cotton. Photo taken on 24 Mar, 93 days after exposure.

The main stem and most vegetative branches produced distorted leaves throughout the season. These branches produced few squares and few of these squares developed.

Baton (2,4-D amine) applied broadcast at 100 g/ha to 8 node cotton. Photo taken on 24 Mar, 93 days after exposure.

Some of the late vegetative branches did develop normally, producing some late squares, flowers and bolls, but few of these bolls opened before harvest.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing a large increase in leaf number, mainly through the production of small, distorted leaves. The increase in leaf number did not adequately compensate for their small size and poor orientation, resulting in a reduction in leaf area and light interception.

**Squares**: most of the early squares were shed. The plant compensated later in the season by producing large numbers of new squares, but none of these squares developed into harvestable bolls.

**Bolls:** some bolls were retained on the lower branches, but almost no bolls developed following the 2,4-D exposure. Bolls which were retained were very small and few opened before harvest.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Nodes/plant** | 21.5 | 24.6 |
| **Leaves/m** | 502 | 1084 |
| **Light interception** | 87% | 79% |
| **Leaf area (cm²/m)** | 22921 | 14693 |
| **Bolls/m** | 114 | 24 |
| **Boll weight (g/boll)** | 4.4 | 0.4 |
| **Days to 50% open** | 154 | - |
| **% Open bolls at picking** | 82% | 8% |
| **Lint yield/ha** | 1649 | 277 |

Heavy 2,4-D exposure at 8 nodes caused extensive leaf deformation on the main stem and most vegetative branches, and a loss of squares and bolls.

There was an increase in leaf number, but most leaves were small, distorted and poorly orientated, giving a reduction in total leaf area and light interception.

The plant retained only a few, small bolls, most of which didn't open, resulting in an 83% reduction in yield.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

**Herbicide:** 2,4-D amine
**Rate:** 8 g a.i./ha
**% of typical field rate** 1%
**Date of exposure:** 4 Jan (7 ½ weeks post-emergence)
**Growth stage at exposure:** 12 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** I
**Translocation:** readily moves to the plant growth points
**Mode of action:** A phenoxy (auxin-type) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein synthesis, resulting in uncontrolled cell division & growth.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Baton (2,4-D amine) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 25 Jan, 21 days after exposure.

Symptoms of 2,4-D damage are just becoming apparent on new growth.

Baton (2,4-D amine) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 25 Jan, 21 days after exposure.

Symptoms of 2,4-D damage are just becoming apparent on new growth. New leaves are cupped, with distorted margins.

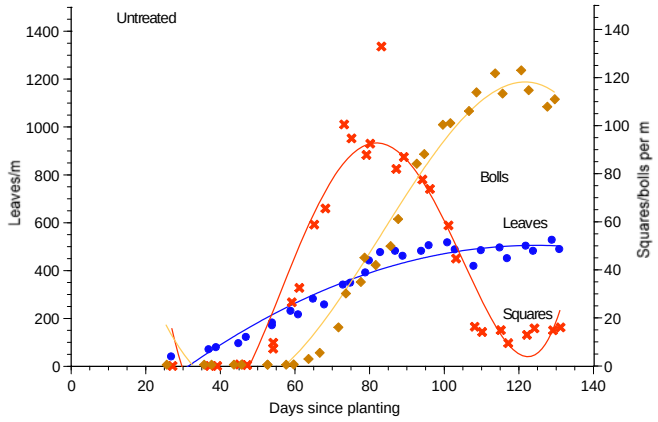
Baton (2,4-D amine) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 24 Mar, 79 days after exposure.

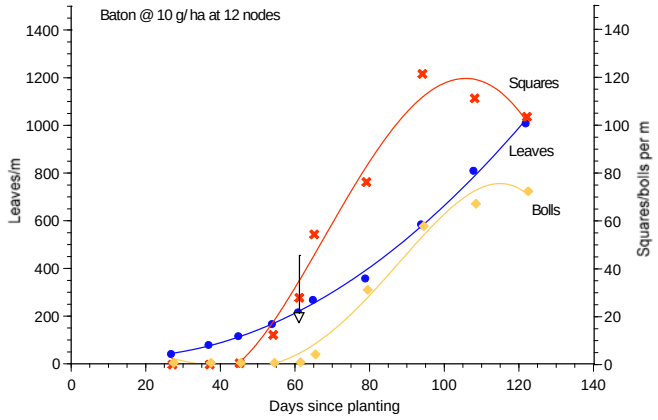
The 2,4-D damage was still apparent, with normal growth up to the 12 node stage. Subsequent growth was distorted. The leaves were short, narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

Baton (2,4-D amine) applied broadcast at 10 g/ha to 12 node cotton. Photo taken on 24 Mar, 79 days after exposure.

Most new growth following the herbicide exposure was distorted. The leaves were short, narrow, cupped, twisted and leathery, with prominent veins.

A large number of distorted squares and flowers developed on the damaged parts of the plant late-season, but few fruit were retained on these parts. What fruit did develop was small and didn't reach maturity.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing a large increase in leaf number, mainly through the production of small, distorted leaves. The increase in leaf number didn't adequately compensate for their small size and poor orientation, resulting in a reduction in leaf area and light interception.

**Squares**: many of the early squares were shed. The plant compensated by producing large numbers of late season squares, but none of these squares developed into harvestable bolls. Peak squaring was delayed by 28 days.

**Bolls:** bolls were retained on the lower branches, but no harvestable bolls developed above the 12th node (point of herbicide exposure). The bolls which did develop on the upper branches were small.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Nodes/plant** | 21.5 | 25.6 |
| **Leaves/m** | 502 | 1006 |
| **Light interception** | 87% | 77% |
| **Leaf area (cm²/m)** | 22921 | 16512 |
| **Bolls/m** | 114 | 72 |
| **Boll weight (g/boll)** | 4.4 | 2.3 |
| **Days to 50% open** | 154 | 153 |
| **% Open bolls at picking** | 82% | 81% |
| **Lint yield/ha** | 1649 | 623 |

2,4-D exposure at 12 nodes caused leaf deformation and a loss of squares and bolls.

There was an increase in leaf number, but most leaves were small, distorted and poorly orientated, giving a reduction in total leaf area and light interception.

The plant retained most bolls on the lower branches, but produced no harvestable bolls on the top part of the plant, resulting in a 62% reduction in yield.

There was no delay in crop maturity with the development of these bottom bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine** |
| **Rate:** | **80 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **4 Jan** |
| | **(7 ½ weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** A phenoxy (auxin-type) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein synthesis, resulting in uncontrolled cell division & growth.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Baton (2,4-D amine) applied broadcast at 100 g/ha to 12 node cotton. Photo taken on 25 Jan, 21 days after exposure.

Symptoms of 2,4-D damage are just becoming apparent.

Baton (2,4-D amine) applied broadcast at 100 g/ha to 12 node cotton. Photo taken on 25 Jan, 21 days after exposure.

Symptoms of 2,4-D damage are just becoming apparent. New leaves are cupped, with distorted margins.

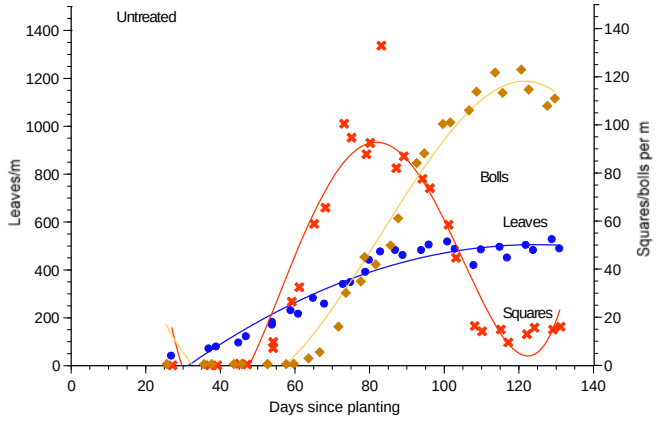
Baton (2,4-D amine) applied broadcast at 100 g/ha to 12 node cotton. Photo taken on 8 Mar, 63 days after exposure.

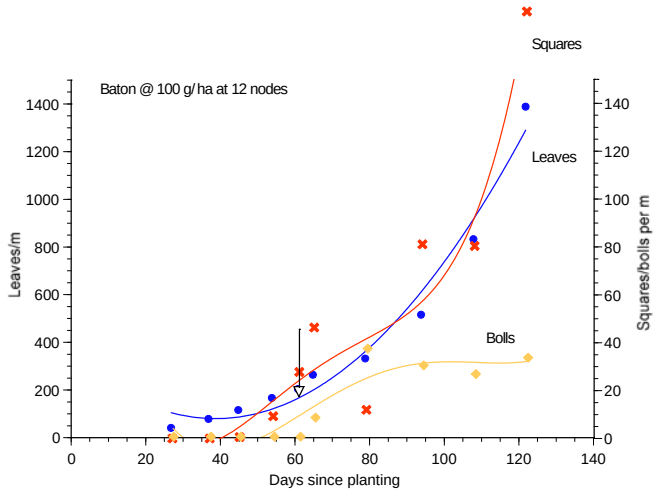
The 2,4-D damage is very obvious, with normal growth up to the 12 node stage. All subsequent growth was very distorted. The leaves were short, narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

Baton (2,4-D amine) applied broadcast at 100 g/ha to 12 node cotton. Photo taken on 24 Mar, 79 days after exposure.

Almost all growth following the herbicide exposure was highly distorted. The leaves were short, narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

A large number of distorted squares developed on the damaged parts of the plant late-season, but few fruit were retained on these parts.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing a large increase in leaf number, mainly through the production of small, distorted leaves. The increase in leaf number did not adequately compensate for their small size and poor orientation, resulting in a reduction in leaf area and light interception.

**Squares**: many of the early squares were shed. The plant compensated later in the season by producing large numbers of new squares, but none of these squares developed into harvestable bolls.

**Bolls:** bolls were retained on the lower branches, but no harvestable bolls developed above the 12th node (point of herbicide exposure). The bolls which were retained were small.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Nodes/plant** | 21.5 | 24.0 |
| **Leaves/m** | 502 | 1386 |
| **Light interception** | 87% | 72% |
| **Leaf area (cm²/m)** | 22921 | 14376 |
| **Bolls/m** | 114 | 33 |
| **Boll weight (g/boll)** | 4.4 | 0.8 |
| **Days to 50% open** | 154 | 152 |
| **% Open bolls at picking** | 82% | 84% |
| **Lint yield/ha** | 1649 | 192 |

Heavy 2,4-D exposure at 12 nodes caused extensive leaf deformation and a loss of squares and bolls.

There was an increase in leaf number, but most leaves were small, distorted and poorly orientated, giving a reduction in total leaf area and light interception.

The plant retained only a few, small bolls on the lower branches, resulting in an 88% reduction in yield.

There was no delay in crop maturity with the development of these bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine** |
| **Rate:** | **8 g a.i./ha** |
| **% of typical field rate** | **1%** |
| **Date of exposure:** | **24 Jan** |
| | **(10 ½ weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

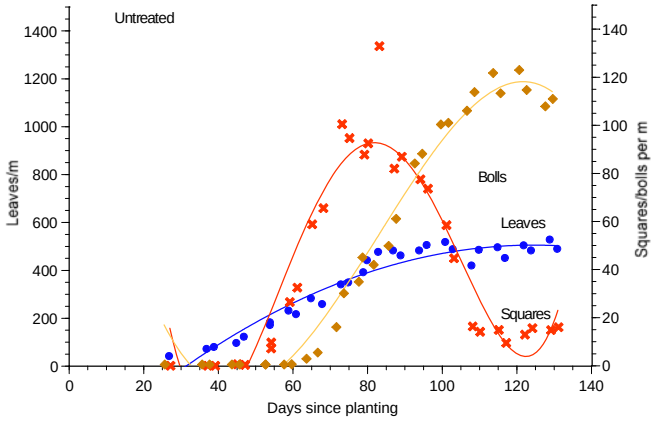
**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** A phenoxy (auxin-type) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein synthesis, resulting in uncontrolled cell division & growth.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

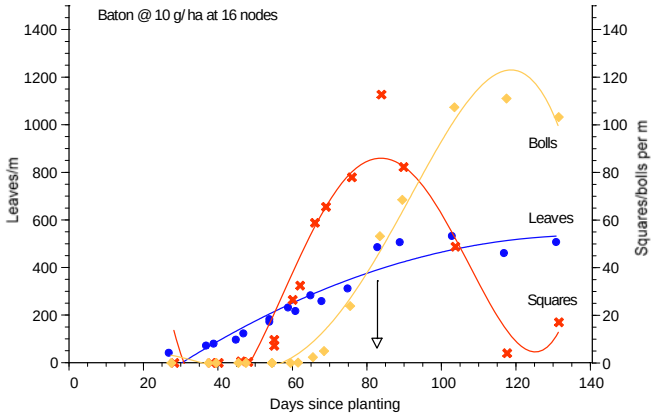
Baton (2,4-D amine) applied broadcast at 10 g/ha to 16 node cotton. Photo taken on 8 Mar, 43 days after exposure.

Little 2,4-D damage was apparent on these plants, with normal growth up to the 16 node stage and only a few cupped leaves with distorted edges in later growth.

Baton (2,4-D amine) applied broadcast at 10 g/ha to 16 node cotton. Photo taken on 8 Mar, 43 days after exposure.

Little 2,4-D damage was apparent on these plants, with normal growth up to the 16 node stage and only a few cupped leaves with distorted edges in later growth.




## Impact on plant growth

**Leaves:** the 1% rate of 2,4-D had little impact on these plants, although there was some decrease in the size of the leaves produced post-exposure, reducing the total leaf area of the plant.

**Squares**: the 1% 2,4-D exposure at 16 nodes had no impact on square production.

**Bolls:** the 1% 2,4-D exposure at 16 nodes had little impact on boll production or retention, but did delay crop maturity by 18 days.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Nodes/plant** | 21.5 | 20.9 |
| **Leaves/m** | 502 | 504 |
| **Light interception** | 87% | 86% |
| **Leaf area (cm²/m)** | 22921 | 16692 |
| **Bolls/m** | 114 | 103 |
| **Boll weight (g/boll)** | 4.4 | 4.9 |
| **Days to 50% open** | 154 | 172 |
| **% Open bolls at picking** | 82% | 74% |
| **Lint yield/ha** | 1649 | 1504 |

2,4-D exposure at 16 nodes had relatively little impact on the plant.

There was no increase in leaf number, but a reduction in total leaf area.

The herbicide exposure had no apparent impact on square or boll production with new squares and bolls produced post-herbicide exposure.

The herbicide exposure did delay crop maturity by 18 days and reduced yield by 9%.

# Herbicide damage guide for cotton

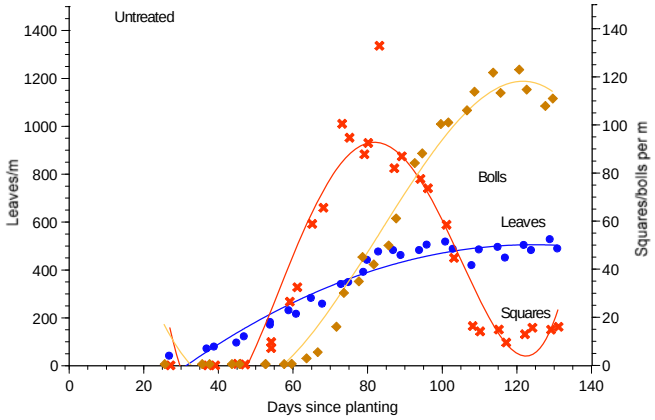
**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

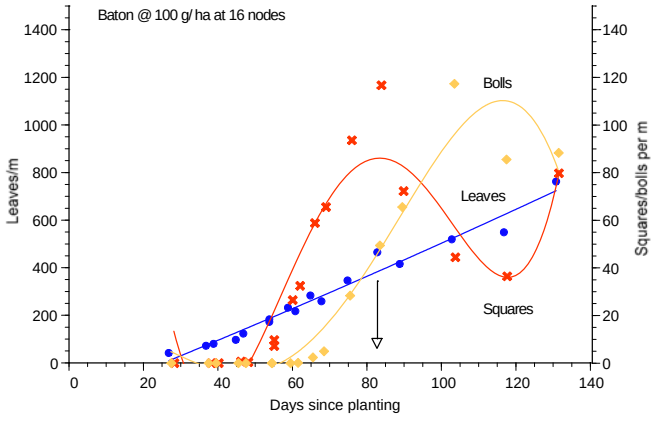
**Herbicide:** 2,4-D amine
**Rate:** 80 g a.i./ha
**% of typical field rate:** 10%
**Date of exposure:** 24 Jan (10½ weeks post-emergence)
**Growth stage at exposure:** 16 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** I
**Translocation:** readily moves to the plant growth points
**Mode of action:** A phenoxy (auxin-type) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein synthesis, resulting in uncontrolled cell division & growth.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing an increase in leaf number through the production of small, distorted leaves. The increase in leaf number did not adequately compensate for their poor orientation, resulting in a reduction in light interception.

**Squares**: the herbicide exposure, occurring at peak squaring, had little impact on squaring, with an increase in the production of late squares.

**Bolls:** most bolls were retained, although these was an increased loss off bolls late in the season.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Nodes/plant** | 21.5 | 25.1 |
| **Leaves/m** | 502 | 759 |
| **Light interception** | 87% | 80% |
| **Leaf area ($cm^2$/m)** | 22921 | 23203 |
| **Bolls/m** | 114 | 88 |
| **Boll weight (g/boll)** | 4.4 | 4.7 |
| **Days to 50% open** | 154 | 155 |
| **% Open bolls at picking** | 82% | 93% |
| **Lint yield/ha** | 1649 | 1148 |

Heavy 2,4-D exposure at 16 nodes had little impact on the lower part of the plant, but caused some late season boll shedding.

There was an increase in leaf number and leaf area, but most damaged leaves were distorted and poorly orientated, giving a reduction in light interception.

The plant retained most lower bolls, resulting in a 30% yield reduction.

2,4-D exposure did not delay the maturity of this crop.

# Recovering from 2,4-D damage - Induced water stress.

**By Graham Charles, Research Agronomist, NSW Dept. of Primary Industries, Cotton CRC & CRDC**

The tips of a cotton crop showing typical symptoms of 2,4-D damage.

Over the years, growers have tried a range of strategies to try to help crops recover from herbicide damage, including:

- Additional irrigations,
- Additional fertilizer, and
- Slashing.

All of which appear to give little or no benefit.

However, an observation made over the last couple of seasons was that phenoxy damage (typically 2,4-D damage) was reduced where cotton plants were stressed at the time of exposure to the herbicide. This observation appears to have some merit, as the phenoxy herbicides act by causing uncontrolled cell division and growth (as well as a range of other effects), such that the plant literally grows itself to death. It stands to reason that a phenoxy herbicide will have little effect on a plant which is not growing. The theory is also supported by observations in the south, where 2,4-D applications to control saffron thistles in wheat in winter can be ineffective if the applications are followed by a series of cloudy days or heavy frosts, where the weeds are not actively growing.

## TESTING THE THEORY

An experiment to test the stress theory was established at ACRI on the 9th October 2009, in what was a hot, dry spring. The crop was exposed to 1% of a typical field rate of 2,4-D amine (16 ml of Amicide 625 per ha) applied at 8 nodes of crop growth on the 27th November, 6 days before the 1st in-crop irrigation (on the 3rd of December), and 24 days before the 2nd irrigation (on the 21st of December). Water stress was imposed on some treatments following the herbicide damage by skipping either the 1st or both the 1st and 2nd irrigations.

The results of the first part of the experiment were quite disappointing (Table 1), with the crop showing no yield reduction due to the herbicide damage and no effect of the water stress – except a small increase in yield on the stressed plots! So, did something go wrong? Yes, it rained, with 47 ml recorded on the day of the 2nd irrigation and a further 186 ml in the following 11 days. The only yield effect of the treatments was a yield increase where the irrigations were missed, presumably due to a reduction in water logging on these treatments!

### Table 1. Impact on lint yield of exposure to a 1% rate of 2,4-D at 8 nodes

| | Irrigations in Nov & Dec | | |
|---|---|---|---|
| | **Full irrigation** | **Missed 1st irrigation** | **Missed 1st & 2nd irrigations** |
| Untreated | 12.7 | 13.0 | 13.7 |
| 1% 2,4-D | 13.2 | 13.4 | 13.7 |

Nevertheless, the herbicide damage and the irrigation delay each caused a delay in crop maturity of 7 or more days, with no indication that delaying the irrigations improved crop recovery from the herbicide damage (Table 2). None of the treatments affected fiber quality.

### Table 2. Days delay in crop maturity from a 1% rate of 2,4-D at 8 nodes

| | Irrigations in Nov & Dec | | |
|---|---|---|---|
| | **Full irrigation** | **Missed 1st irrigation** | **Missed 1st & 2nd irrigations** |
| Untreated | - | 7 | 7 |
| 1% 2,4-D | 22 | 15 | 21 |

## A SECOND TRY

The treatments were repeated with the next two irrigations, with the 2,4-D applied at 18 nodes of crop growth, on the 11th of January. This spray, again at 1%, occurred 10 days before the 3rd irrigation (21 January), and 24 days before the 4th irrigation (4 February), with some treatments skipping these two irrigations.

Again rain occurred on the 3 days following the 4th irrigation (46 ml), but this time the rain had little impact on the results.

This time the data did support the theory that a stressed plant would be less affected by 2,4-D damage, with a reduction in the effect of 2,4-D damage due to imposing water stress after the herbicide exposure: from a 19%

reduction in yield from 2,4-D damage with full irrigation, down to a 9% reduction with 2 missed irrigations when compared with treatments with the same water regime but without the herbicide damage (Table 3). However, missing two irrigations in the middle of the season caused a 34% yield reduction (in the absence of 2,4-D), so any benefit by reducing the impact of the 2,4-D damage was more than lost by the damage caused by missing the irrigations!

Looking at it another way. The 2,4-D damage caused a 2.5 bale yield loss under full irrigation. Imposing water stress after the damage was first noticed resulted in a further 2.5 bale yield loss, with a 5 bale yield loss from the combination of 2,4-D and water stress!! Imposing water stress is a really bad way of dealing with 2,4-D damage!

### Table 3. Impact on lint yield of exposure to a 1% rate of 2,4-D at 18 nodes

| | Irrigations in Jan & Feb | | |
|---|---|---|---|
| | **Full irrigation** | **Missed 3rd irrigation** | **Missed 3rd & 4th irrigations** |
| Untreated | 12.7 | 13.0 | 8.4 |
| 1% 2,4-D | 10.2 | 10.9 | 7.7 |
| Yield reduction | 19% | 16% | 9% |

Again, the herbicide damage and the irrigation delay each caused a delay in crop maturity of 7 or more days, with no indication that delaying the irrigations improved crop recovery from the herbicide damage (Table 4). None of the treatments affected fiber quality.

### Table 4. Days delay in crop maturity from a 1% rate of 2,4-D at 18 nodes

| | Irrigations in Jan & Feb | | |
|---|---|---|---|
| | **Full irrigation** | **Missed 3rd irrigation** | **Missed 3rd & 4th irrigations** |
| Untreated | - | 7 | 7 |
| 1% 2,4-D | 14 | 26 | 18 |

So, the theory of using moisture stress to ameliorate 2,4-D damage appears to be sound, but in practice it's like cutting off your arm to save your hand. It just doesn't work!

The option of not irrigating a 2,4-D damaged crop for a few weeks mid-season to see how bad the damage is, is a poor option. The decision to persist with or to terminate a crop should be made as soon as possible after damage is observed and the crop given every opportunity to compensate, if this is the decision.

For more information on herbicide damage and crop response, see the Cotton CRC website at:

www.cottoncrc.org.au/content/Industry/Tools/Herbicide_Damage_Identification.aspx

This project was funded by Industry & Investment NSW, the CRDC and the Cotton CRC. Thanks go to my support staff involved in this work and to Rose Brodrick for her helpful comments.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **9 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **10th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** I
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 18 days after crop emergence.

No symptoms of clopyralid damage were apparent on the seedlings at any stage.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha and incorporated prior to planting cotton. Photo taken on 21st Nov, 35 days after crop emergence.

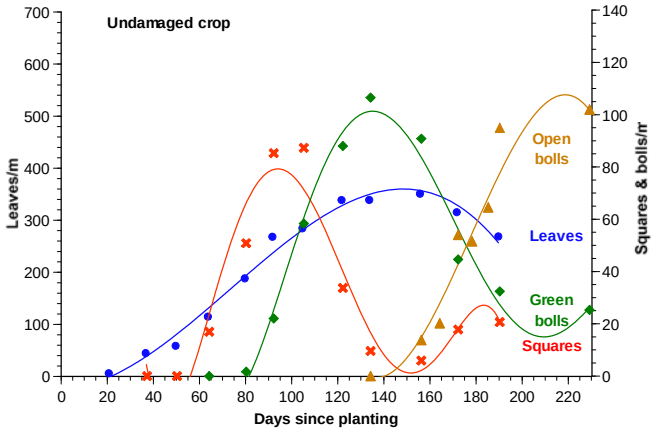
No symptoms of clopyralid damage were apparent at any stage.

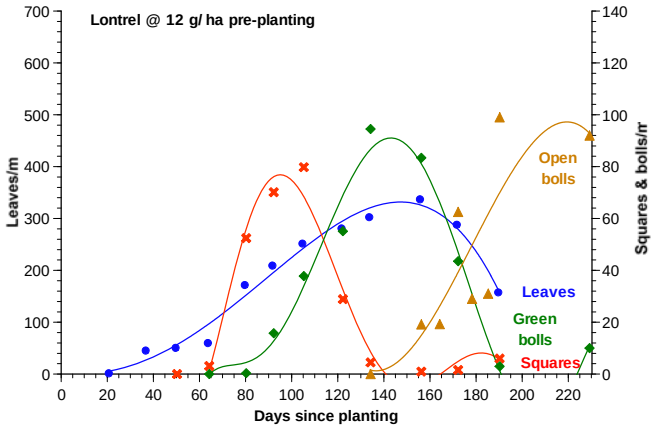
Lontrel ® (clopyralid) applied broadcast at 12 ml/ha and incorporated prior to planting cotton. Photo taken on 16th Dec, 60 days after crop emergence.

No symptoms of clopyralid damage were apparent at any stage.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha and incorporated prior to planting cotton. Photo taken on 17th Jan, 92 days after crop emergence.

No symptoms of clopyralid damage were apparent at any stage.




## Impact on plant growth

**Plants**: exposure to the lighter rate of residual clopyralid had no observable affect on crop growth or development, with no damage symptoms apparent at any stage.

**Leaves:** the herbicide caused no obvious damage, but plants shed leaves late in the season and were 21% smaller by weight and had 42% fewer leaves and 41% less leaf area at defoliation.

**Squares**: the herbicide had no impact on square production although plants had fewer late-season squares.

**Bolls:** there was no apparent affect on boll production or the pattern of boll retention during the main part of the season, but plants retained 20% fewer bolls and 10% fewer open bolls at picking. There was no delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was an 11% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | clopyralid 10% pre-plant |
|---|---|---|
| **Nodes/plant** | 24.9 | 24.9 |
| **Leaves/m*** | 268 | 156 |
| **Leaf area (cm²/m)*** | 6144 | 3621 |
| **Reduction in leaf area*** | | 41% |
| **Bolls/m** | 127 | 102 |
| **Boll weight (g/open boll)** | 5.6 | 6.1 |
| **Retention posit's 1-3^** | 91% | 94% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 16 |
| **Days to 50% open bolls** | 179 | 180 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 80% | 90% |
| **Lint yield (kg/ha)** | 2079 | 1844 |


**Summary**

Exposure to 10% of a typical field rate of residual clopyralid caused no observable damage symptoms at any stage.

Nevertheless, plants were smaller and had fewer leaves and less leaf area at defoliation, and retained fewer green and mature bolls at picking. There was no delay in crop maturity, or reduction in ginning turnout or fibre quality but lint yield was reduced by 11%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **45 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **10th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Nov, 18 days after crop emergence.

No symptoms of clopyralid damage were apparent on the seedlings at this stage other than reddening of the stems and petioles.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha and incorporated prior to planting cotton. Photo taken on 21st Nov, 35 days after crop emergence.

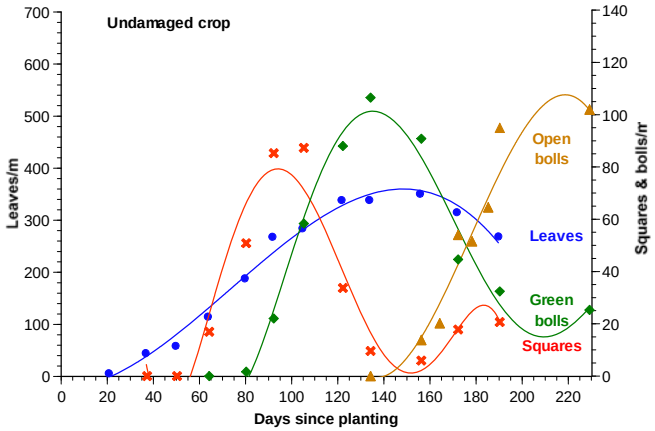
No symptoms of clopyralid damage were apparent on most seedlings 35 days after emergence. However, the newly emerged leaves of some seedlings were crinkled and leathery, with symptoms typical of the synthetic auxin herbicides.

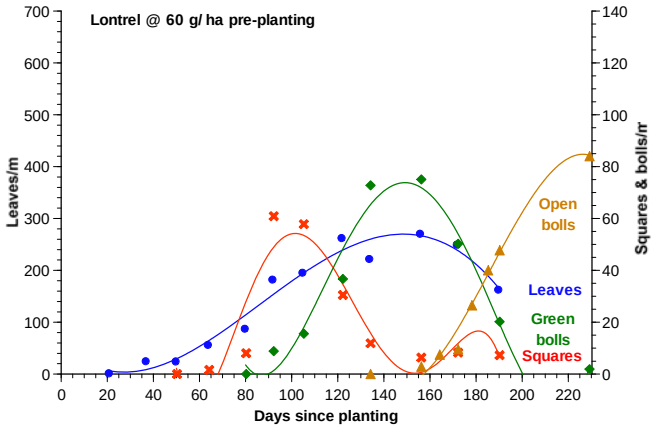
Lontrel ® (clopyralid) applied broadcast at 60 ml/ha and incorporated prior to planting cotton. Photo taken on 16th Dec, 60 days after crop emergence.

Most plants were growing normally 60 days after emergence, but symptoms of clopyralid damage were still apparent on some seedlings. These symptoms included stunting and crinkled and leathery leaves.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha and incorporated prior to planting cotton. Photo taken on 17th Jan, 92 days after crop emergence.

No symptoms of clopyralid damage remained 90 days after emergence other than a reduction in plant size and delay in growth and development.




## Impact on plant growth

**Plants**: exposure to the heavier rate of residual clopyralid caused strong reddening of the stems and petioles and leaf distortion on some plants. There was an 18% reduction in the plant stand, 17% increase in tipped-out plants, a 6.6 cm and 2.8 node reduction in plant height and 44% reduction in plant weight.

**Leaves:** the herbicide caused no obvious damage to most plants, but leaf distortion was apparent on some plants. Plants had 40% fewer leaves and 35% less leaf area at defoliation.

**Squares**: there was a 15 day delay in the start of square production and a 30% reduction in peak squaring.

**Bolls:** there was a 10 day delay in initial boll retention, with peak boll retention reduced by 29% and delayed by 10 days and the first open bolls by 20 days. Plants retained 33% fewer bolls at picking and there was an 8 day delay in crop maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure, but there was a 25% reduction in lint yield.

**Final plant count data**

| | undamaged comparison | clopyralid 50% pre-plant |
|---|---|---|
| **Nodes/plant** | 24.9 | 22.2 |
| **Leaves/m*** | 268 | 161 |
| **Leaf area (cm²/m)*** | 6144 | 3999 |
| **Reduction in leaf area*** | | 35% |
| **Bolls/m** | 127 | 86 |
| **Boll weight (g/open boll)** | 5.6 | 5.1 |
| **Retention posit's 1-3^** | 91% | 89% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 17 |
| **Days to 50% open bolls** | 179 | 187 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 80% | 98% |
| **Lint yield (kg/ha)** | 2079 | 1554 |

## Summary

Exposure to 50% of a typical field rate of residual clopyralid caused relatively little observable damage to the crop with initial reddening, stunting and some distorted leaves.

Nevertheless, there was a reduction in the plant stand and increased tipping-out. Plants had fewer leaves and less leaf area late in the season and retained fewer green and mature bolls at picking. There was no reduction in ginning turnout or fibre quality but lint yield was reduced by 25%.

**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **9 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **20th Nov (5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** I
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 5 node cotton. Photo taken on 5th Dec, 15 days after exposure.

No symptoms of clopyralid damage were apparent on the seedlings at any stage other than some reddening of the stems and petioles.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 5 node cotton. Photo taken on 16th Dec, 26 days after exposure.

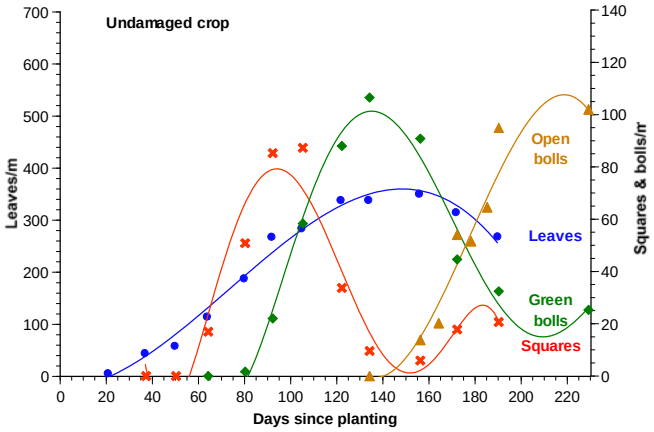
No symptoms of clopyralid damage remained 26 days after exposure.

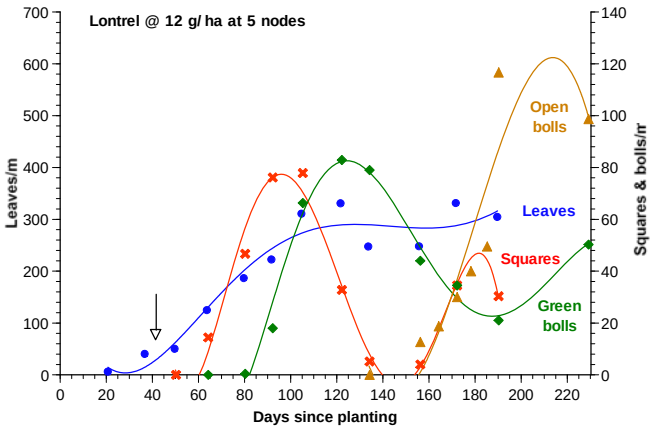
Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 5 node cotton. Photo taken on 29th Dec, 39 days after exposure.

No symptoms of clopyralid damage remained 39 days after exposure. The leaf damage apparent on some leaves in this photo was inadvertently caused by a 2nd herbicide.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 5 node cotton. Photo taken on 17th Jan, 58 days after exposure.

No symptoms of clopyralid damage remained 58 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of clopyralid at 5 nodes initially caused reddening of the stems and petioles but no other obvious damage. There were no effects on plant size.

**Leaves:** the herbicide caused no obvious leaf damage, but there was a reduction in mid-season leaf production, with plants producing more late-season leaves. Plants were 29% heavier and had 13% more leaves and 33% more leaf area at defoliation.

**Squares**: there was no apparent effect on square production.

**Bolls:** there were no apparent effects on initial boll production or retention, but plants retained 22% fewer bolls at peak boll production and produced additional late-season green bolls. There was a 5 day delay in average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

| Final count data | | |
|---|---|---|
| | **undamaged comparison** | **clopyralid 10% @ 5 nodes** |
| **Nodes/plant** | 24.9 | 25.5 |
| **Leaves/m*** | 268 | 303 |
| **Leaf area (cm²/m)*** | 6144 | 8202 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 138 |
| **Boll weight (g/open boll)** | 5.6 | 5.4 |
| **Retention posit's 1-3^** | 91% | 89% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 17 |
| **Days to 50% open bolls** | 179 | 184 |
| **Maturity delay (days)** | | 5 |
| **% Open bolls at picking** | 80% | 72% |
| **Lint yield (kg/ha)** | 2079 | 1986 |


## Summary

Exposure to 10% of a typical field rate of clopyralid at 5 nodes caused reddening of the stems and petioles. There were no major impacts on plant growth and development although plants were smaller mid-season, producing more late-season growth. There were no effects on square production, but plants retained fewer mid-season bolls and retained additional late-season green bolls, causing a 5 days delay in average boll maturity. There was no reduction in ginning turnout, fibre quality or lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **45 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **20th Nov (5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** I
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel® (clopyralid) applied broadcast at 60 ml/ha to 5 node cotton. Photo taken on 5th Dec, 15 days after exposure.

No symptoms of clopyralid damage were apparent on the seedlings at this stage other than reddening of the stems and petioles.

Lontrel® (clopyralid) applied broadcast at 60 ml/ha to 5 node cotton. Photo taken on 16th Dec, 26 days after exposure.

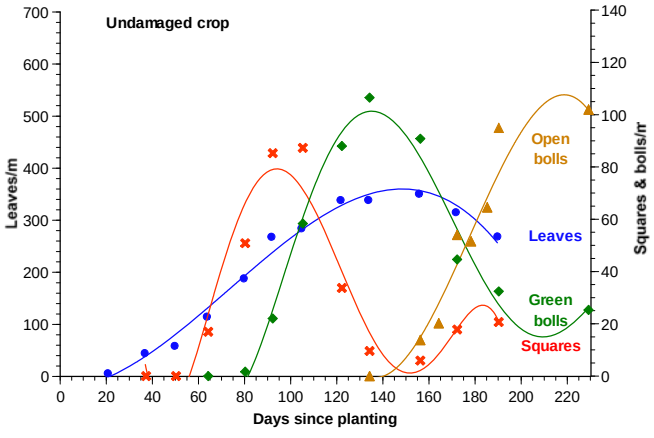
No symptoms of clopyralid damage were apparent 26 days after exposure.

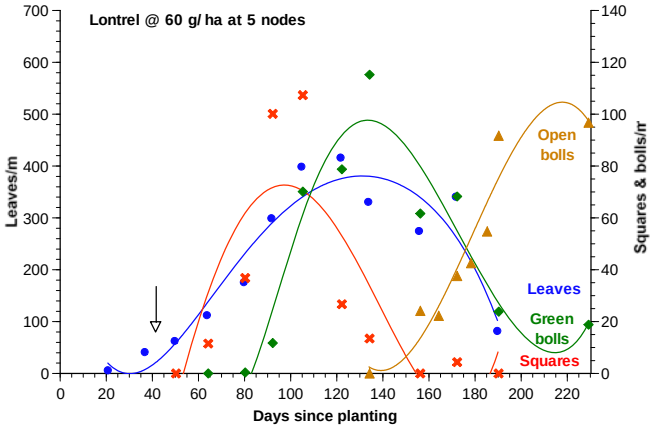
Lontrel® (clopyralid) applied broadcast at 60 ml/ha to 5 node cotton. Photo taken on 29th Dec, 39 days after exposure.

No symptoms of clopyralid damage were apparent 39 days after exposure. The leaf damage apparent on some leaves in this photo was inadvertently caused by a 2nd herbicide.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 5 node cotton. Photo taken on 17th Jan, 58 days after exposure.

No symptoms of clopyralid damage remained 58 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of clopyralid at 5 nodes initially caused reddening of the stems and petioles but no other obvious damage. There were no effects on plant size although plants shed a lot of leaves late in the season.

**Leaves:** the herbicide caused no obvious leaf damage, but plants shed a lot of leaves late in the season, retaining 70& fewer leave and 55% less leaf area at defoliation.

**Squares**: there was no apparent effect on square production through the main part of the season, but plants produced few late-season squares.

**Bolls:** there were no apparent effects on boll production or retention or on average boll maturity.

**Lint**: ginning turnout, fibre quality and lint yield were unaffected by the herbicide exposure.

**Final count data**

| | undamaged comparison | clopyralid 50% @ 5 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 25.9 |
| **Leaves/m*** | 268 | 81 |
| **Leaf area (cm²/m)*** | 6144 | 2781 |
| **Reduction in leaf area*** | | 55% |
| **Bolls/m** | 127 | 116 |
| **Boll weight (g/open boll)** | 5.6 | 5.9 |
| **Retention posit's 1-3^** | 91% | 90% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 18 |
| **Days to 50% open bolls** | 179 | 181 |
| **Maturity delay (days)** | | 2 |
| **% Open bolls at picking** | 80% | 84% |
| **Lint yield (kg/ha)** | 2079 | 1977 |


## Summary

Exposure to 50% of a typical field rate of clopyralid at 5 nodes caused initial reddening of the stems and petioles, but caused no other damage to the plants.

There were no observable impacts on plant growth and development. There were no major effects on square and bolls production and retention, no delay in average boll maturity, no reduction in ginning turnout or fibre quality and no reduction in lint yield.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **9 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **15th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** I
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 12 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Strong symptoms of clopyralid damage were apparent 14 days after exposure on some of the upper leaves with reddening and blistering of the leaf margins.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 12 node cotton. Photo taken on 4th Jan, 20 days after exposure.

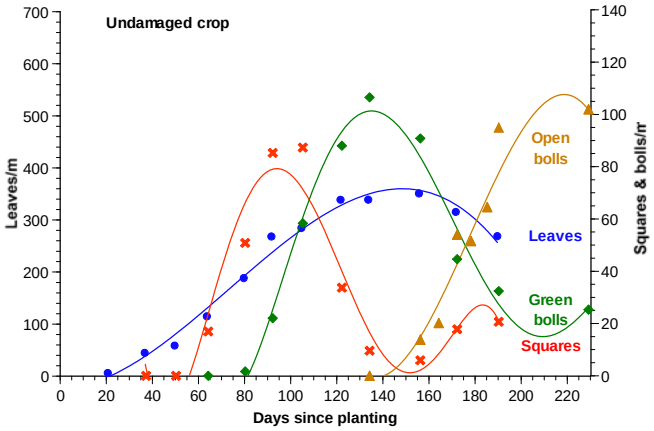
Most of the symptoms of clopyralid damage had faded 20 days after exposure, with some reddening still apparent on the margins of a few upper leaves.

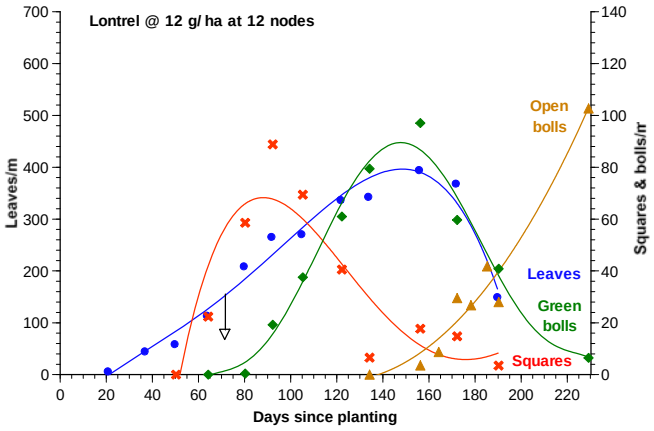
Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 12 node cotton. Photo taken on 17th Jan, 33 days after exposure.

No symptoms of clopyralid damage remained 33 days after exposure.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 12 node cotton. Photo taken on 9th Feb, 56 days after exposure.

No symptoms of clopyralid damage remained 56 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of clopyralid at 12 nodes initially caused strong reddening of the margins of some upper leaves. Plants compensated for the damage, but there was a delay in growth and development and increased inter-node lengths, with the plants 3 nodes and15 cm taller but 31% lighter at defoliation.

**Leaves:** the herbicide caused strong reddening of the margins of some upper leaves and early senescence. Plants had 45% fewer leaves and 36% less leaf area at defoliation.

**Squares**: there was no immediate effect on square production, but plants produced fewer late-season squares.

**Bolls:** there was a 20 day delay in peak boll production and bolls were slow to open, delaying average boll maturity by 23 day. Plants retained few immature bolls at picking, increasing average boll weight.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure but lint yield was down by 15%.

| Final count data | | |
|---|---|---|
| | **undamaged comparison** | **clopyralid 10% @ 12 nodes** |
| **Nodes/plant** | 24.9 | 27.8 |
| **Leaves/m*** | 268 | 148 |
| **Leaf area (cm²/m)*** | 6144 | 3939 |
| **Reduction in leaf area*** | | 36% |
| **Bolls/m** | 127 | 109 |
| **Boll weight (g/open boll)** | 5.6 | 6.0 |
| **Retention posit's 1-3^** | 91% | 87% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 - 17 |
| **Days to 50% open bolls** | 179 | 202 |
| **Maturity delay (days)** | | 23 |
| **% Open bolls at picking** | 80% | 94% |
| **Lint yield (kg/ha)** | 2079 | 1762 |


## Summary

Exposure to 10% of a typical field rate of clopyralid at 12 nodes caused reddening and blistering of the leaf margins of the upper leaves.

This damage triggered increased vegetative growth and there were a delay in crop development, delaying peak boll production and average boll maturity. Bolls were slow to open but plants retained few immature bolls at picking. Ginning turnout and fibre quality were unaffected, but lint yield was reduced by 15%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **45 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **15th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** I
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 12 node cotton. Photo taken on 29th Dec, 14 days after exposure.

Symptoms of clopyralid damage were apparent 14 days after exposure on the upper leaves with yellowing and reddening and reddening of the petioles.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 12 node cotton. Photo taken on 4th Jan, 20 days after exposure.

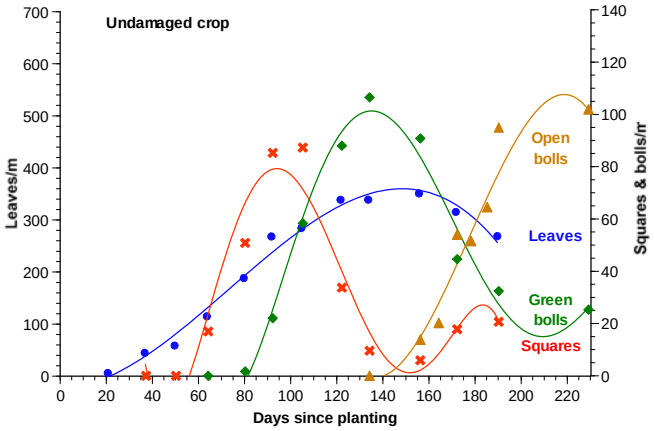
Most of the symptoms of clopyralid damage had faded 20 days after exposure, with yellowing still apparent on some upper leaves.

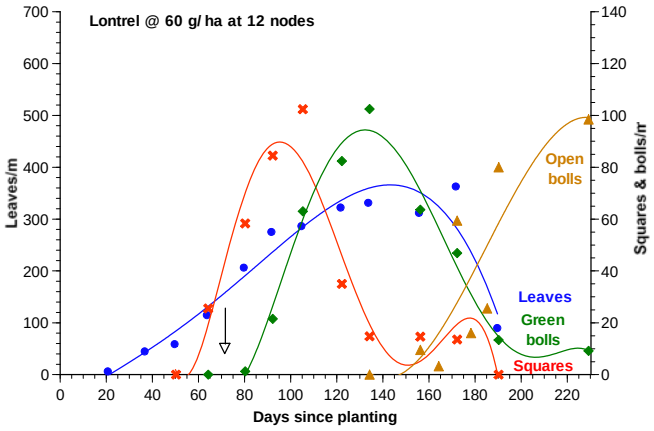
Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 12 node cotton. Photo taken on 17th Jan, 33 days after exposure.

No symptoms of clopyralid damage remained 33 days after exposure.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 12 node cotton. Photo taken on 9th Feb, 56 days after exposure.

No symptoms of clopyralid damage remained 56 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of clopyralid at 12 nodes initially caused yellowing and reddening of the upper leaves and reddening of the petioles. Plants had increased inter-node lengths, with 16 cm taller but 15% lighter at defoliation.

**Leaves:** the herbicide caused yellowing and reddening of the upper leaves and early senescence. Plants had 67% fewer leaves and 62% less leaf area at defoliation.

**Squares**: there was no immediate effect on square production, but plants produced fewer late-season squares.

**Bolls:** plants shed bolls from the first 3 fruiting positions, delaying average boll maturity by 8 day. Plants retained few immature bolls at picking.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure but lint yield was down by 24%.

**Final count data**

| | undamaged comparison | clopyralid 50% @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 26.2 |
| **Leaves/m*** | 268 | 88 |
| **Leaf area (cm²/m)*** | 6144 | 2337 |
| **Reduction in leaf area*** | | 62% |
| **Bolls/m** | 127 | 108 |
| **Boll weight (g/open boll)** | 5.6 | 5.7 |
| **Retention posit's 1-3^** | 91% | 82% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 - 17 |
| **Days to 50% open bolls** | 179 | 187 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 80% | 91% |
| **Lint yield (kg/ha)** | 2079 | 1573 |


## Summary

Exposure to 50% of a typical field rate of clopyralid at 12 nodes caused yellowing and reddening of the upper leaves and reddening of the petioles.
This damage triggered increased vegetative growth and there were a delay in crop development, delaying peak boll production and average boll maturity. Bolls were slow to open but plants retained fewer immature bolls at picking. Ginning turnout and fibre quality were unaffected, but lint yield was reduced by 24%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **9 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **3rd Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** I
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 15 node cotton. Photo taken on 12th Jan, 9 days after exposure.

Very mild symptoms of clopyralid damage were apparent 9 days after exposure with yellowing of some of the upper leaves.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 15 node cotton. Photo taken on 17th Jan, 14 days after exposure.

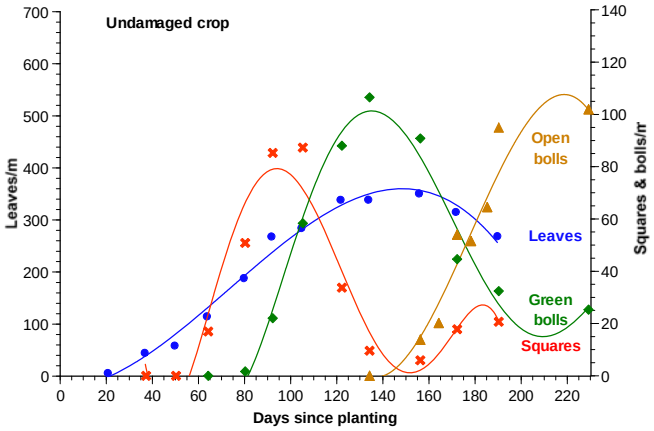
Very mild symptoms of clopyralid damage were apparent 14 days after exposure with yellowing of some of the upper leaves.

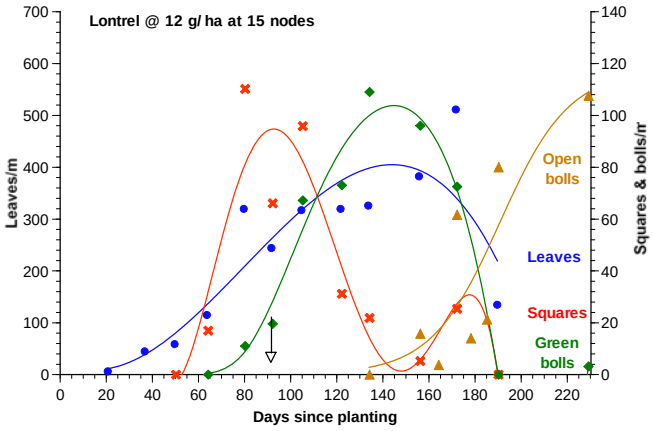
Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 15 node cotton. Photo taken on 9th Feb, 37 days after exposure.

No symptoms of clopyralid damage remained 37 days after exposure. The damage apparent on leaves in this photo was inadvertently caused by a 2nd herbicide.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 15 node cotton. Photo taken on 5th Mar, 62 days after exposure.

No symptoms of clopyralid damage remained 62 days after exposure.




## Impact on plant growth

**Plants**: exposure to the lighter rate of clopyralid at 15 nodes initially caused very mild yellowing on some upper leaves. This seemed to cause only minor plant damage other than an increase in internode lengths, early leaf senescence and shedding of immature bolls during defoliation.

**Leaves:** the herbicide caused very mild yellowing on some upper leaves and early senescence. Plants had 50% fewer leaves and 57% less leaf area at defoliation.

**Squares**: there were no obvious changes in square production.

**Bolls:** retention was largely unaffected by the herbicide exposure, although few green bolls were retained during defoliation. The pattern of boll retention was unchanged but there were 13% fewer bolls retained at picking and a 10 day delay in average boll maturity.

**Lint**: ginning turnout was down by 2.2%, but fibre quality and lint yield were unaffected by the herbicide exposure.

**Final count data**

| | undamaged comparison | clopyralid 10% @ 15 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 24.2 |
| **Leaves/m*** | 268 | 133 |
| **Leaf area (cm²/m)*** | 6144 | 2661 |
| **Reduction in leaf area*** | | 57% |
| **Bolls/m** | 127 | 111 |
| **Boll weight (g/open boll)** | 5.6 | 5.3 |
| **Retention posit's 1-3^** | 91% | 93% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 18 |
| **Days to 50% open bolls** | 179 | 189 |
| **Maturity delay (days)** | | 10 |
| **% Open bolls at picking** | 80% | 97% |
| **Lint yield (kg/ha)** | 2079 | 2031 |


## Summary

Exposure to 10% of a typical field rate of clopyralid at 15 nodes caused very mild yellowing on some upper leaves.

This damage had little impact on the plant other than increased internode lengths and to lead to premature leaf senescence and the loss of some late immature bolls. Plants retained fewer bolls at picking and average boll maturity was delayed. Ginning turnout was reduced, but fibre quality and lint yield were unaffected.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **45 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **3rd Jan (11 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **X** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 15 node cotton. Photo taken on 12th Jan, 9 days after exposure.

Very mild symptoms of clopyralid damage were apparent 9 days after exposure with yellowing of some of the upper leaves.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 15 node cotton. Photo taken on 17th Jan, 14 days after exposure.

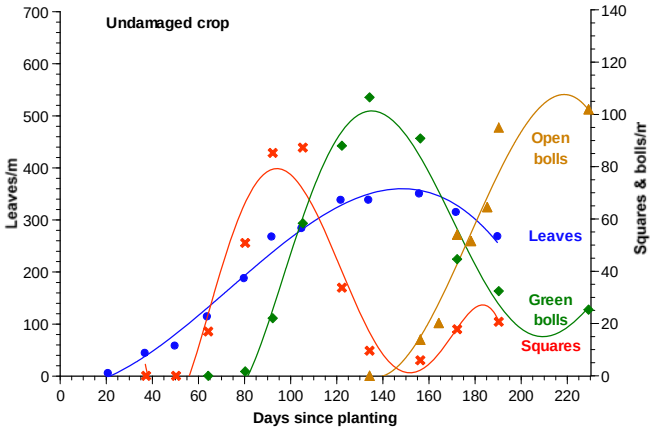
Stronger symptoms of clopyralid damage were apparent 14 days after exposure on a few upper leaves with yellowing and blistering of the leaf margins. Very mild symptoms were apparent on other upper leaves with general yellowing.

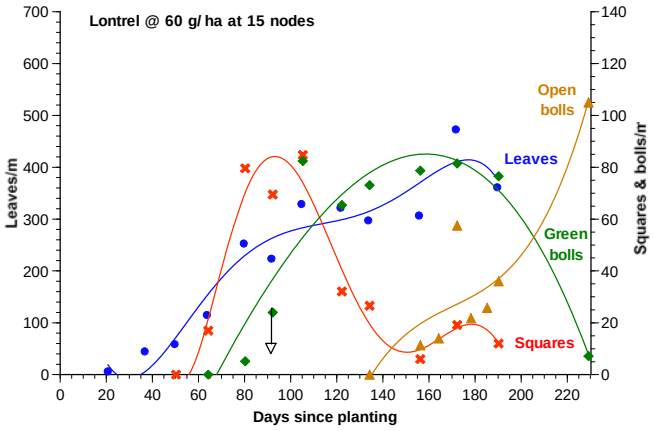
Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 15 node cotton. Photo taken on 9th Feb, 37 days after exposure.

No symptoms of clopyralid damage remained 37 days after exposure. The damage apparent on leaves in this photo was inadvertently caused by a 2nd herbicide.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 15 node cotton. Photo taken on 5th Mar, 62 days after exposure.

No symptoms of clopyralid damage remained 62 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of clopyralid at 15 nodes initially caused very mild yellowing on some upper leaves followed by blistering of some leaf margins. Plants lost some leaves and green bolls, delaying crop growth and development.

**Leaves:** the herbicide caused mild yellowing on some upper leaves and delaying crop development. Plants put on a flush of late growth and had 35% more leaves and 78% more leaf area at defoliation, with average leaf size up by 32%.

**Squares**: there were no obvious changes in square production.

**Bolls:** some early bolls were shed, with additional bolls retained at the top of the plant. Peak boll production was delayed by 35 days and bolls were slow to open. There was a 23 day delay in average boll maturity.

**Lint**: ginning turnout was down by 2.7%, but fibre quality was unaffected by the herbicide exposure. Lint yield was reduced by 35%.

| Final count data | | |
|---|---|---|
| | **undamaged comparison** | **clopyralid 50% @ 15 nodes** |
| **Nodes/plant** | 24.9 | 26.3 |
| **Leaves/m*** | 268 | 360 |
| **Leaf area (cm²/m)*** | 6144 | 10953 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 127 | 112 |
| **Boll weight (g/open boll)** | 5.6 | 6.0 |
| **Retention posit's 1-3^** | 91% | 90% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 7 - 18 |
| **Days to 50% open bolls** | 179 | 202 |
| **Maturity delay (days)** | | 23 |
| **% Open bolls at picking** | 80% | 94% |
| **Lint yield (kg/ha)** | 2079 | 1358 |


## Summary

Exposure to 50% of a typical field rate of clopyralid at 15 nodes caused mild yellowing and blistering on some upper leaves.

Plants lost some leaves and green bolls, delaying crop growth and development. Peak boll production was delayed and additional bolls were retained at the top of the plant. Bolls were slow to open, with a delay in average boll maturity. Fibre quality was unaffected but ginning turnout was reduced and lint yield was down by 35%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **9 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **18th Jan** |
| | **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **18 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 18 node cotton. Photo taken on 9th Feb, 22 days after exposure.

No symptoms of clopyralid damage were apparent at any stage.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 18 node cotton. Photo taken on 15th Feb, 28 days after exposure.

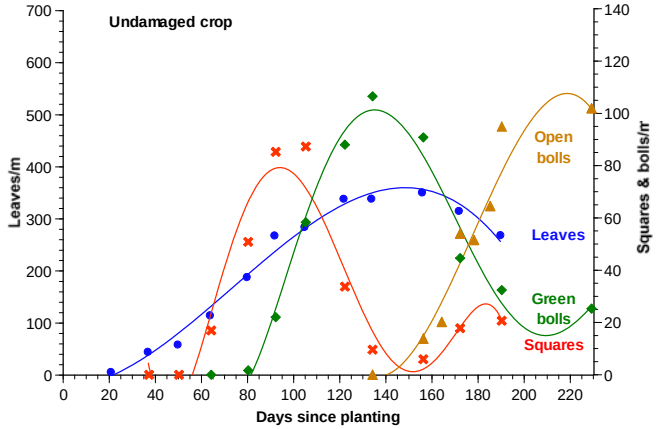
No symptoms of clopyralid damage were apparent at any stage.

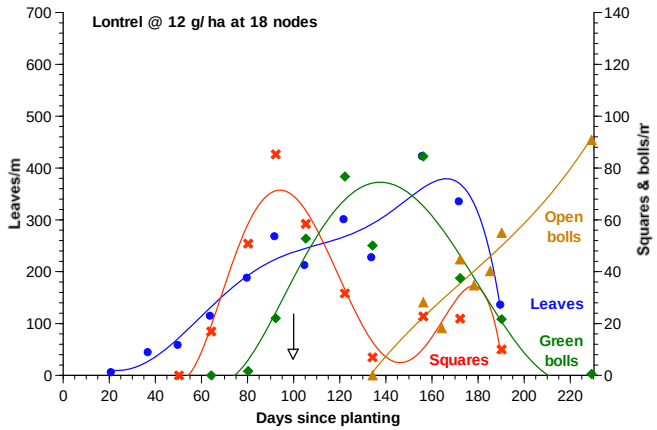
Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 18 node cotton. Photo taken on 22nd Feb, 35 days after exposure.

No symptoms of clopyralid damage were apparent at any stage.

Lontrel ® (clopyralid) applied broadcast at 12 ml/ha to 18 node cotton. Photo taken on 14th Mar, 56 days after exposure.

No symptoms of clopyralid damage were apparent at any stage.




## Impact on plant growth

**Plants**: exposure to the lighter rate of clopyralid at 18 nodes caused no obvious damage symptoms, but growth and development were affected.

**Leaves:** the herbicide caused no obvious damage symptoms, but leaf development slowed after exposure and plants prematurely senesced. Plants had 50% fewer leaves and 62% less leaf area at defoliation, with average leaf size down by 24%.

**Squares**: there were no obvious changes in square production.

**Bolls:** peak green boll retention was delayed by 20 days and down by 21% following the herbicide exposure, with few green bolls present at picking. The pattern of boll retention was unchanged but bolls were slow to mature and there were 28% fewer bolls retained at picking, with a 5 day delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure but lint yield was down by 24%.

**Final count data**

| | undamaged comparison | clopyralid 10% @ 18 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 24.3 |
| **Leaves/m*** | 268 | 135 |
| **Leaf area (cm²/m)*** | 6144 | 2348 |
| **Reduction in leaf area*** | | 62% |
| **Bolls/m** | 127 | 91 |
| **Boll weight (g/open boll)** | 5.6 | 6.1 |
| **Retention posit's 1-3^** | 91% | 98% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 6 - 15 |
| **Days to 50% open bolls** | 179 | 184 |
| **Maturity delay (days)** | | 5 |
| **% Open bolls at picking** | 80% | 99% |
| **Lint yield (kg/ha)** | 2079 | 1584 |


## Summary

Exposure to 10% of a typical field rate of clopyralid at 18 nodes caused no obvious damage symptoms, but crop growth and development were delayed and plants senesced prematurely.

Peak green boll retention was delayed and reduced. The pattern of boll retention was unchanged but bolls were slow to mature and there were fewer bolls at picking, with a delay in average boll maturity. Ginning turnout and fibre quality were unaffected, but lint yield was reduced by 24%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **clopyralid** |
| **Rate:** | **45 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **18th Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **18 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** I
**Translocation:** rapidly absorbed and translocated by roots and leaves
**Mode of action:** a synthetic auxin that affects plant growth, nitrogen metabolism and enzyme production. Low concentrations cause uncontrolled cell growth
**Residual activity:** moderate residual activity. Plant-back to cotton of 3 - 6 months
**Soil half-life:** 12 – 70 days

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 18 node cotton. Photo taken on 9th Feb, 22 days after exposure.

Symptoms of clopyralid damage were apparent 22 days after exposure on some upper leaves with yellowing and reddening and blistering of the leaf margins. Very mild symptoms were apparent on other upper leaves with general yellowing.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 18 node cotton. Photo taken on 15th Feb, 28 days after exposure.

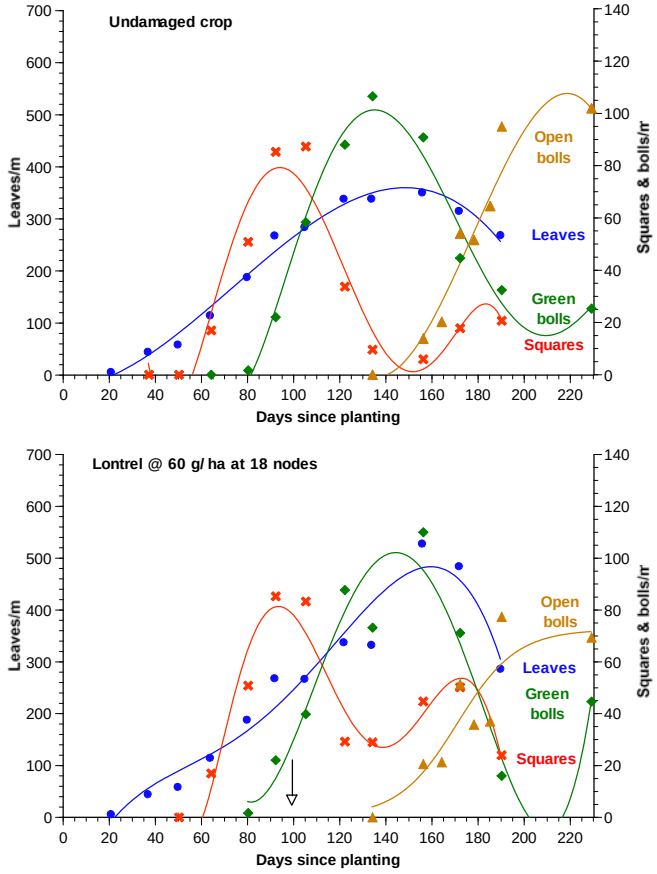
Very mild symptoms of clopyralid damage remained 28 days after exposure with general yellowing on some upper leaves.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 18 node cotton. Photo taken on 22nd Feb, 35 days after exposure.

No symptoms of clopyralid damage were apparent 35 days after exposure.

Lontrel ® (clopyralid) applied broadcast at 60 ml/ha to 18 node cotton. Photo taken on 14th Mar, 56 days after exposure.

No symptoms of clopyralid damage were apparent 56 days after exposure.




## Impact on plant growth

**Plants**: exposure to the heavier rate of clopyralid at 18 nodes caused yellowing and reddening on some upper leaves with blistering of some leaf margins. The damage triggered a late flush of vegetative growth and plants were 16 cm and 5 nodes taller but 30% lighter at defoliation.

**Leaves:** Plants produced a flush of late growth but senesced prematurely and had 15% less leaf area at defoliation, with average leaf size down by 21%.

**Squares**: plants produced a flush of late squares.

**Bolls:** peak green boll retention was delayed by 20 days and plants produced a flush of late green bolls that did not contribute towards yield. The pattern of boll retention was unchanged but bolls were slow to mature and there were 32% fewer open bolls retained at picking, with a 9 day delay in average boll maturity.

**Lint**: ginning turnout and fibre quality were unaffected by the herbicide exposure but lint yield was down by 48%.

**Final count data**

| | undamaged comparison | clopyralid 50% @ 18 nodes |
|---|---|---|
| **Nodes/plant** | 24.9 | 29.9 |
| **Leaves/m*** | 268 | 285 |
| **Leaf area (cm²/m)*** | 6144 | 5203 |
| **Reduction in leaf area*** | | 15% |
| **Bolls/m** | 127 | 114 |
| **Boll weight (g/open boll)** | 5.6 | 5.3 |
| **Retention posit's 1-3^** | 91% | 90% |
| **Nodes carrying >80% bolls#** | 6 – 16 | 8 - 18 |
| **Days to 50% open bolls** | 179 | 188 |
| **Maturity delay (days)** | | 9 |
| **% Open bolls at picking** | 80% | 61% |
| **Lint yield (kg/ha)** | 2079 | 1074 |


## Summary

Exposure to 50% of a typical field rate of clopyralid at 18 nodes caused yellowing and reddening on some upper leaves with blistering of some leaf margins. The damage triggered a late flush of vegetative growth, squares and green bolls.

The pattern of boll retention was unchanged but bolls were slow to mature and there were fewer open bolls at picking, with a delay in average boll maturity. Ginning turnout and fibre quality were unaffected, but lint yield was reduced by 48%.


**Note*** These parameters were recorded at defoliation, the remainder at picking.
**Note^** Percentage of bolls retained in fruiting positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** dicamba
**Rate:** 28 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 12th Nov (6 weeks post-emergence)
**Growth stage at exposure:** 6 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** I
**Translocation:** readily absorbed by leaves
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited
**Soil half-life:** 4 – 14 days

Kamba 500 applied broadcast at 56 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

There were no initial symptoms of dicamba damage apparent 3 days after exposure.

Kamba 500 applied broadcast at 56 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

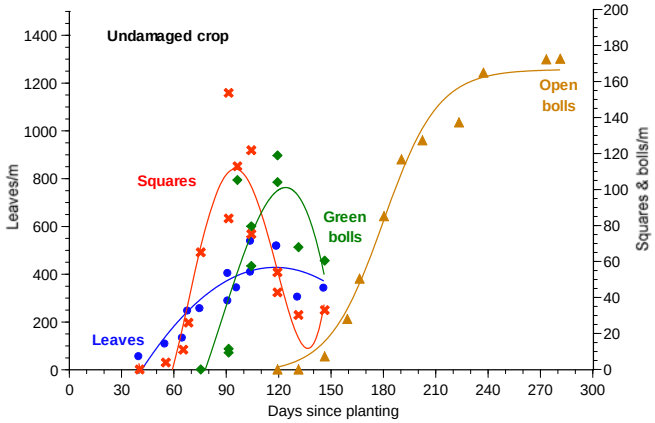
By 10 days, plants were showing some cupping of the new leaves and reddening of the leaf margins.

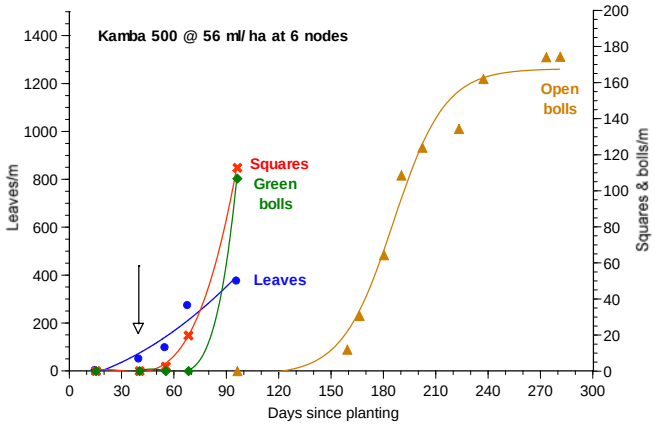
Kamba 500 applied broadcast at 56 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

Plants had resumed growth 29 days after exposure, but the new growth was showing symptoms typical of Group I damage. The symptoms ranged from almost normal leaves with a leathery appearance and heavy venation, to cupped leaves and more typical "wedge" shaped leaves ending in multiple "fingers".

Kamba 500 applied broadcast at 56 ml/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Most leaves appeared to be normal by this stage. A few distorted leaves with crinkled edges were still apparent.




## Impact on plant growth

**Plants:** exposed to a 10% rate of dicamba at 6 nodes showed mild initial symptoms of herbicide damage. Plants were 51 cm and 2.2 nodes taller at picking.

**Leaves:** leaves that emerged following the herbicide exposure were distorted with symptoms typical of Group I damage. There was no reduction in leaf number or leaf area mid-season.

**Squares**: dicamba damage delayed square production by around 10 days, but did not affect peak squaring.

**Bolls:** boll production and retention were largely unaffected by the herbicide, although 16% fewer bolls were retained on positions 1 – 3, with more bolls retained on the lateral branches. There was a 9 day delay in the average boll maturity, with 7% fewer bolls open at picking.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.2) and lint yield was reduced by 25%.

**Final plant count data**

| | undamaged | dicamba |
|---|---|---|
| **Nodes/plant** | 27.8 | 30.0 |
| **Leaves/m*** | 342 | 374 |
| **Leaf area (cm²/m)*** | 17713 | 17303 |
| **Reduction in leaf area*** | | 2% |
| **Bolls/m** | 200 | 219 |
| **Boll weight (g/open boll)** | 4.2 | 4.1 |
| **Retention in posit's 1-3^** | 88% | 74% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 21 |
| **Days to 50% open** | 187 | 196 |
| **Maturity delay (days)** | | 9 |
| **% Open bolls at picking** | 86% | 80% |
| **Lint yield/ha** | 2246 | 1676 |

Exposure to 10% of a typical rate of dicamba at 6 nodes caused relatively mild symptoms of herbicide damage, with minimal affect on leaf number, leaf area and square production. Inter-node length did increase, with plants 61 cm taller at picking.

The retention of mature bolls was largely unaffected, with more bolls retained on outer positions and on the lateral branches. There was a reduction in fibre maturity, a delay in crop maturity and a 25% reduction in lint yield.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** dicamba
**Rate:** 140 g a.i./ha
**% of typical field rate** 50%
**Date of exposure:** 12th Nov (6 weeks post-emergence)
**Growth stage at exposure:** 6 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** I
**Translocation:** readily absorbed by leaves
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited
**Soil half-life:** 4 – 14 days

Kamba 500 applied broadcast at 280 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

There were few initial symptoms of dicamba damage apparent 3 days after exposure. There was some cupping of new leaves, with reddening around the edges.

Kamba 500 applied broadcast at 280 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

By 10 days, plants were showing elongated petioles on the new leaves. Cupping and reddening of the new leaves was more obvious.

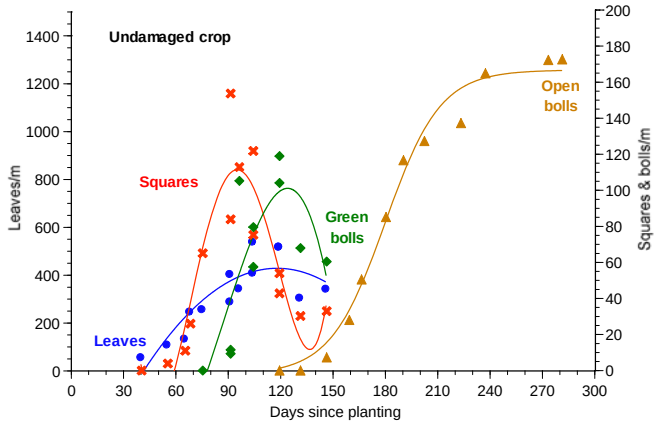
Kamba 500 applied broadcast at 280 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

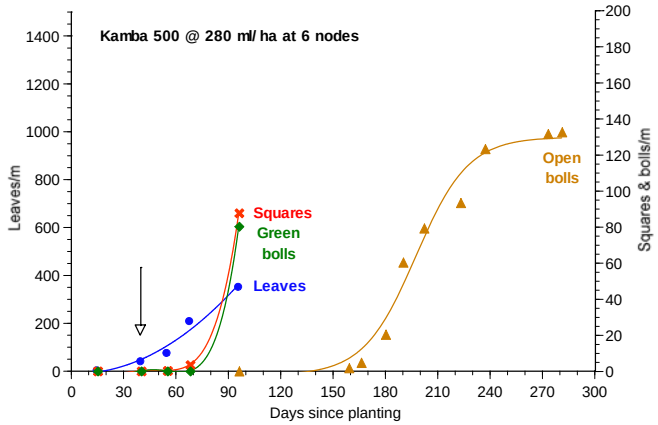
Plants had resumed growth 29 days after exposure, but new growth was showing symptoms typical of Group I damage. Distortion ranges from almost normal leaves with a leathery appearance and heavy venation, to cupped leaves and more typical "wedge" shaped leaves ending in multiple "fingers".

Kamba 500 applied broadcast at 280 ml/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Some distorted leaves with crinkled edges were still apparent 51 days after exposure, although more normal leaves were emerging on newly developing lateral branches.

Most symptoms of damage had disappeared by 25th Jan, 74 days after exposure.




## Impact on plant growth

**Plants:** exposure to a 50% rate of dicamba at 6 nodes caused stunting and damage to new growth. 43% of plants were tipped-out and plants were 16 cm shorter and 25% smaller by weight.

**Leaves:** leaves that emerged following the herbicide exposure were distorted, with symptoms typical of Group I damage. Plants had 10% less leaf area mid-season.

**Squares**: dicamba damage delayed square production by around 15 days.

**Bolls:** the pattern of boll retention was affected, with many bolls retained on the lateral branches. There were 23% fewer bolls at picking, with 37% fewer bolls retained in positions 1 - 3. Few mature bolls were retained above node 18, nine nodes from the top of the plant. There was a 17 day delay in average boll maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.0) and 0.9% more short fibres. Lint yield was reduced by 47%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **dicamba** |
| **Nodes/plant** | 27.8 | 26.9 |
| **Leaves/m*** | 342 | 349 |
| **Leaf area (cm²/m)*** | 17713 | 15871 |
| **Reduction in leaf area*** | | 10% |
| **Bolls/m** | 200 | 154 |
| **Boll weight (g/open boll)** | 4.2 | 4.4 |
| **Retention in posit's 1-3^** | 88% | 55% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 18 |
| **Days to 50% open** | 187 | 204 |
| **Maturity delay (days)** | | 17 |
| **% Open bolls at picking** | 86% | 86% |
| **Lint yield/ha** | 2246 | 1197 |

Exposure to 50% of a typical field rate of dicamba at 6 nodes caused only relatively mild symptoms of herbicide damage, but caused tipping-out and stunting, and had a big impact on boll retention, with reduced boll retention on all nodes and no bolls retained at the top of the plant (top 9 nodes).

The herbicide damage caused a reduction in boll number and fibre quality, a delay in crop maturity and a 47% reduction in lint yield.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** dicamba
**Rate:** 28 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 5th Dec (9 weeks post-emergence)
**Growth stage at exposure:** 11 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** I
**Translocation:** readily absorbed by leaves
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited
**Soil half-life:** 4 – 14 days

Kamba 500 applied broadcast at 56 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

By 6 days, plants were showing some yellowing and cupping of the new leaves, with reddening of the leaf margins.

Kamba 500 applied broadcast at 56 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

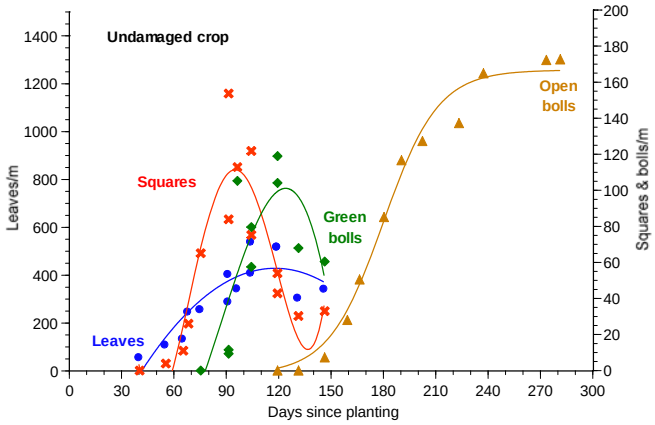
By 16 days, new growth with symptoms typical of Group I damage was obvious. Distortion ranged from almost normal leaves with a leathery appearance and heavy venation, to cupped leaves and more typical "wedge" shaped leaves ending in multiple "fingers".

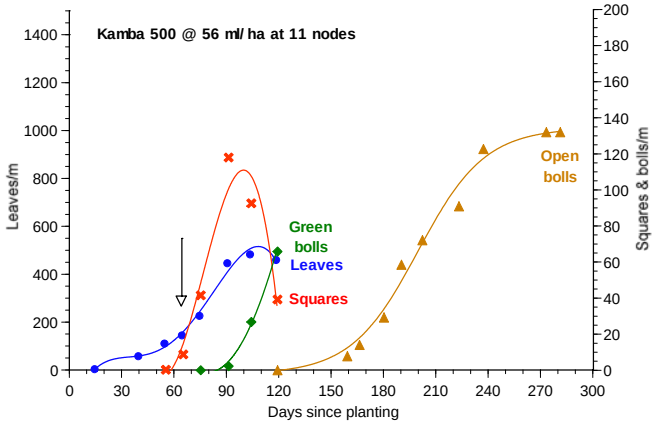
Kamba 500 applied broadcast at 56 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

New growth on these plants was very distorted, with small leaves and long internodes. Distortion ranged from almost normal leaves with a leathery appearance and heavy venation, to cupped leaves and more typical "wedge" shaped leaves ending in multiple "fingers".

Kamba 500 applied broadcast at 56 ml/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Distorted new growth with long internodes continued to top the plant 40 days after exposure.
Most of the damage symptoms disappeared by 50 days after exposure.




## Impact on plant growth

**Plants:** exposure to a 10% rate of dicamba at 11 nodes caused distortion of new leaves. Plants were initially stunted and were 39% small by weight mid-season.

**Leaves:** leaves that emerged following exposure were distorted with symptoms typical of Group I damage. This was a 12% reduction in leaf number and a 23% reduction in leaf area mid-season.

**Squares**: the damage had little effect on square production.

**Bolls:** there was an 11% reduction in retention on positions 1 – 3 and plants only retained mature bolls to node 21, fives nodes fewer than undamaged plants. There were 13% fewer boll at picking and bolls were 20% lighter. There was a 27 days delay in the average boll maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.1) and 13% more short fibres. Lint yield was reduced by 54%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **dicamba** |
| **Nodes/plant** | 27.8 | 27.3 |
| **Leaves/m*** | 342 | 456 |
| **Leaf area (cm²/m)*** | 13541 | 10478 |
| **Reduction in leaf area*** | | 23% |
| **Bolls/m** | 200 | 175 |
| **Boll weight (g/open boll)** | 4.2 | 3.4 |
| **Retention in posit's 1-3^** | 88% | 79% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 5 - 22 |
| **Days to 50% open** | 187 | 214 |
| **Maturity delay (days)** | | 27 |
| **% Open bolls at picking** | 86% | 76% |
| **Lint yield/ha** | 2246 | 1027 |

Exposure to 10% of a typical field rate of dicamba at 11 nodes caused symptoms typical of Group I damage. Plants had fewer leaves and less leaf area mid-season.

Square production was unaffected, but plants shed early bolls, retaining more bolls on the outer fruiting positions. There was a reduction in boll number and boll weight at picking. Crop maturity was delayed and many bolls were still immature at picking, reducing fibre quality. Lint yield was reduced by 54%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** dicamba
**Rate:** 140 g a.i./ha
**% of typical field rate** 50%
**Date of exposure:** 5th Dec (9 weeks post-emergence)
**Growth stage at exposure:** 11 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | x |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide group:** I
**Translocation:** readily absorbed by leaves
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited
**Soil half-life:** 4 – 14 days

Kamba 500 applied broadcast at 280 ml/ha to 11 node cotton. Photo taken on 14th Dec, 9 days after exposure.

The only symptoms of dicamba damage apparent 9 days after exposure were cupping of the new leaves, with reddening around the edges.

Kamba 500 applied broadcast at 280 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

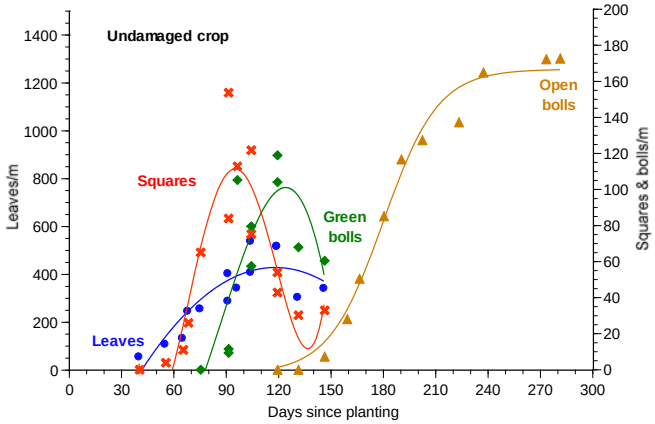
By 16 days, distorted growth was becoming apparent on the new leaves, a symptom typical of Group I damage. Many of the emerging new leaves were "wedge" shaped, ending in multiple "fingers". Cupping and reddening of the newer leaves was still apparent.

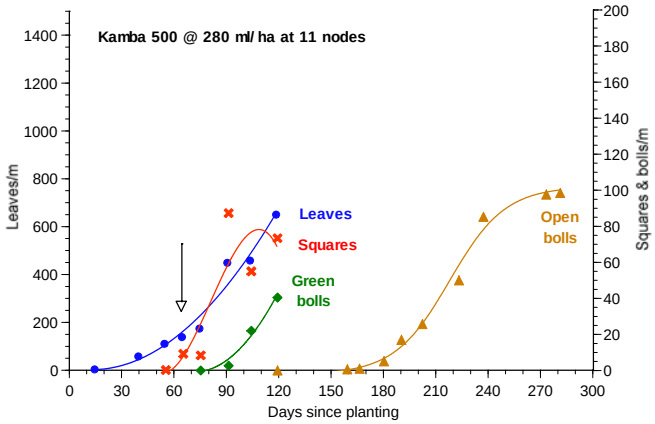
Kamba 500 applied broadcast at 280 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

Plants were beginning to resume normal growth on the laterals, but new growth on the main stem was showing symptoms typical of Group I damage. Distortion ranged from almost normal leaves with a leathery appearance and heavy venation, to cupped leaves and more typical "wedge" shaped leaves ending in multiple "fingers".

Kamba 500 applied broadcast at 280 ml/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Symptoms of damage were disappearing as new 'normal' growth developed. Distorted growth could still be found in the centre of the plant.




## Impact on plant growth

**Plants:** exposure to a 50% rate of dicamba at 11 nodes caused stunting and symptoms typical of Group I damage. Plants remained 17 cm and 7 nodes shorter at picking and were 28% smaller by weight.

**Leaves:** plants compensated for the herbicide damage by producing a mass of vegetative growth, resulting in 25% more leaves and 19% more leaf area mid-season.

**Squares**: the damage delayed peak square production by around 30 days and reduced peak squaring by around 30%.

**Bolls:** the herbicide exposure delayed boll production by around 30 days. Early bolls were shed from the first 3 fruiting positions, with 68% of bolls retained on outer positions. Boll weight was down by 16% and final boll retention by 38%. Boll maturity was delayed by 39 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.0) and lint yield was reduced by 59%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **dicamba** |
| **Nodes/plant** | 27.8 | 20.9 |
| **Leaves/m*** | 342 | 647 |
| **Leaf area (cm²/m)*** | 13541 | 16064 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 200 | 123 |
| **Boll weight (g/open boll)** | 4.2 | 3.6 |
| **Retention in posit's 1-3^** | 88% | 32% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 4 - 20 |
| **Days to 50% open** | 187 | 226 |
| **Maturity delay (days)** | | 39 |
| **% Open bolls at picking** | 86% | 80% |
| **Lint yield/ha** | 2246 | 923 |

Exposure to 50% of a typical field rate of dicamba at 11 nodes caused moderate damage to emerging leaves with symptoms typical of a Group I herbicide. Plants responded to the damage by producing additional leaves and leaf area.

Many early bolls were shed, changing the pattern of boll retention and boll size, with few bolls retained on the main stem. Crop maturity was delayed, with many bolls still immature at picking, reducing fibre quality. Lint yield was down by 59%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **dicamba** |
| **Rate:** | **28 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **2nd Jan** |
| | **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily absorbed by leaves
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited
**Soil half-life:** 4 – 14 days

Kamba 500 applied broadcast at 56 ml/ha to 15 node cotton. Photo taken on 4th Jan, 2 days after exposure.

There were no obvious signs of herbicide damage 2 days after exposure to this rate.

Kamba 500 applied broadcast at 56 ml/ha to 15 node cotton. Photo taken on 7th Jan, 5 days after exposure.

By 5 days after exposure, some of the younger leaves were yellowish and distorted. They were often “cupped” or “bubbled”, with raised, reddish edges.

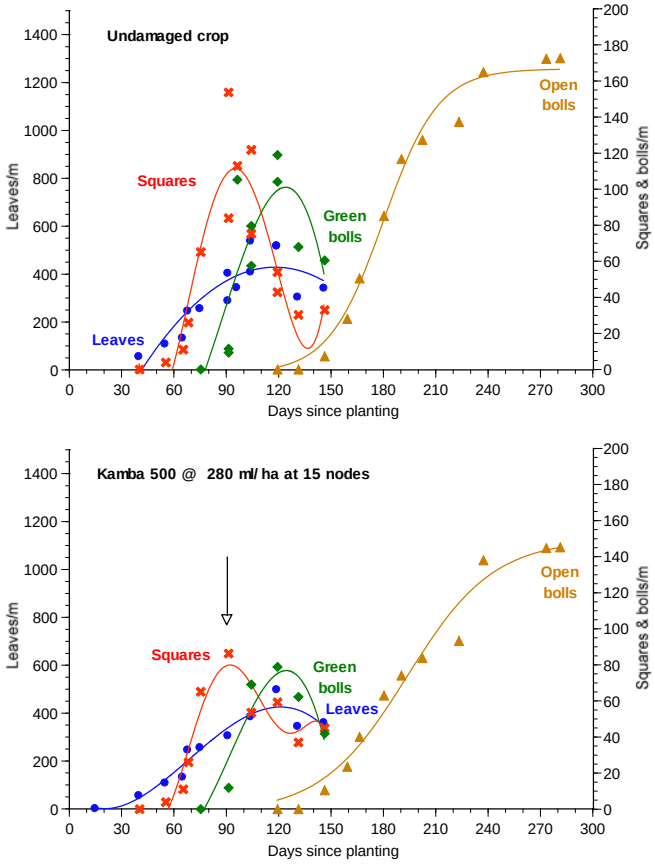
Kamba 500 applied broadcast at 56 ml/ha to 15 node cotton. Photo taken on 14th Jan, 14 days after exposure.

By 14 days, the plants were topped with distorted, rank growth with long internodes. Many of the emerging leaves on this top growth were “wedge” shaped, ending in multiple “fingers”. Cupping and reddening of the some leaves was also still apparent.

Kamba 500 applied broadcast at 56 ml/ha to 15 node cotton. Photo taken on 31st Jan, 29 days after exposure.

Distorted new growth with long internodes continued to top the plant 29 days after exposure.

Most of the damage symptoms had disappeared by 50 days after exposure.




## Impact on plant growth

**Plants:** a 10% rate of dicamba damaged exposed and developing leaves, and increased inter-node length, with plants 22 cm and 1.5 nodes taller at picking.

**Leaves:** the herbicide caused distinct yellowing and cupping of young, exposed leaves and the production of distorted new leaves, typical of Group I damage. Plants had 9% less leaf area mid-season.

**Squares**: peak square production was down by 44%, but the plants compensated with additional squares later in the season.

**Bolls:** many early bolls were shed from the first 3 fruiting positions, reducing peak boll retention. Plants compensated, setting bolls on the lateral branches and outer fruiting positions, with mature bolls to the top of the plant. Final boll retention was down 7% and boll weight down 16%. Boll maturity was delayed by 22 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.3) and lint yield was reduced by 27%.

**Final plant count data**

| | undamaged | dicamba |
|---|---|---|
| **Nodes/plant** | 27.8 | 29.3 |
| **Leaves/m*** | 342 | 396 |
| **Leaf area (cm²/m)*** | 22084 | 20092 |
| **Reduction in leaf area*** | | 9% |
| **Bolls/m** | 200 | 187 |
| **Boll weight (g/open boll)** | 4.2 | 3.6 |
| **Retention in posit's 1-3^** | 88% | 72% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 24 |
| **Days to 50% open** | 187 | 209 |
| **Maturity delay (days)** | | 22 |
| **% Open bolls at picking** | 86% | 78% |
| **Lint yield/ha** | 2246 | 1632 |

Exposure to 10% of a typical field rate of dicamba at 15 nodes caused little visible damage to the crop but affected plant height and leaf area.

Square production and boll retention were affected, with many of the early bolls shed. Bolls were retained on outer fruiting positions and on lateral branches, but there was a reduction in boll size and a delay in crop maturity. Fibre quality was reduced and lint yield was reduced by 27%, in what was a very long season.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **dicamba** |
| **Rate:** | **140 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **2nd Jan** **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily absorbed by leaves
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited
**Soil half-life:** 4 – 14 days

Kamba 500 applied broadcast at 280 ml/ha to 15 node cotton. Photo taken on 4 Jan, 2 days after exposure.

The only symptoms of dicamba damage apparent 2 days after exposure was twisting of the petioles on a few of the upper leaves.

Kamba 500 applied broadcast at 280 ml/ha to 15 node cotton. Photo taken on 11 Jan, 9 days after exposure.

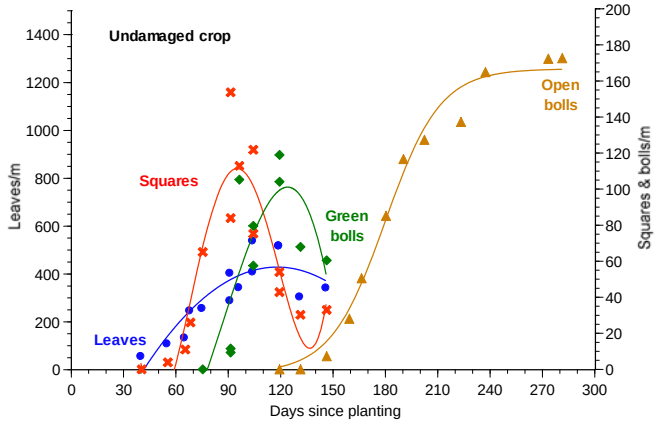
By 9 days after exposure, some of the younger leaves were yellowish and distorted. They were “cupped”, with raised, reddish edges.

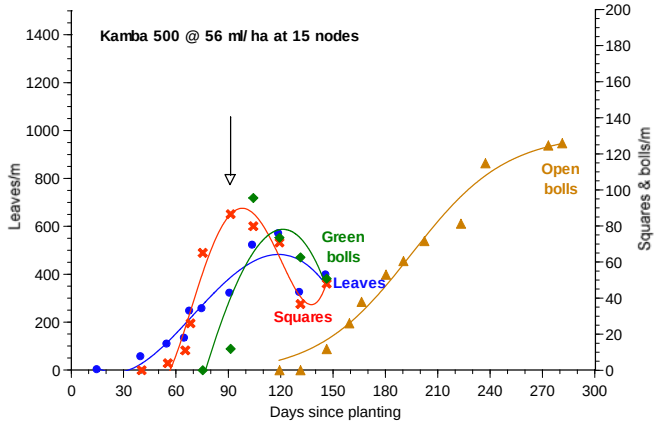
Kamba 500 applied broadcast at 280 ml/ha to 15 node cotton. Photo taken on 31 Jan, 29 days after exposure.

By 29 days, rank new growth was appearing at the top of the plants, with long internodes and distorted growth, typical of Group I damage. Many of the emerging leaves were “wedge” shaped, ending in multiple “fingers”. Cupping and reddening of the some leaves was also still apparent.

Kamba 500 applied broadcast at 280 ml/ha to 15 node cotton. Photo taken on 11 Feb, 40 days after exposure.

Rank new distorted growth was very obvious at the top of the plants 40 days after exposure. Most top leaves were "wedge" shaped, ending in multiple "fingers".




## Impact on plant growth

**Plants:** exposure to a 50% rate of dicamba at 15 nodes caused extensive leaf damage but had no other obvious affects.

**Leaves:** leaves which emerged from the top of the plant following the herbicide exposure were highly distorted, with symptoms typical of Group I damage.

**Squares**: the herbicide reduced peak square production, but plants compensated by producing additional later-season squares.

**Bolls:** many early bolls were shed following the herbicide exposure, with additional bolls retained on the lateral branches. There were 8% fewer bolls retained in the first 3 fruiting positions and 14% fewer bolls in total at picking. Boll weight was reduced by17% and the average boll maturity was delayed by 28 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (2.85), reduced fibre length and 11.5% short fibres. Lint yield was reduced by 48%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **dicamba** |
| **Nodes/plant** | 27.8 | 28.5 |
| **Leaves/m*** | 342 | 359 |
| **Leaf area (cm²/m)*** | 22084 | 22711 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 200 | 171 |
| **Boll weight (g/open boll)** | 4.2 | 3.5 |
| **Retention in posit's 1-3^** | 88% | 81% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 4 - 23 |
| **Days to 50% open** | 187 | 215 |
| **Maturity delay (days)** | | 28 |
| **% Open bolls at picking** | 86% | 73% |
| **Lint yield/ha** | 2246 | 1160 |

Exposure to 50% of a typical field rate of dicamba initially cause mild damage symptoms, but had a large effect on later leaf development.

Square production and the pattern of boll retention were affected by the herbicide, with many early bolls shed. Additional bolls were retained on the lateral branches, but there was a reduction in boll number, boll size, boll maturity and fibre quality. The herbicide damage caused a 48% reduction in lint yield.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **fluroxypyr** |
| **Rate:** | **36 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **12th Nov** (6 weeks post-emergence) |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production.
**Residual activity:** limited
**Soil half-life:** 11 - 38 days in moist soil

Starane® 300 applied broadcast at 120 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

There were few symptoms of fluroxypyr damage apparent 3 days after exposure to the 10% rate. There was some reddening of the stems, petiole twisting and bending and leaf cupping but it was difficult to distinguish this damage from background thrip damage.

Starane® 300 applied broadcast at 120 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

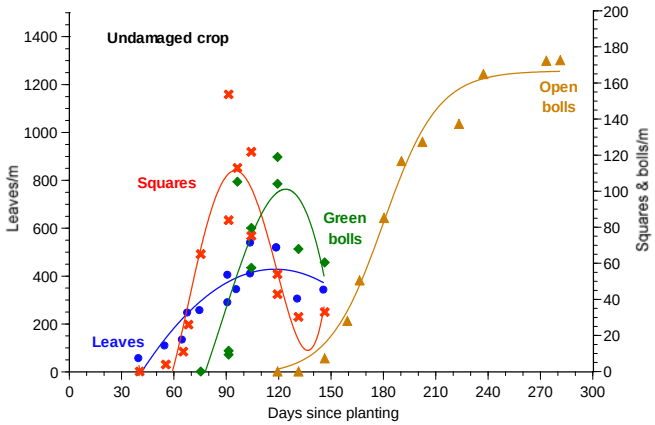
Some initial symptoms of fluroxypyr damage were still apparent 10 days after exposure. New leaves were yellowed, cupped and distorted, with discoloured edges.

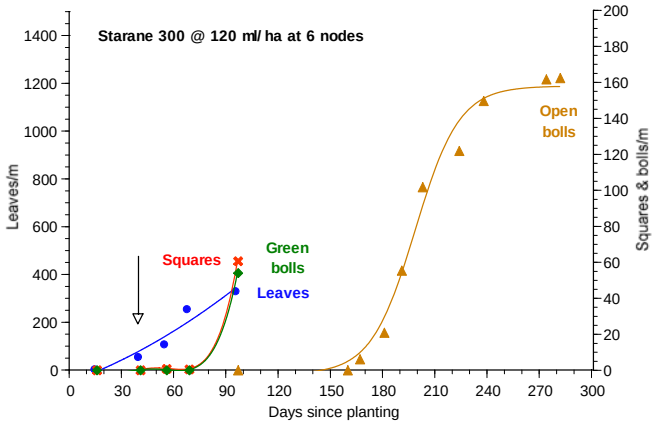
Starane® 300 applied broadcast at 120 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

The typical signs of Group I damage were readily apparent 29 days after exposure. New leaves were twisted and distorted, often "wedge" shaped, ending in a row of short "fingers".

Starane® 300 applied broadcast at 120 ml/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Plants had resumed normal growth by 51 days after exposure, although some crinkling of the leaf margins was still apparent on older leaves and distorted leaves could be found under the new outer leaves.




## Impact on plant growth

**Plants:** exposure to the 10% rate of fluroxypyr primarily damaged emerging leaves. There were 25% more tipped-out plants, and plants were 8 cm and 4.9 nodes shorter and 44% smaller by weight.

**Leaves:** which emerged after the herbicide exposure were small, distorted and often "wedge" shaped. Plants had 38% less leaf area at the last observation.

**Squares**: square production was delayed by 20 days by the herbicide exposure.

**Bolls:** many early bolls were lost, with 41% fewer bolls retained in positions 1 – 3. Additional bolls were retained on the lateral branches, with few mature bolls retained above node 19, 7 nodes lower than the undamaged crop. There was an 8% reduction in the number of bolls at picking, an 11% reduction in boll weight, and a 17 day delay in maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.1). Lint yield was reduced by 41%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **fluroxypyr** |
| **Nodes/plant** | 27.8 | 23.0 |
| **Leaves/m*** | 342 | 327 |
| **Leaf area (cm²/m)*** | 17713 | 10928 |
| **Reduction in leaf area*** | | 38% |
| **Bolls/m** | 200 | 184 |
| **Boll weight (g/open boll)** | 4.2 | 3.8 |
| **Retention in posit's 1-3^** | 88% | 52% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 15 |
| **Days to 50% open** | 187 | 204 |
| **Maturity delay (days)** | | 17 |
| **% Open bolls at picking** | 86% | 88% |
| **Lint yield/ha** | 2246 | 1326 |

Exposure to 10% of a typical field rate of fluroxypyr at 6 nodes caused leaf yellowing and cupping, and extensive deformation on newly emerging leaves. Plant growth and development were delayed.

There was a loss of early squares and bolls, with greatly reduced retention on the first 3 fruiting positions. Plants retained additional bolls on the lateral branches, but there were reductions in final boll number, boll weight, crop maturity and fibre quality. Lint yield was reduced by 41%.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **fluroxypyr** |
| **Rate:** | **180 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **12th Nov** (6 weeks post-emergence) |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production.
**Residual activity:** limited
**Soil half-life:** 11 - 38 days in moist soil

Starane® 300 applied broadcast at 600 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

Initial symptoms of fluroxypyr damage were apparent after only 3 days, with reddening of the stems, petiole twisting and bending, leaf cupping and some leaf discolouration and burning.

Starane® 300 applied broadcast at 600 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

Initial symptoms of fluroxypyr damage were still apparent after 10 days, with reddening of the stems and petiole twisting and bending. New leaves were yellowed, cupped and distorted, with discoloured edges.

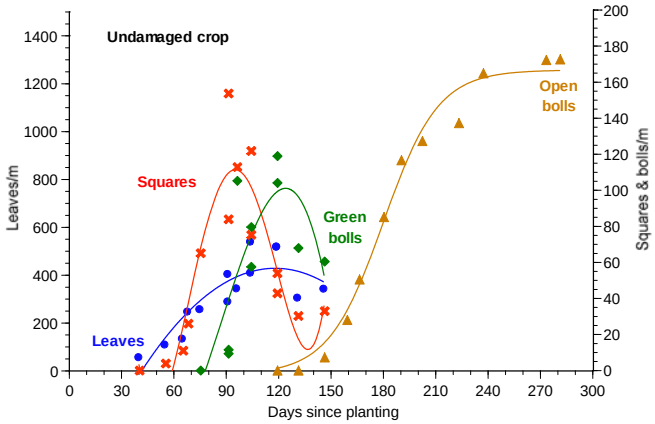
Starane® 300 applied broadcast at 600 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

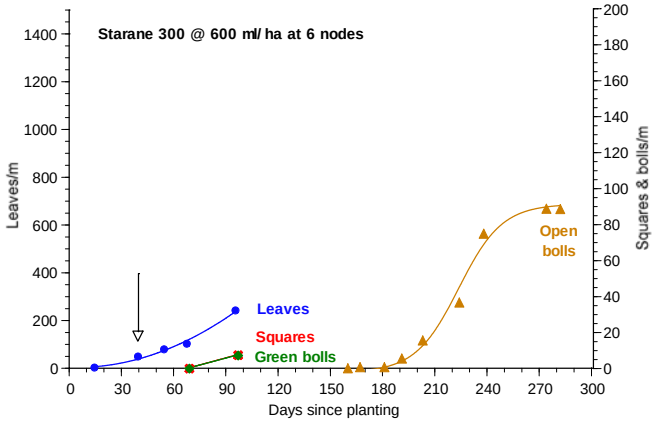
Initial symptoms of fluroxypyr damage were becoming less apparent 29 days after exposure, but new leaves were emerging, showing the typical signs of Group I damage. The leaves were distorted, often "wedge" shaped, ending in a row of short "fingers".

Starane® 300 applied broadcast at 600 ml/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

The fluroxypyr damage was very obvious 51 days after exposure, with elongated internodes and distorted leaves which were twisted and leathery, with prominent veins.

By 25 Jan, 74 days after exposure, plants had resumed normal growth, although with a big delay in maturity and a reduction in lint yield.




## Impact on plant growth

**Plants:** exposed to the 50% rate of fluroxypyr were extensively damaged and were slow to recover from this damage. Plants were 29 cm and 9 nodes shorter, 90% smaller by weight and 16% more were tipped out.

**Leaves:** that developed following exposure were small, distorted and often "wedge" shaped. Plants had 30% fewer leaves and 87% less leaf area at the last observation.

**Squares**: plants were very slow to recover from the herbicide damage with few squares produced in the first 100 days.

**Bolls:** retention was delayed by 60 days, with most retained bolls on lateral branches and few mature bolls above node 15. There was a 36% reduction in the final boll retention, with 41% fewer bolls in positions 1 – 3, a 23% reduction in boll weight, 19% fewer bolls open at picking, and a 49 day delay in crop maturity.

**Lint:** ginning turnout was unaffected, but the cotton was immature, with low micronare (3.1) and 1.1% more short fibres. Lint yield was reduced by 58%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **fluroxypyr** |
| **Nodes/plant** | 27.8 | 18.7 |
| **Leaves/m*** | 342 | 239 |
| **Leaf area (cm²/m)*** | 17713 | 2236 |
| **Reduction in leaf area*** | | 87% |
| **Bolls/m** | 200 | 128 |
| **Boll weight (g/open boll)** | 4.2 | 3.3 |
| **Retention in posit's 1-3^** | 88% | 52% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 14 |
| **Days to 50% open** | 187 | 236 |
| **Maturity delay (days)** | | 49 |
| **% Open bolls at picking** | 86% | 69% |
| **Lint yield/ha** | 2246 | 946 |

Exposure to 50% of a typical field rate of fluroxypyr at 6 nodes caused extensive leaf deformation and a loss of leaves, squares and bolls through the middle of the season. Plants compensated for the damage, setting new bolls on the lateral branches.

There was a reduction in boll number, boll size, the proportion of bolls open at picking, boll maturity and fibre quality. Lint yield was reduced by 58% in a long season with picking delayed till early June.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **fluroxypyr** |
| **Rate:** | **36 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **5th Dec** |
| | **(9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production.
**Residual activity:** limited
**Soil half-life:** 11 - 38 days in moist soil

Starane® 300 applied broadcast at 120 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Initial symptoms of fluroxypyr damage were apparent after only a couple of days, with reddening of the stems, petiole twisting and bending, leaf cupping and some leaf discolouration and burning.

Starane® 300 applied broadcast at 120 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

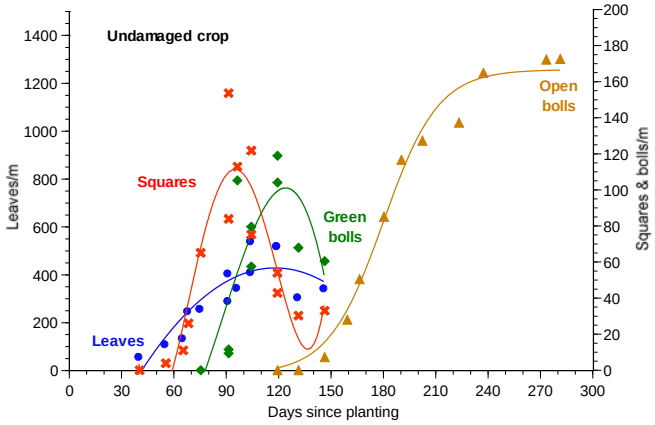
Initial symptoms of fluroxypyr damage were still readily apparent 16 days after exposure, with reddening of the stems, petiole twisting and bending and some necrotic spots.

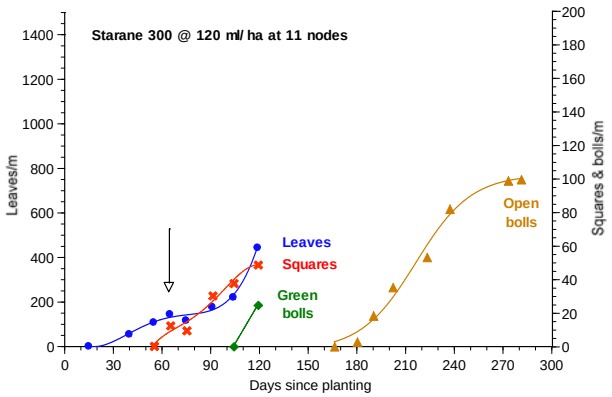
Starane® 300 applied broadcast at 120 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

Plants had resumed 'normal' growth 28 days after exposure. The more typical symptoms of Group I damage with leaf distortion etc. were not apparent at any stage.

Starane® 300 applied broadcast at 120 ml/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Plants were growing normally 40 days after exposure, although distorted petioles and leaves could still be found at the base of the plant.




## Impact on plant growth

**Plants:** exposure to the 10% rate of fluroxypyr damaged the crop, distorting petioles and misaligning the leaves. Plants were stunted, 57% smaller by weight at the last observation.

**Leaves:** plants had 14% fewer leaves and 11% less leaf area mid-season, compared to undamaged plants.

**Squares**: many of the early squares were shed and squaring was delayed by 30 days.

**Bolls:** many of the early bolls were shed following the herbicide exposure. The initial boll retention was delayed by 30 days, with 17% fewer bolls retained in the first 3 positions. Final boll retention was reduced by 41% and boll size was down 12%. There was a 35 day delay in crop maturity.

**Lint:** ginning turnout was unaffected by the herbicide exposure, but the cotton was immature, with low micronare (2.8). Lint yield was reduced by 63%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **fluroxypyr** |
| **Nodes/plant** | 27.8 | 23.5 |
| **Leaves/m*** | 342 | 443 |
| **Leaf area (cm²/m)*** | 13541 | 12088 |
| **Reduction in leaf area*** | | 11% |
| **Bolls/m** | 200 | 118 |
| **Boll weight (g/open boll)** | 4.2 | 3.7 |
| **Retention in posit's 1-3^** | 88% | 73% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 4 - 21 |
| **Days to 50% open** | 187 | 222 |
| **Maturity delay (days)** | | 35 |
| **% Open bolls at picking** | 86% | 84% |
| **Lint yield/ha** | 2246 | 832 |

Exposure to 10% of a typical field rate of fluroxypyr at 11 nodes caused extensive petiole damage and delaying plant growth and development, stunting the crop.

Many of the early squares and bolls were shed, with a reduction in the proportion of bolls retained on in the first 3 fruiting positions. There was a reduction in boll retention, boll weight, crop maturity, the proportion of bolls open at picking and fibre quality. Lint yield was reduced by 63%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **fluroxypyr** |
| **Rate:** | **180 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **5th Dec** |
| | **(9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production.
**Residual activity:** limited
**Soil half-life:** 11 - 38 days in moist soil

Starane® 300 applied broadcast at 600 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Initial symptoms of fluroxypyr damage were apparent after only a couple of days, with reddening of the stems, petiole twisting and bending, leaf cupping and some leaf discolouration and burning.

Starane® 300 applied broadcast at 600 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

Initial symptoms of fluroxypyr damage were still very apparent 16 days after exposure, with reddening of the stems, petiole twisting and bending and necrotic spots on the leaves.

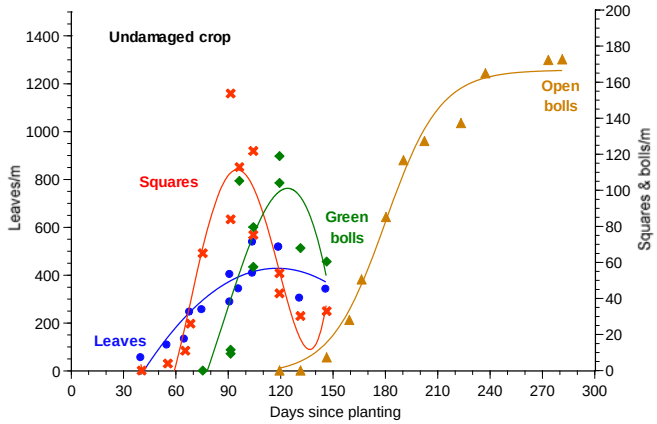
Starane® 300 applied broadcast at 600 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

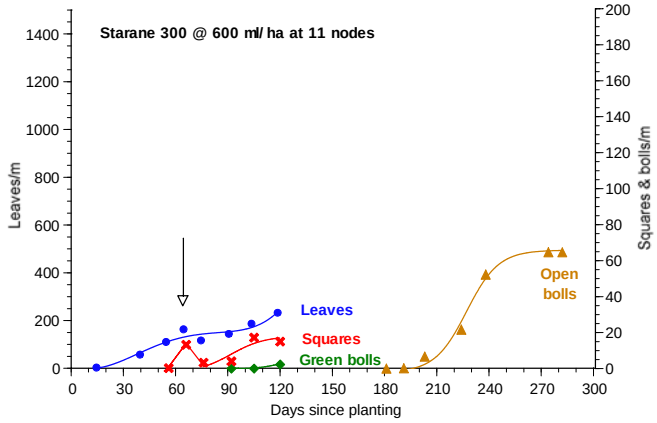
Plants have shown few changes over the time since exposure, with no new growth apparent 28 days after exposure. Fluroxypyr damage was still obvious as reddening of the stems, petiole twisting and bending and necrotic spots on the leaves.

Starane® 300 applied broadcast at 600 ml/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Plants began to resume normal growth by 40 days after exposure, although damage was still readily apparent under the outer leaves. Surprisingly, few symptoms typical of Group I damage were observed.

By 25 Jan, 51 days after exposure, some plants had resumed normal growth, but many remain stunted and severely distorted.




## Impact on plant growth

**Plants:** exposure to the 50% rate of fluroxypyr caused bending and twisting of the stems and petioles, giving a "crazy", wilted appearance. Plants took 40 - 70 days or so to recover from this damage and were 91 cm and 6.9 nodes shorter and 84% smaller by weight at the last observation compared to the undamaged crop.

**Leaves:** plants had 54% fewer leaves and 53% less leaf area mid-season.

**Squares**: all squares were shed following the herbicide exposure and plants were slow to recover from the damage.

**Bolls:** bolls retention was delayed, with most bolls retained on the lateral branches. The final boll number was down by 47%, boll weight by 29% and the proportion of open bolls at picking by 29%. Crop maturity was delayed by 59%.

**Lint:** ginning turnout was down 6% and the cotton was immature, with low micronare (2.8), reduced strength and 12.8% short fibres. Lint yield was reduced by 78%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **fluroxypyr** |
| **Nodes/plant** | 27.8 | 20.9 |
| **Leaves/m*** | 342 | 240 |
| **Leaf area (cm²/m)*** | 13541 | 6314 |
| **Reduction in leaf area*** | | 53% |
| **Bolls/m** | 200 | 106 |
| **Boll weight (g/open boll)** | 4.2 | 3.0 |
| **Retention in posit's 1-3^** | 88% | 48% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 16 |
| **Days to 50% open** | 187 | 246 |
| **Maturity delay (days)** | | 59 |
| **% Open bolls at picking** | 86% | 61% |
| **Lint yield/ha** | 2246 | 489 |

Exposure to 50% of a typical field rate of fluroxypyr at 11 nodes caused extensive crop damage, stopping plant growth and development for many weeks.

Plants eventually compensated for the damage, with new growth on the lateral branches, but retained few bolls on any node. Most bolls were retained on the outer fruiting positions, but there was a reduction in boll number, boll weight, crop maturity and fibre quality. Lint yield was reduced by 78%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **fluroxypyr** |
| **Rate:** | **36 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **2nd Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production.
**Residual activity:** limited
**Soil half-life:** 11 - 38 days in moist soil

Starane® 300 applied broadcast at 120 ml/ha to 15 node cotton. Photo taken on 4th Jan, 2 days after exposure.

Initial symptoms of fluroxypyr damage were apparent after only a couple of days, with petiole twisting and bending, misaligning many of the leaves.

This gave the plants a wilted appearance.

Starane® 300 applied broadcast at 120 ml/ha to 15 node cotton. Photo taken on 11th Jan, 9 days after exposure.

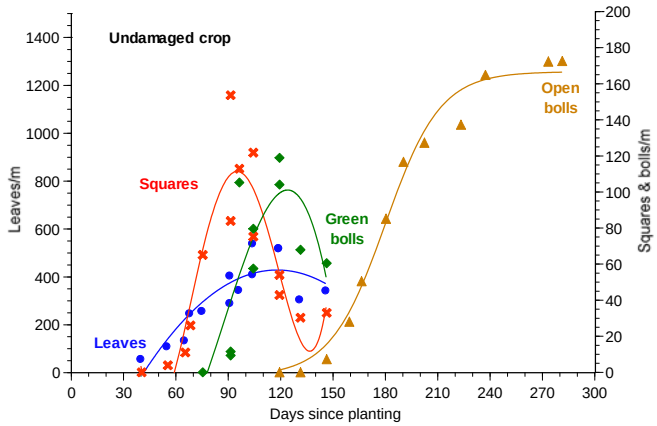
Initial symptoms of fluroxypyr damage were still very apparent 9 days after exposure, with reddening of the stems, and petiole twisting and bending.

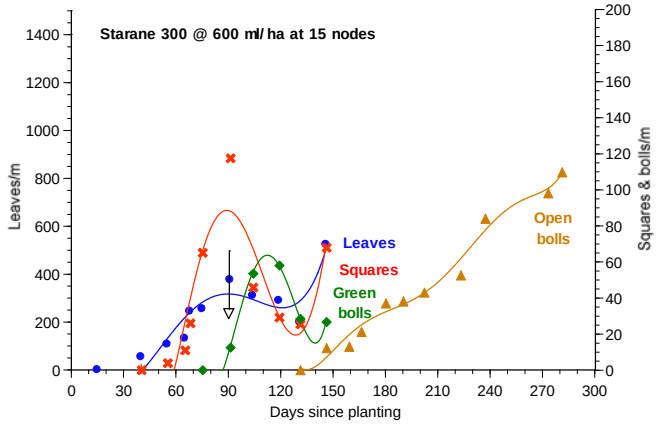
Starane® 300 applied broadcast at 120 ml/ha to 15 node cotton. Photo taken on 31st Jan, 29 days after exposure.

Plants had resumed normal growth 29 days after exposure. The symptoms typical of Group I damage, including leaf distortion, were not apparent at any stage.

Starane® 300 applied broadcast at 120 ml/ha to 15 node cotton. Photo taken on 11th Feb, 40 days after exposure.

Plants were growing normally 40 days after exposure, although the last internodes were longer than normal.




## Impact on plant growth

**Plants:** exposure to the 10% rate of fluroxypyr caused bending of the stems and petioles, giving a wilted appearance. Plants had 4.2 more nodes at picking.

**Leaves:** the exposure had a relatively mild impact on leaf production, with no reduction in leaf number and an 11% reduction in leaf area.

**Squares**: there were no obvious effects on squaring.

**Bolls:** many early bolls were shed following the herbicide exposure. There were 9% fewer bolls retained in positions 1 - 3, but more late bolls retained at the top of the plant (to node 27). There was a 31% reduction in boll number, 30% reduction in boll weight and an 8% reduction in the proportion of open bolls at picking. Crop maturity was delayed by 45 days.

**Lint:** ginning turnout was down 5% and the cotton was immature and below base grade, with low micronare (2.75), reduced strength, and fibres length of 1.11". Lint yield was reduced by 61%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **fluroxypyr** |
| **Nodes/plant** | 27.8 | 32.0 |
| **Leaves/m*** | 342 | 339 |
| **Leaf area (cm²/m)*** | 22084 | 19754 |
| **Reduction in leaf area*** | | 11% |
| **Bolls/m** | 200 | 139 |
| **Boll weight (g/open boll)** | 4.2 | 3.0 |
| **Retention in posit's 1-3^** | 88% | 80% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 5 - 27 |
| **Days to 50% open** | 187 | 232 |
| **Maturity delay (days)** | | 45 |
| **% Open bolls at picking** | 86% | 79% |
| **Lint yield/ha** | 2246 | 866 |

Exposure to 10% of a typical field rate of fluroxypyr at 15 nodes caused petiole and stem distortion and the loss of early squares and bolls. Plants compensated with late-season growth and bolls.

Late-season bolls were retained towards the top of the plant, with mature bolls retained to node 28. There was a reduction in boll number, boll weight, crop maturity and fibre quality. Lint yield was reduced by 61% .

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **fluroxypyr** |
| **Rate:** | **180 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **2nd Jan** |
| | **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production.
**Residual activity:** limited
**Soil half-life:** 11 - 38 days in moist soil

Starane® 300 applied broadcast at 600 ml/ha to 15 node cotton. Photo taken on 4th Jan, 2 days after exposure.

Symptoms of fluroxypyr damage were apparent after only a couple of days, with petiole reddening, twisting and bending. Most exposed leaves were mis-orientated, giving the crop a wilted appearance.

Starane® 300 applied broadcast at 600 ml/ha to 15 node cotton. Photo taken on 11th Jan, 9 days after exposure.

Symptoms of fluroxypyr damage had intensified by 9 days, with twisting and reddening of the stems and petioles, and some reddening of the squares and backs of the leaves.

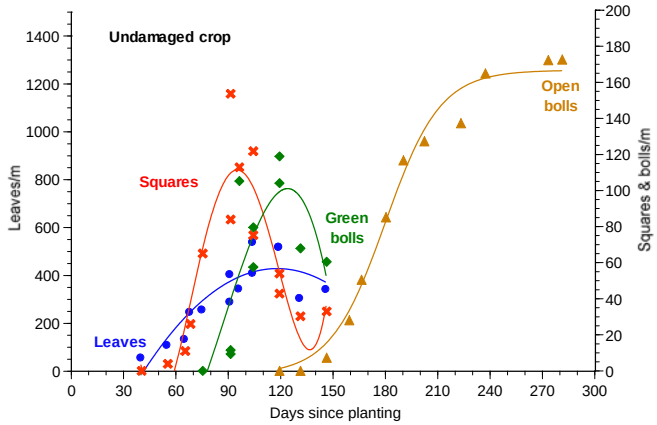
Starane® 300 applied broadcast at 600 ml/ha to 15 node cotton. Photo taken on 31st Jan, 29 days after exposure.

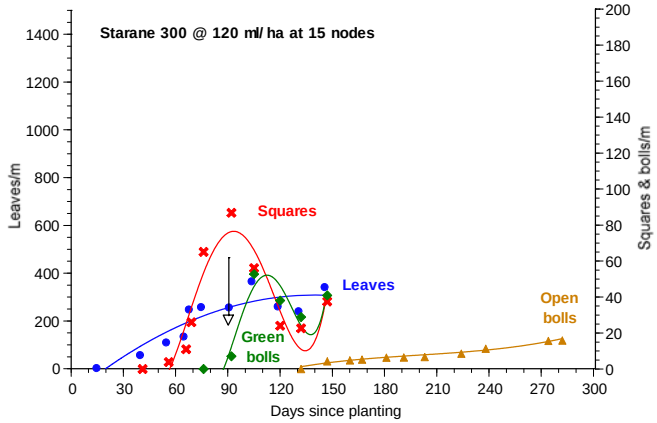
Plants showed few changes over the 29 days since exposure, with no new growth apparent. Fluroxypyr damage was still obvious as reddening of the stems and petiole twisting and bending.

Starane® 300 applied broadcast at 600 ml/ha to 15 node cotton. Photo taken on 11th Feb, 40 days after exposure.

Plants have shown few changes over the time since exposure, with no new growth apparent. Damage was still obvious as reddening of the stems and petiole twisting and bending. Surprisingly, few symptoms typical of Group I damage were observed.

By 3rd Mar, 60 days after exposure, plants had resumed normal growth.




## Impact on plant growth

**Plants:** exposure to the 50% rate of fluroxypyr caused bending and twisting of the stems and petioles, giving a "crazy", wilted appearance. Plants were slow to recover from the damage and were 49 cm and 7.4 nodes shorter at picking.

**Leaves:** plants producing a large number of new, highly distorted, wedge shaped leaves. This resulted in a 54% increase in leaf number but no increase in leaf area.

**Squares**: plants shed a large proportion of squares after the herbicide exposure, reducing peak squaring by 44%.

**Bolls:** plants retained few bolls following the herbicide exposure. There was a 70% reduction in final boll number and a 48% reduction in boll weight. Crop maturity was delayed by >93 days, with 26% of bolls open at picking (16 open bolls/m).

**Lint:** ginning turnout was down by 12% and the cotton was immature, with low micronare (2.45), reduced strength, fibre length of 1.08" and 12.4% short fibres. Lint yield was reduced by 95%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **fluroxypyr** |
| **Nodes/plant** | 27.8 | 20.4 |
| **Leaves/m*** | 342 | 524 |
| **Leaf area (cm²/m)*** | 22084 | 20722 |
| **Reduction in leaf area*** | | 6% |
| **Bolls/m** | 200 | 60 |
| **Boll weight (g/open boll)** | 4.2 | 2.2 |
| **Retention in posit's 1-3^** | 88% | 80% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 8 - 22 |
| **Days to 50% open** | 187 | >280 |
| **Maturity delay (days)** | | >93 |
| **% Open bolls at picking** | 86% | 26% |
| **Lint yield/ha** | 2246 | 101 |

Exposure to 50% of a typical field rate of fluroxypyr at 15 nodes caused extensive damage, bending and twisting the petioles and delaying plant growth and development.

Plants were unable to compensate for damage at this stage, retaining few bolls, many of which were immature. This lead to a large decrease in boll weight and the number of mature bolls open at picking. Lint yield was reduced by 95% and the fibre quality was poor.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA** |
| **Rate:** | **105 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **12th Nov** (6 weeks post-emergence) |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily absorbed by leaves and highly mobile within the plant
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots
**Soil half-life:** 5 – 6 days, but will persist for up to 6 months in dry soil

MCPA 500 applied broadcast at 210 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

Initial symptoms of MCPA damage were apparent after only 3 days, with some twisting of the petioles and main stem.

MCPA 500 applied broadcast at 210 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

The initial symptoms were still apparent 10 days after exposure.

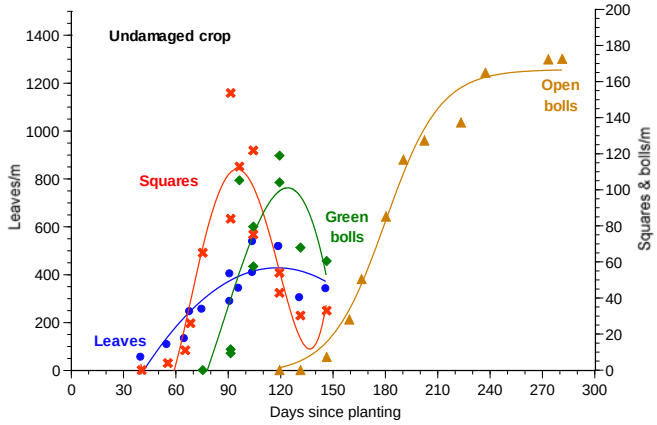
MCPA 500 applied broadcast at 210 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

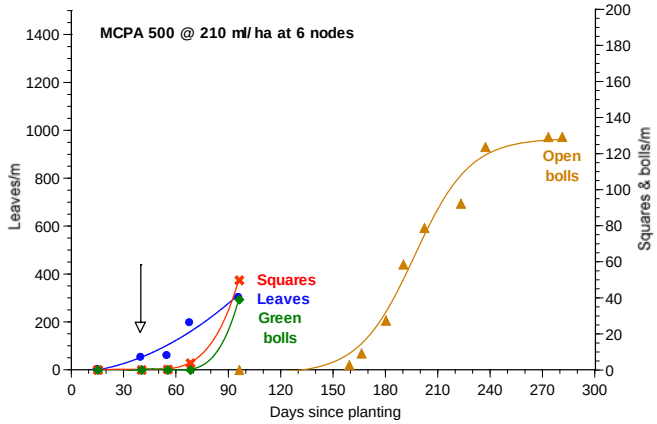
Plants had resumed growth 29 days after exposure, but new growth was showing typical phenoxy damage. New leaves were distorted, with crinkled edges and ending in a row of short "fingers". Many of the distorted leaves were more square in shape, not as fine as distorted leaves from some of the other Group I herbicides.

MCPA 500 applied broadcast at 210 ml/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Distorted leaves were still very apparent although more normal leaves were emerging on newly developing lateral branches.

Most symptoms of damage disappeared by 25th Jan, 74 days after exposure, although a few abnormal leaves were still apparent. These leaves were heavily veined and leathery in appearance.




## Impact on plant growth

**Plants:** exposure to the 10% rate of MCPA caused bending of the petioles and stems and damaged new leaves. Plants were 14 cm shorter and 57% smaller by weight, with 25% more seedlings tipped-out.

**Leaves:** new leaves were highly distorted, although the leaves were not as fine as is often the case with other Group I herbicides. Plants had 12% fewer leaves and 52% less leaf area mid-season.

**Squares**: square production was delayed by around 20 days.

**Bolls:** many of the young bolls were shed following the herbicide exposure, reducing retention on the first 3 fruiting positions by 29%. Additional bolls were retained on the lateral branches, but plants retained 19% fewer bolls at picking and boll weight was down 18%. There was a 20 day delay in average boll maturity.

**Lint:** ginning turnout was unaffected, but the cotton was immature, with low micronare (2.9) and 11.8% short fibres. Lint yield was reduced by 45%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **MCPA** |
| **Nodes/plant** | 27.8 | 27.6 |
| **Leaves/m*** | 342 | 301 |
| **Leaf area (cm²/m)*** | 17713 | 8455 |
| **Reduction in leaf area*** | | 52% |
| **Bolls/m** | 200 | 138 |
| **Boll weight (g/open boll)** | 4.2 | 3.5 |
| **Retention in posit's 1-3^** | 88% | 62% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 19 |
| **Days to 50% open** | 187 | 207 |
| **Maturity delay (days)** | | 20 |
| **% Open bolls at picking** | 86% | 80% |
| **Lint yield/ha** | 2246 | 1231 |

Exposure to 10% of a typical field rate of MCPA at 6 nodes caused a 20 – 30 day delay in plant growth and development. Plants were stunted, with less leaf area mid-season.
Many of the young bolls were shed following the herbicide exposure. Additional bolls were retained on the lateral branches, but boll number and boll size were reduced. Crop maturity was delayed and fibre quality was reduced. Lint yield was reduced by 45%.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA** |
| **Rate:** | **525 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **12th Nov** (6 weeks post-emergence) |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily absorbed by leaves and highly mobile within the plant
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots
**Soil half-life:** 5 – 6 days, but will persist for up to 6 months in dry soil

MCPA 500 applied broadcast at 1.05 L/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

Initial symptoms of MCPA damage were apparent after only 3 days, with twisting of the petioles and main stem. Some leaf burning was also apparent with necrotic spots on the leaves.

MCPA 500 applied broadcast at 1.05 L/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

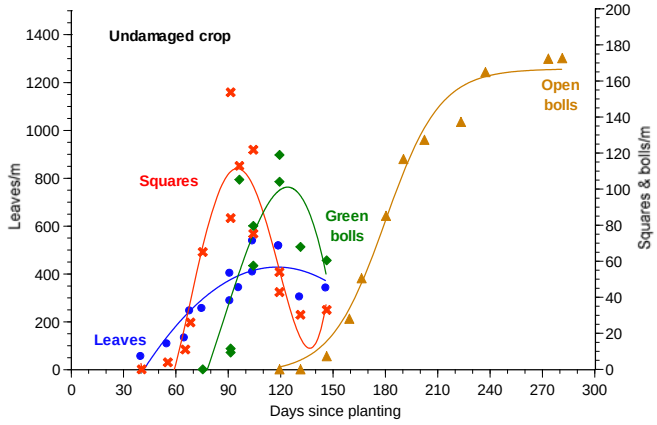
The initial symptoms had largely disappeared 10 days after exposure, although there was still some twisting of the petioles and main stem. Necrotic spots were still obvious on the leaves.

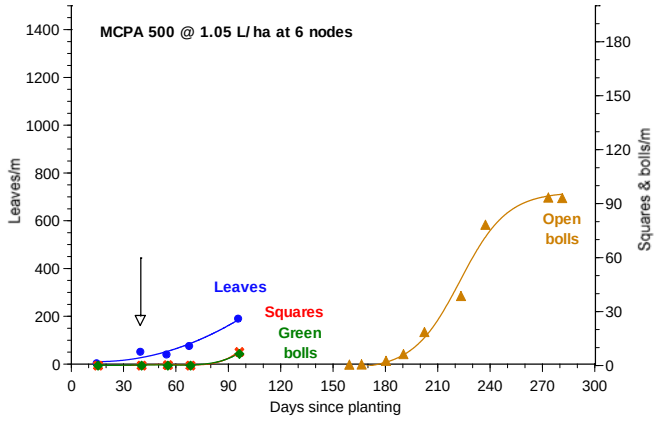
MCPA 500 applied broadcast at 1.05 L/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

Plants had resumed growth, but new growth was showing symptoms typical of Group I damage. New leaves were distorted, with crinkled edges and ending in a row of short "fingers". Many of the distorted leaves were more square in shape, not as fine as distorted leaves from some of the other Group I herbicides.

MCPA 500 applied broadcast at 1.05 L/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Distorted leaves were still very apparent 51 days after exposure, although more normal leaves were emerging on newly developing lateral branches.
Most symptoms of damage had disappeared 74 days after exposure, although a few abnormal leaves were still apparent. These leaves were heavily veined and leathery in appearance.




## Impact on plant growth

**Plants:** exposure to a 50% rate of MCPA caused bending of the petioles and main stems, leaf burn and damage to emerging leaves. Plants were 15 cm and 3.5 nodes shorter and 79% smaller by weight, with 25% more seedlings tipped-out.

**Leaves:** were highly distorted, with symptoms typical of Group I damage. Plants had 45% fewer leaves and 79% less leaf area compared to the undamaged crop.

**Squares**: square production was delayed by 30 – 40 days.

**Bolls:** most bolls were shed following the herbicide exposure, with 24% fewer bolls retained on the first 3 fruiting positions. Additional bolls were retained on the lateral branches, but plants retained 43% fewer bolls at picking and boll weight was down by 20%. Average boll maturity was delayed by 41 days.

**Lint:** ginning turnout was reduced by 8% by the herbicide damage and the cotton was immature at picking, with low micronare (2.8). Lint yield was reduced by 64%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **MCPA** |
| **Nodes/plant** | 27.8 | 24.4 |
| **Leaves/m*** | 342 | 187 |
| **Leaf area (cm²/m)*** | 17713 | 3780 |
| **Reduction in leaf area*** | | 79% |
| **Bolls/m** | 200 | 113 |
| **Boll weight (g/open boll)** | 4.2 | 3.4 |
| **Retention in posit's 1-3^** | 88% | 67% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 18 |
| **Days to 50% open** | 187 | 228 |
| **Maturity delay (days)** | | 41 |
| **% Open bolls at picking** | 86% | 82% |
| **Lint yield/ha** | 2246 | 812 |

Exposure to 50% of a typical field rate of MCPA at 6 nodes caused extensive damage to the crop, tipping-out many plants and reducing plant height and size. Plant development was delayed by 20 – 30 days. Leaf number and leaf area were greatly reduced mid-season.

Early bolls were shed, with increased retention on the lateral branches and outer fruiting positions. There was a reduction in boll retention, boll weight, fibre quality, crop maturity and a 64% reduction in lint yield.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA** |
| **Rate:** | **105 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **5th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily absorbed by leaves and highly mobile within the plant
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots
**Soil half-life:** 5 – 6 days, but will persist for up to 6 months in dry soil

MCPA 500 applied broadcast at 210 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Mild symptoms of MCPA damage were apparent 6 days after exposure, with some reddening of the leaves and petioles and twisting of the petioles and main stem, causing mis-orientation of the leaves.

MCPA 500 applied broadcast at 210 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

The initial symptoms had largely disappeared 16 days after exposure, although some necrotic spots and discolouration of the leaves were still apparent. New leaves were yellowish.

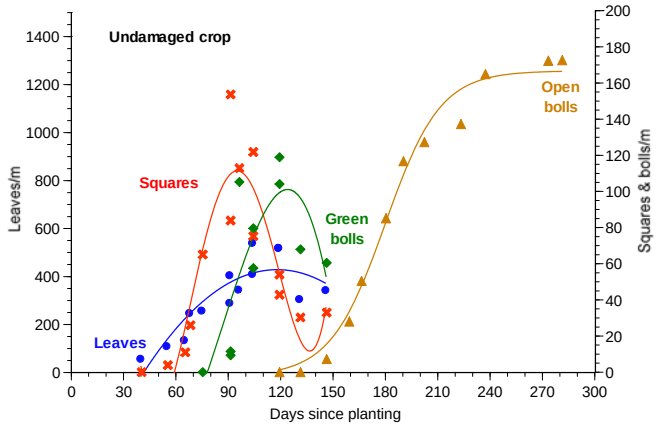
MCPA 500 applied broadcast at 210 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

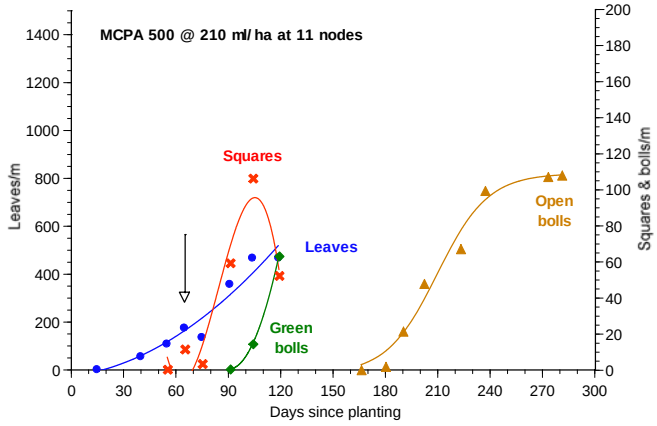
Plants had resumed growth 28 days after exposure, but new growth was showing symptoms typical of Group I damage. New leaves were distorted, with crinkled edges and ending in a row of short “fingers”.

MCPA 500 applied broadcast at 210 ml/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Distorted leaves were still very apparent at the top of the plant 40 days after exposure, although more normal leaves were emerging on newly developing lateral branches.

Most symptoms of damage had disappeared by 57 days after exposure, although a few abnormal leaves were still apparent.




## Impact on plant growth

**Plants:** exposure to the 10% rate of MCPA delayed plant growth and development. Plants were 8 cm and 1 node shorter and 40% smaller by weight mid-season.

**Leaves:** the herbicide initially caused some loss of leaf area and bending of the petioles and main stems, reducing leaf efficiency. New leaves were distorted. Plants had 10% fewer leaves and 41% less leaf area mid-season.

**Squares**: square production was delayed by around 10 days and peak squaring was reduced by 31%.

**Bolls:** boll retention was delayed by around 20 days, with many of the early bolls shed. Later bolls were retained on the lateral branches and the outer fruiting positions. At picking, plants retained 33% fewer bolls. Average boll maturity was delayed by 28 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.0). Lint yield was reduced by 47%.

**Final plant count data**

| | undamaged | MCPA |
|---|---|---|
| **Nodes/plant** | 27.8 | 26.9 |
| **Leaves/m*** | 342 | 467 |
| **Leaf area (cm²/m)*** | 13541 | 7993 |
| **Reduction in leaf area*** | | 41% |
| **Bolls/m** | 200 | 135 |
| **Boll weight (g/open boll)** | 4.2 | 3.9 |
| **Retention in posit's 1-3^** | 88% | 58% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 3 - 24 |
| **Days to 50% open** | 187 | 215 |
| **Maturity delay (days)** | | 28 |
| **% Open bolls at picking** | 86% | 80% |
| **Lint yield/ha** | 2246 | 1199 |

Exposure to 10% of a typical field rate of MCPA at 11 nodes caused a 10 – 20 day delay in plant growth and development. Plants were stunted and leaf area was greatly reduced mid-season.

Many early bolls were shed, with increased retention on the lateral branches and outer fruiting positions. There was a reduction in boll retention, boll weight, fibre quality and crop maturity. Lint yield was reduced by 47%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA** |
| **Rate:** | **525 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **5th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily absorbed by leaves and highly mobile within the plant
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots
**Soil half-life:** 5 – 6 days, but will persist for up to 6 months in dry soil

MCPA 500 applied broadcast at 1.05 L/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Initial symptoms of MCPA damage were apparent 6 days after exposure, with twisting of the petioles and main stem. Some leaf burning could also be seen, with necrotic spots on the leaves.

MCPA 500 applied broadcast at 1.05 L/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

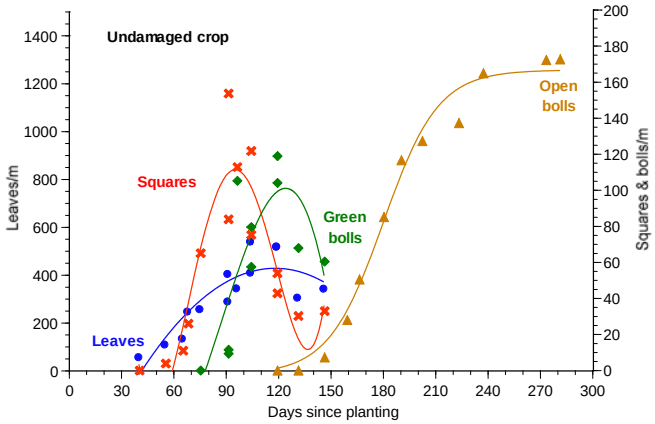
The initial symptoms of MCPA damage were still apparent 16 days after exposure, with twisting of the petioles and main stem. Some leaf burning could also be seen, with necrotic spots and patches on the leaves.

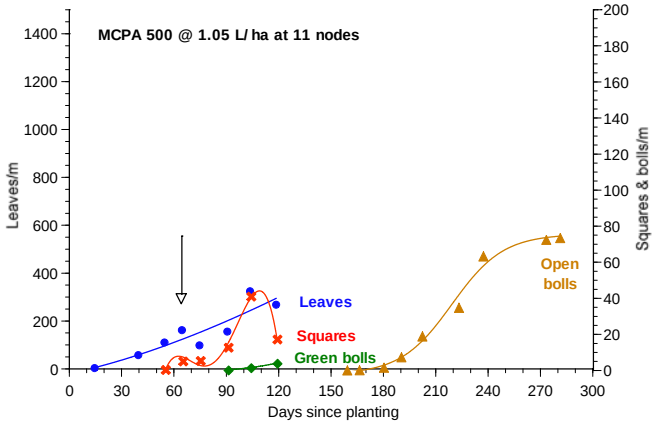
MCPA 500 applied broadcast at 1.05 L/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Plants had resumed growth 40 days after exposure, but new growth was showing symptoms typical of Group I damage. New leaves were distorted, with crinkled edges and ending in a row of short “fingers”. Many of the distorted leaves were more square in shape, and not as fine as distorted leaves from some of the other phenoxy herbicides.

MCPA 500 applied broadcast at 1.05 L/ha to 11 node cotton. Photo taken on 31st Jan, 57 days after exposure.

Long internodes and distorted leaves were still apparent 57 days after exposure, although more normal leaves were emerging on newly developing lateral branches.




## Impact on plant growth

**Plants:** exposure to a 50% rate of MCPA caused extensive damage, delaying crop growth and development. Plants were 41 cm and 2 nodes shorter and 77% smaller by weight mid-season.

**Leaves:** initial damage included leaf burning and mis-orientation. New leaves were distorted. Plants had 49% fewer leaves and 56% less leaf area mid-season.

**Squares**: most squares were shed following the herbicide exposure, delaying squaring and greatly reducing peak squaring.

**Bolls:** boll retention was delayed by over 40 days, with many of the early bolls shed. Later bolls were retained on the lateral branches and the outer fruiting positions, but few mature bolls were retained above node 9. Boll retention at picking was down 45%, and bolls were 24% smaller. Boll maturity was delayed by 48 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (2.9). Lint yield was reduced by 67%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **MCPA** |
| **Nodes/plant** | 27.8 | 25.7 |
| **Leaves/m*** | 342 | 265 |
| **Leaf area (cm²/m)*** | 13541 | 5972 |
| **Reduction in leaf area*** | | 56% |
| **Bolls/m** | 200 | 110 |
| **Boll weight (g/open boll)** | 4.2 | 3.2 |
| **Retention in posit's 1-3^** | 88% | 51% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 2 - 18 |
| **Days to 50% open** | 187 | 235 |
| **Maturity delay (days)** | | 48 |
| **% Open bolls at picking** | 86% | 67% |
| **Lint yield/ha** | 2246 | 731 |

Exposure to 50% of a typical field rate of MCPA caused severe damage to 11 node cotton, delaying plant growth and development. Plants were severely stunted, with fewer leaves.

Many squares and early bolls were shed. Additional bolls were retained on the lateral branches and outer fruiting positions, but most of these bolls were immature at picking. There was a reduction in boll retention, boll weight, fibre quality and crop maturity. Lint yield was reduced by 67%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA** |
| **Rate:** | **105 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **2nd Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily absorbed by leaves and highly mobile within the plant
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots
**Soil half-life:** 5 – 6 days, but will persist for up to 6 months in dry soil

MCPA 500 applied broadcast at 210 ml/ha to 15 node cotton. Photo taken on 4th Jan, 2 days after exposure.

Initial symptoms of MCPA damage were apparent 2 days after exposure. Plants had a wilted appearance, with twisting of the petioles and main stem, causing mis-orientation of most of the outer leaves.

MCPA 500 applied broadcast at 210 ml/ha to 15 node cotton. Photo taken on 14th Jan, 12 days after exposure.

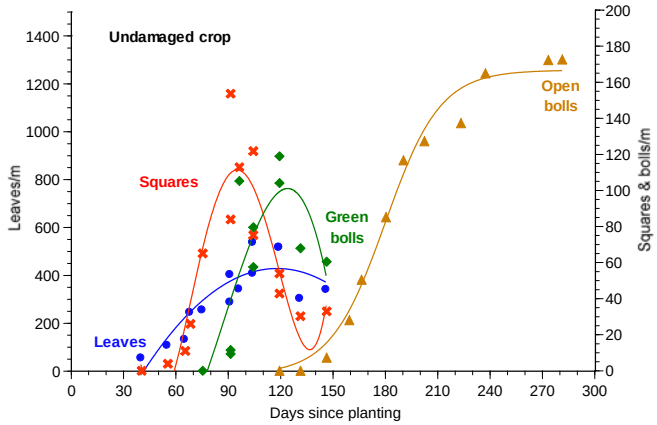
The initial symptoms of MCPA damage were still apparent 12 days after exposure, with twisting of the petioles and main stem. A reddish discolouration had developed on many of the leaves and was particularly prominent on the veins.

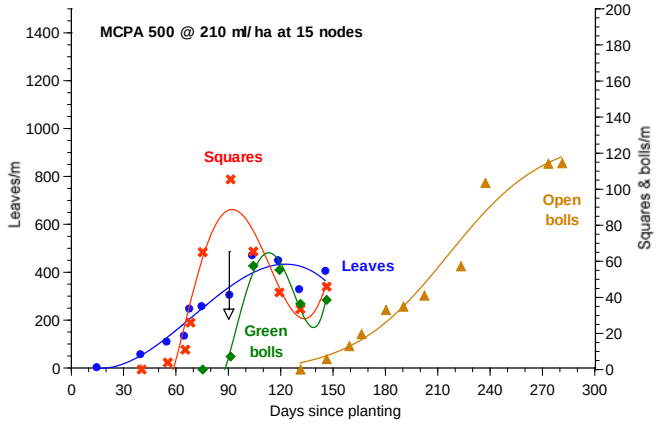
MCPA 500 applied broadcast at 210 ml/ha to 15 node cotton. Photo taken on 25th Jan, 23 days after exposure.

Many of the petioles remain twisted, although most leaves had resumed a more normal orientation. The stems and petioles were still distinctly reddish, with discoloured remaining on some leaves. New leaves were starting to emerge at the top of the plant, but these were showing some signs of phenoxy damage. These leaves were distorted, with crinkled edges and ended in a row of short “fingers”.

MCPA 500 applied broadcast at 210 ml/ha to 15 node cotton. Photo taken on 11th Feb, 40 days after exposure.

Long internodes and distorted leaves were apparent at the top of the plant 40 days after exposure. New leaves were distorted, with crinkled edges and ended in a row of short "fingers", typical of phenoxy damage.




## Impact on plant growth

**Plants:** exposure to a 10% rate of MCPA damaged petioles, stems and new leaves.

**Leaves:** leaf growth and development were initially delayed, but plants compensated and developed more leaves and leaf area later in the season. New leaves were distorted, showing symptoms typical of Group I damage.

**Squares**: the herbicide exposure reduced peak square production, but plants compensated, producing more late-season squares.

**Bolls:** some early boll were shed following the herbicide exposure, with 12% fewer bolls in positions 1 – 3 and few bolls on nodes 10 – 12. Final boll retention was down 22% and boll weight was down by 22%. Boll maturity was delayed by 41 days, with 13% fewer bolls open at picking.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.0) and 10.2% short fibres. Lint yield was reduced by 40%

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **MCPA** |
| **Nodes/plant** | 27.8 | 28.3 |
| **Leaves/m*** | 342 | 403 |
| **Leaf area (cm²/m)*** | 22084 | 24390 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 200 | 157 |
| **Boll weight (g/open boll)** | 4.2 | 3.3 |
| **Retention in posit's 1-3^** | 88% | 77% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 5 - 24 |
| **Days to 50% open** | 187 | 228 |
| **Maturity delay (days)** | | 41 |
| **% Open bolls at picking** | 86% | 75% |
| **Lint yield/ha** | 2246 | 1339 |

Exposure to 10% of a typical field rate of MCPA at 15 nodes appeared to cause relatively little damage to the plants, with some leaf damage and distortion, but plants compensated for this.

However, some early bolls were shed and plants were unable to fully compensate with late season bolls. There was a reduction in boll number, boll weight, crop maturity and fibre quality. Lint yield was reduced by 40%.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA** |
| **Rate:** | **525 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **2nd Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **I**
**Translocation:** readily absorbed by leaves and highly mobile within the plant
**Mode of action:** an auxin-type herbicide that affects plant growth, nitrogen metabolism and enzyme production
**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots
**Soil half-life:** 5 – 6 days, but will persist for up to 6 months in dry soil

MCPA 500 applied broadcast at 1.05 L/ha to 15 node cotton. Photo taken on 4th Jan, 2 days after exposure.

Initial symptoms of MCPA damage were apparent 2 days after exposure. Plants had a wilted appearance, with twisting of the petioles and main stem.

MCPA 500 applied broadcast at 1.05 L/ha to 15 node cotton. Photo taken on 11th Jan, 9 days after exposure.

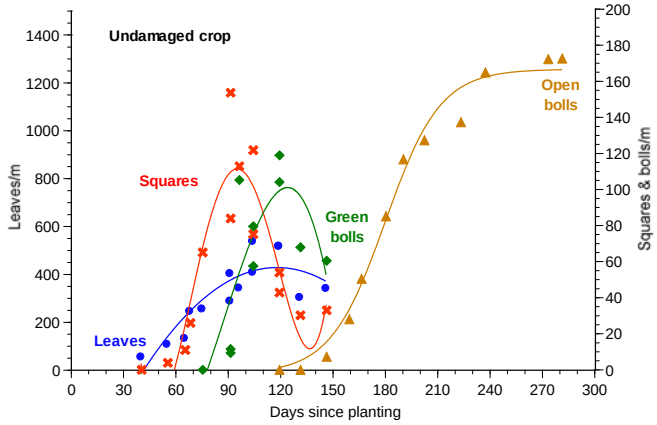
The initial symptoms of MCPA damage were still apparent 9 days after exposure, with twisting of the petioles and main stem. A red discolouration had developed on many of the leaves, suggesting light burning of the leaves. The veins of these leaves were deeper red in colour.

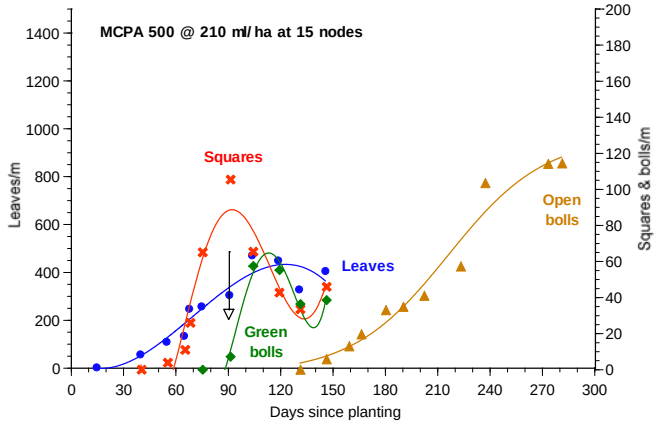
MCPA 500 applied broadcast at 1.05 L/ha to 15 node cotton. Photo taken on 25th Jan, 23 days after exposure.

Many of the petioles remain twisted 23 days after exposure, although most leaves had resumed a more normal orientation. The stems, veins and some leaves were discoloured. New leaves were starting to emerge at the top of the plant and these were showing symptoms typical of Group I damage.

MCPA 500 applied broadcast at 1.05 L/ha to 15 node cotton. Photo taken on 11th Feb, 40 days after exposure.

Long internodes and distorted leaves were apparent at the top of the plants 40 days after exposure. New leaves were distorted, with crinkled edges and ended in a row of short "fingers", as is typical with Group I damage.




## Impact on plant growth

**Plants:** exposure to a 50% rate of MCPA damaged the plants, delaying crop growth and development. Plants were 25% smaller by weight at the last observation.

**Leaves:** new leaves were distorted. Plants had 17% fewer leaves and 49% less leaf area compared to undamaged plants.

**Squares**: the herbicide damage reduced peak squaring, but plants compensated, setting more late squares.

**Bolls:** some early boll were shed following the herbicide exposure, with 12% fewer bolls retained in positions 1 – 3 and few bolls on nodes 8 – 13. Additional bolls were retained to the top of the plant, but final boll retention was down 36% and boll weight was down by 24%. Average boll maturity was delayed by 29 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature and below base grade, with low micronare (2.6), fibre length of 1.117", 10.6% short fibres, and reduced fibre strength. Lint yield was reduced by 62%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **MCPA** |
| **Nodes/plant** | 27.8 | 28.4 |
| **Leaves/m*** | 342 | 282 |
| **Leaf area (cm²/m)*** | 22084 | 11283 |
| **Reduction in leaf area*** | | 49% |
| **Bolls/m** | 200 | 128 |
| **Boll weight (g/open boll)** | 4.2 | 3.2 |
| **Retention in posit's 1-3^** | 88% | 78% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 7 - 27 |
| **Days to 50% open** | 187 | 216 |
| **Maturity delay (days)** | | 29 |
| **% Open bolls at picking** | 86% | 89% |
| **Lint yield/ha** | 2246 | 863 |

Exposure to 50% of a typical field rate of MCPA at 15 nodes delayed plant growth and development for several weeks. Plants were smaller, with fewer leaves and less leaf area at the last observation.

Many early season squares and bolls were shed. Additional late season bolls were retained on outer fruiting positions and higher up the plant. There was a reduction in the final boll number, boll weight, crop maturity and fibre quality. Lint yield was reduced by 62%.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** 2,4-D amine + picloram
**Rate:** 30 g + 7.5 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 14th Oct (pre-planting)
**Growth stage at exposure:**

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | |

## Herbicidal action

**Herbicide group: I**

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 27th Nov, 35 days after emergence.

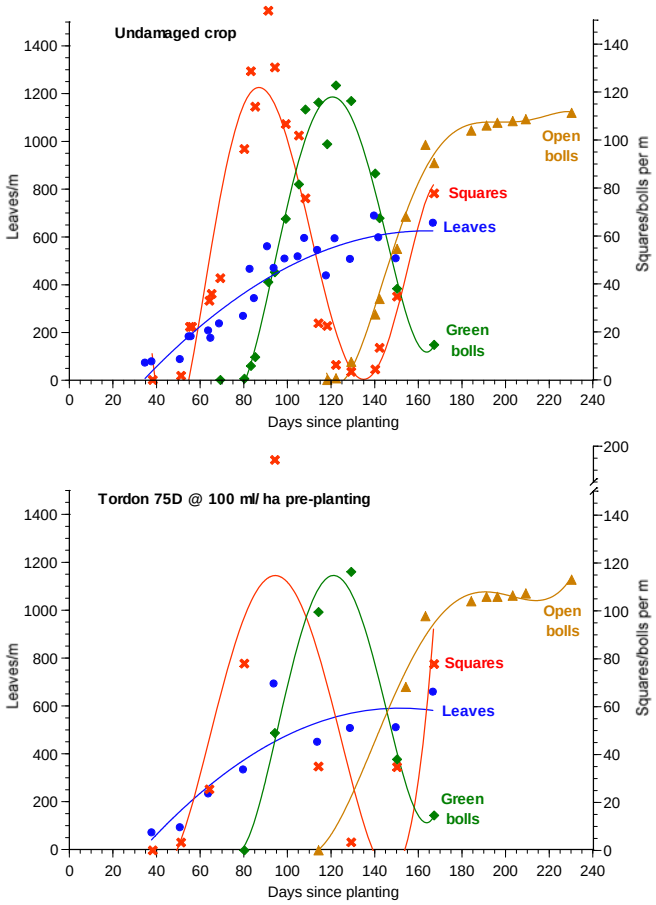
Most plants were growing normally 35 days after emergence. However, symptoms of herbicide damage were apparent on some plants, such as the plant in the photo. New leaves on this plant were cupped and rounded, with crinkled edges and a slightly leathery appearance typical of Group I damage.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

Most plants were growing normally 42 days after emergence. However, symptoms of herbicide damage were apparent on a few plants. Damage symptoms were apparent on one leaf on the plant in the centre of this photo. The leaf was slightly cupped, with crinkled edges and a slightly leathery appearance.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 31st Dec, 69 days after emergence.

The only sign of herbicide damage at this stage, 69 days after emergence, was the crinkled edges seen on many of the leaves in this photo.




## Impact on plant growth

**Plants:** exposure to the 10% rate of 2,4-D + picloram residue caused no visual damage to most plants. However, there was a 13% reduction in the plant stand, plants were 17 cm and 1.3 nodes shorter at picking and were 12% lighter by weight.

**Leaves:** symptoms of damage were visible on some leaves. These leaves were distorted, cupped and with crinkled edges, often with a leathery surface. Plants had 18% fewer leaves and 42% less leaf area at the last observation.

**Squares**: there was no obvious affect on square production.

**Bolls:** there was no affect on boll production or retention, with no change in the distribution of bolls on the plants or delay in crop maturity, although proportionally fewer bolls were open at picking.

**Lint:** the herbicide damage didn't affect ginning turnout, but the cotton fell below base grade with 11.4% short fibres, 1.114" staple length and reduced fibre strength. Lint yield was unaffected.

**Final plant count data**

| | undamaged crop | 2,4-D + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 29.6 |
| **Leaves/m*** | 543 | 447 |
| **Leaf area (cm²/m)*** | 23764 | 13881 |
| **Reduction in leaf area*** | | 42% |
| **Bolls/m** | 132 | 140 |
| **Boll weight (g/open boll)** | 5.3 | 5.2 |
| **Retention in posit's 1-3^** | 95% | 97% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 18 |
| **Days to 50% open bolls** | 157 | 157 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 81% |
| **Lint yield/ha** | 2380 | 2257 |

Exposure to residues of 10% of a typical field rate of 2,4-D + picloram had no obvious impact on most plants, with only a small amount of leaf damage. However, plants were affected season-long, with reductions in plant size and leaf area.

Boll production, the pattern of boll retention, crop maturity and lint yield were unaffected, but there was a reduction in fibre quality.

Note* Leaf number and leaf area were last recorded 114 days after planting.

Note^ Percentage of bolls retained in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine + picloram** |
| **Rate:** | **150 g + 37.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **14th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group: I**

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha and incorporated prior to planting cotton. Photo taken on 24th Nov, 31 days after emergence.

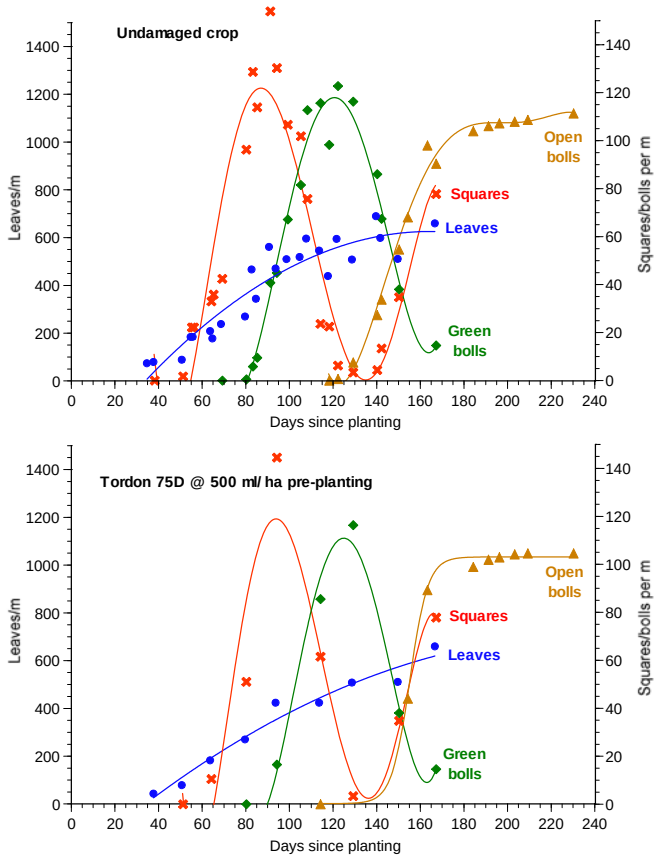
Most plants were growing normally 31 days after emergence. However, symptoms of herbicide damage were apparent on some plants. New leaves on the plant in this photo were cupped, with yellow to reddish margins.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

Most plants were apparently undamaged, but typical symptoms of Group I damage were apparent on some plants 42 days after emergence. Symptoms included leaf distortion and cupping. Some leaves had a leathery appearance with prominent veins.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha and incorporated prior to planting cotton. Photo taken on 31st Dec, 69 days after emergence.

Some plants had distorted leaves, typical of Group I damage 69 days after emergence. Damaged leaves had crinkled edges, a leathery surface, and were distorted in shape, often ending in pointed 'fingers'.




## Impact on plant growth

**Plants:** exposure to 2,4-D + picloram residue caused no visual damage to most plants. However, there was a 30% reduction in the plant stand and plants were 7% smaller by weight at the last observation.

**Leaves:** herbicide damage initially caused cupping and yellowing of the expanding leaves of some plants. Later, these plants had distorted leaves, with damage typical of Group I herbicides. Plants had 22% fewer leaves at the last observation.

**Squares**: there was no observable affect on square production.

**Bolls:** there was no obvious affect on boll production, the pattern of retention or boll weight, but plants had 19% fewer bolls and proportionally fewer of these bolls were open at picking (down by 12%).

**Lint:** the herbicide damage didn't affect ginning turnout, but the cotton fell below base grade with 11.3% short fibres, 1.113" staple length and a 6.5% reduction in fibre strength. Lint yield was down 24%.

**Final plant count data**

| | undamaged crop | 2,4-D + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 32.2 |
| **Leaves/m*** | 543 | 421 |
| **Leaf area (cm²/m)*** | 23764 | 22622 |
| **Reduction in leaf area*** | | 5% |
| **Bolls/m** | 132 | 107 |
| **Boll weight (g/open boll)** | 5.3 | 5.4 |
| **Retention in posit's 1-3^** | 95% | 96% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 18 |
| **Days to 50% open bolls** | 157 | 156 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 75% |
| **Lint yield/ha** | 2380 | 1811 |

Exposure to residues of 50% of a typical field rate of 2,4-D + picloram had no apparent effect on most plants, but reduced the plant stand and caused stunting and leaf damage to some plants, with symptoms typical of the Group I herbicides.

Square and boll production appeared to be largely unaffected, but there was a reduction in the final boll retention, the proportion of open bolls and fibre quality. Lint yield was reduced by 24%.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1-3

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine + picloram** |
| **Rate:** | **30 g + 7.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **25th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

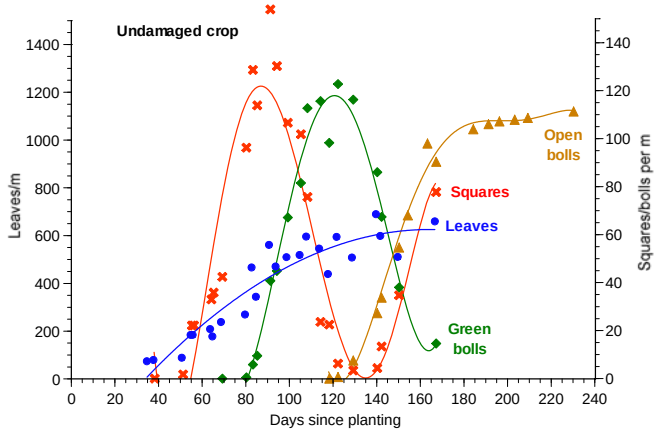
Symptoms of herbicide damage were apparent on the expanding leaves, which are cupped and discoloured, yellowish, turning reddish towards the margins 6 days after exposure.

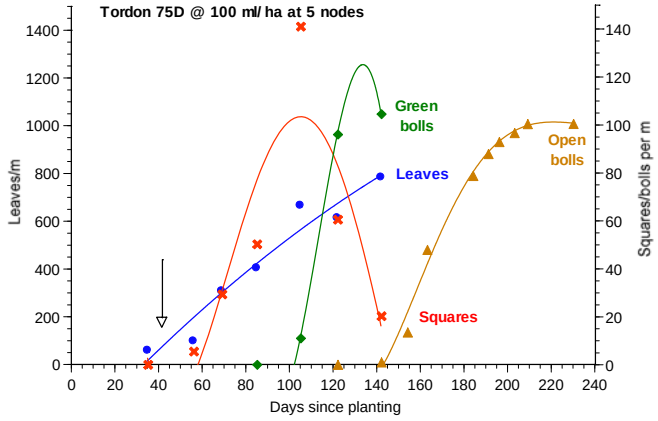
Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

Symptoms typical of Group I damage were obvious on all newly emerged leaves 20 days after exposure. New leaves were mildly to heavily distorted, cupped with crinkled edges or tending towards a narrow wedge shape, ending in multiple narrow fingers.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha to 5 node cotton. Photo taken on 14th Jan, 50 days after exposure.

Most of the top growth was still highly distorted 50 days after exposure, although 'normal' leaves had emerged from the lateral branches. The top leaves were mildly to heavily distorted, cupped with crinkled edges or tending towards a narrow wedge shape, ending in multiple narrow fingers. The leaf surface was lightly blistered and leathery in appearance.




## Impact on plant growth

**Plants:** exposure to the 10% rate of 2,4-D + picloram at 5 nodes caused extensive damage to new growth. The plant stand was reduced by 17%, 80% more plants were tipped-out and plants were 24 cm and 1.3 nodes shorter at picking.

**Leaves:** the herbicide exposure damaged most expanding leaves and all new leaf growth for more than 50 days.

**Squares**: peak square production was delayed by around 15 days.

**Bolls:** no early bolls were retained following the herbicide exposure, resulting in a 25 day delay in initial boll retention. The pattern of boll retention was also altered, with more bolls retained on lateral branches and on outer fruiting positions. Peak boll retention was not delayed, but plants retained 28% fewer bolls and crop maturity was delayed by 15 days.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide exposure, but lint yield was reduced by 26%.

**Final plant count data**

| | undamaged crop | 2,4-D + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 29.6 |
| **Leaves/m*** | 595 | 785 |
| **Leaf area (cm²/m)*** | 24900 | 26835 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 95 |
| **Boll weight (g/open boll)** | 5.3 | 5.2 |
| **Retention in posit's 1-3^** | 95% | 80% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 2 - 18 |
| **Days to 50% open bolls** | 157 | 172 |
| **Maturity delay (days)** | | 15 |
| **% Open bolls at picking** | 85% | 86% |
| **Lint yield/ha** | 2380 | 1753 |

Exposure to 10% of a typical field rate of 2,4-D + picloram at 5 nodes caused extensive leaf damage, reduced the plant stand, and tipped-out many plants, delaying crop growth and development.

Few bolls were retained on the main stem, but the lateral branches developing normally and held most of the boll load. This reduced the boll load and delayed crop maturity but didn't affect fibre quality. Lint yield was reduced by 26%.

Note* Leaf number and leaf area were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine + picloram** |
| **Rate:** | **150 g + 37.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **25th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### 2,4-D

**Translocation:** readily moves to the plant growth points

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited

**Soil half-life:** 10 days in moist soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

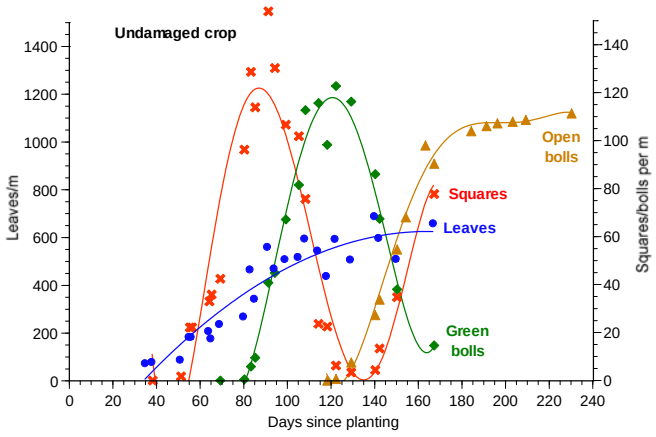
The plants were extensively damaged by the herbicide 6 days after exposure. Plant distortion, with petiole twisting and leaf mis-orientation was apparent soon after the exposure. Leaf burning (red discolouration) was apparent by 6 days, and the growing tips were severely burned.

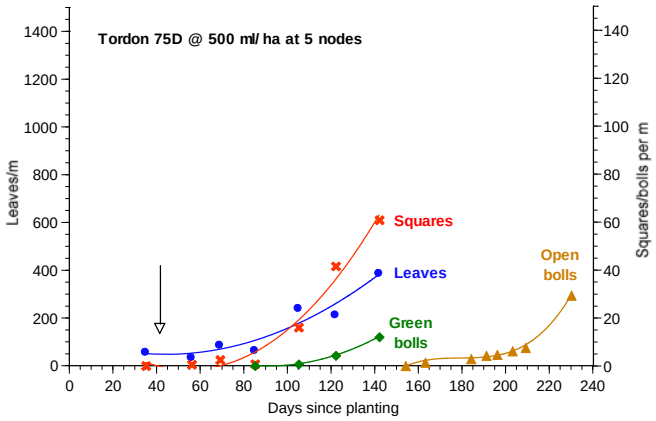
Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

The appearance of the plants changed little over the next 14 days, with no growth occurring on most plants. Leaf damage and some leaf loss, petiole twisting and terminal burning were still very obvious.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 5 node cotton. Photo taken on 14th Jan, 50 days after exposure.

Some plants had not begun to recover from the herbicide damage 50 days after exposure. Growth had resumed on some plants, but the growth was highly distorted. The leaves were cupped with crinkled edges or tending towards a narrow wedge shape, ending in multiple narrow fingers. The leaf surface was lightly blistered and leathery in appearance.




## Impact on plant growth

**Plants:** exposure to the 50% rate of 2,4-D + picloram at 5 nodes severely damaged leaves and terminals, suppressing growth and development for 50 days or more. The plant stand was reduced by 26% and 75% of plants were tipped-out. Plants were 9.8 nodes and 44 cm shorter at picking and 74% smaller by weight.

**Leaves:** all new leaves were distorted. Plants had 35% fewer leaves and 42% less leaf area at the last observation.

**Squares**: square production was delayed by 40 days and peak squaring was reduced.

**Bolls:** no early bolls were retained following the herbicide exposure, giving a 30 day delay in boll retention. Most retained bolls were on the outer fruiting positions on the lateral branches, though few bolls were retained anywhere on the plant. The final boll load was reduced by 52%, boll weight was down 25% and average crop maturity was delayed by more than 80 days.

**Lint:** ginning turnout and fibre quality were unaffected, but lint yield was down 67%.

**Final plant count data**

| | undamaged crop | 2,4-D + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 21.1 |
| **Leaves/m*** | 595 | 386 |
| **Leaf area (cm²/m)*** | 24900 | 14461 |
| **Reduction in leaf area*** | | 42% |
| **Bolls/m** | 132 | 63.8 |
| **Boll weight (g/open boll)** | 5.3 | 3.9 |
| **Retention in posit's 1-3^** | 95% | 57% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 5 - 25 |
| **Days to 50% open bolls** | 157 | >237 |
| **Maturity delay (days)** | | >80 |
| **% Open bolls at picking** | 85% | 46% |
| **Lint yield/ha** | 2380 | 794 |

Exposure to 50% of a typical field rate of 2,4-D + picloram at 5 nodes caused extensive leaf and terminal damage, delaying crop growth and development by around 58 days. Lateral branches were not as affected, but plants were slow to initiate the laterals.

Most bolls were retained on the outer fruiting positions on the lateral branches. Boll production, boll size and crop maturity were all affected. Lint yield was down 67%.

Note* Leaf number and leaf area were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1-3

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine + picloram** |
| **Rate:** | **30 g + 7.5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha to 9 node cotton. Photo taken on 15th Dec, 7 days after exposure.

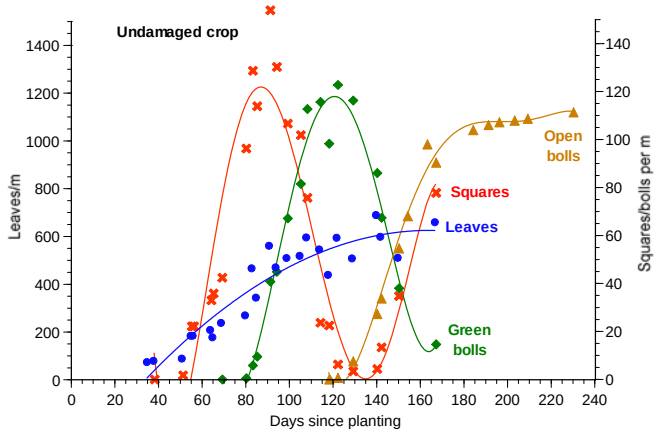
Plant distortion, with petiole reddening and twisting and leaf mis-orientation was apparent soon after the exposure. Leaf burning (red discolouration) was apparent 7 days after exposure.

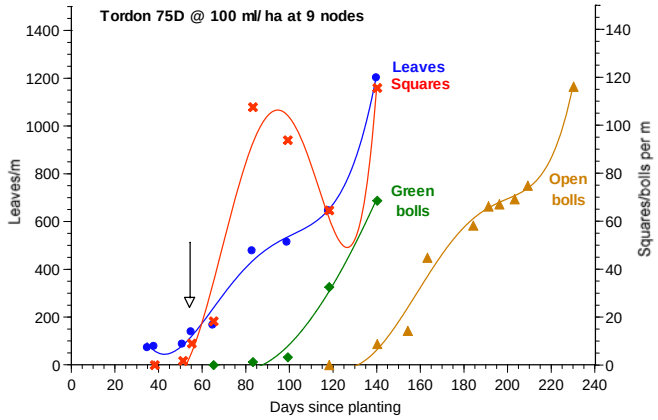
Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

Plants had taken on a stalky appearance, with long internodes and small, often mis-orientated leaves 28 days after exposure. The new growth was highly distorted. Most new leaves were a narrow wedge shape, ending in multiple narrow fingers. The leaf surface was lightly blistered and leathery in appearance.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 100 ml/ha to 9 node cotton. Photo taken on 14th Jan, 37 days after exposure.

Highly distorted growth was obvious on all plants, fringed by some normal growth emerging from the base of the plants 37 days after exposure. The distorted leaves were cupped with crinkled edges or tending towards a narrow wedge shape, ending in multiple narrow fingers. The leaf surface was lightly blistered and leathery in appearance.




## Impact on plant growth

**Plants:** exposure to the 10% rate of 2,4-D + picloram at 9 nodes damaged the plants, damaging leaves and terminals, doubling the proportion of tipped-out plants. Plants responded, producing a flush of new distorted leaf growth, but remained 13 cm shorter at picking.

**Leaves:** plants had 75% more leaves and 40% more leaf area at the last observation.

**Squares**: peak squaring was reduced by around 32%, but plants produced additional late squares.

**Bolls:** few early bolls were retained following the herbicide exposure, giving a 35 day delay in initial boll retention. Additional bolls were retained on lateral branches and outer fruiting positions, increasing the final boll load by 32% but reducing boll weight by 32% and delaying crop maturity by 48 days.

**Lint:** the herbicide damage didn't affect fibre quality but reduced ginning turnout by 6.9% and lint yield by 56%.

**Final plant count data**

| | undamaged crop | 2,4-D + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 30.1 |
| **Leaves/m*** | 687 | 1201 |
| **Leaf area (cm²/m)*** | 23830 | 33438 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 174 |
| **Boll weight (g/open boll)** | 5.3 | 3.6 |
| **Retention in posit's 1-3^** | 95% | 58% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 5 - 20 |
| **Days to 50% open bolls** | 157 | 205 |
| **Maturity delay (days)** | | 48 |
| **% Open bolls at picking** | 85% | 67% |
| **Lint yield/ha** | 2380 | 1052 |

Exposure to 10% of a typical field rate of 2,4-D + picloram at 9 nodes caused extensive leaf and terminal damage.

Plants producing a flush of new, distorted leaf growth, and a flush of late bolls on the lateral branches and the outer fruiting positions. Many of these bolls were small and not mature at picking.

Crop maturity was delayed by 48 days and lint yield was reduced by 56%.

Note* Leaf number and leaf area were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine + picloram** |
| **Rate:** | **150 g + 37.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 9 node cotton. Photo taken on 15th Dec, 7 days after exposure.

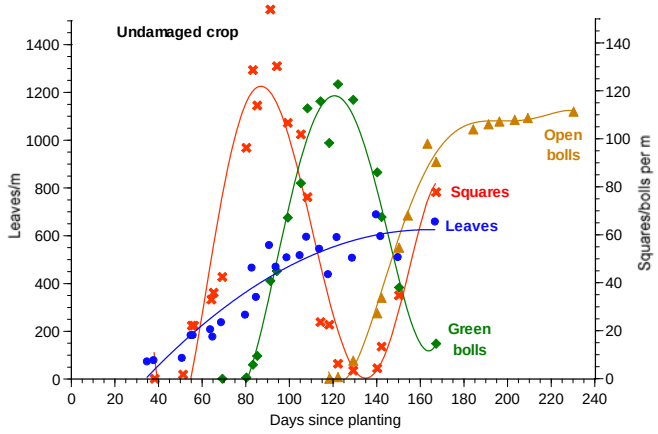
The plants were extensively damaged by the herbicide. Plant distortion, with petiole reddening and twisting and leaf mis-orientation was apparent soon after the exposure. Leaf burning (red discolouration) was apparent 7 days after exposure, and the growing tips were severely damaged.

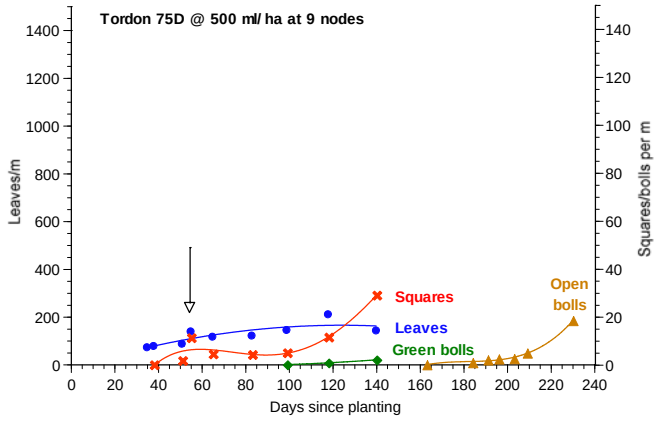
Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

Plants had begun to recover by 28 days after exposure, with new top growth and lateral growth. The new growth was highly distorted. Most new leaves were a narrow wedge shape, ending in multiple narrow fingers. The leaf surface was lightly blistered and leathery in appearance.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 9 node cotton. Photo taken on 14th Jan, 37 days after exposure.

Highly distorted growth is obvious on all plants, fringed by some normal growth at the base of the plants 37 days after exposure. The distorted leaves were cupped with crinkled edges or tending towards a narrow wedge shape, ending in multiple narrow fingers. The leaf surface was lightly blistered and leathery in appearance.




## Impact on plant growth

**Plants:** exposure to the 50% rate of 2,4-D + picloram at 9 nodes damaging the leaves and terminals, delaying plant growth and development. New growth was distorted and 65% of plants were tipped out. Plants were 13 nodes and 70 cm shorter at picking, and 84% smaller by weight.

**Leaves:** plants had 79% fewer leaves and 82% less leaf area at the last observation.

**Squares**: square production was delayed by more than 60 days and peak squaring was greatly reduced.

**Bolls:** no early bolls were retained following the herbicide exposure, giving a >70 day delay in boll retention. Most retained bolls were on the outer fruiting positions of the lateral branches, though few bolls were retained. The final boll load was reduced by 65%, only 53% of bolls were open at picking, boll weight was down 14% and crop maturity was delayed by >80 days.

**Lint:** ginning turnout was reduced by 8.4% and the fibre was immature, with low micronaire (3.3). Lint yield was down 87%.

**Final plant count data**

| | undamaged crop | 2,4-D + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 17.9 |
| **Leaves/m*** | 687 | 141 |
| **Leaf area (cm²/m)*** | 23830 | 4203 |
| **Reduction in leaf area*** | | 82% |
| **Bolls/m** | 132 | 46 |
| **Boll weight (g/open boll)** | 5.3 | 4.5 |
| **Retention in posit's 1-3^** | 95% | 53% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 10 - 18 |
| **Days to 50% open bolls** | 157 | >237 |
| **Maturity delay (days)** | | >80 |
| **% Open bolls at picking** | 85% | 40% |
| **Lint yield/ha** | 2380 | 310 |

Exposure to 50% of a typical field rate of 2,4-D + picloram at 9 nodes caused extensive leaf and terminal damage, delaying crop growth and development on both the main stem and lateral branches. Plants were very slow to recover from the damage and remained very stunted.

Boll production, the pattern of boll retention, boll size, ginning percentage, fibre quality and crop maturity were all affected. Lint yield was reduced by 87%.

Note* Leaf number and leaf area were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1-3

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **2,4-D amine + picloram** |
| **Rate:** | **150 g + 37.5 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (12 weeks post-emergence)** |
| **Growth stage at exposure:** | **17 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 17 node cotton. Photo taken on 19th Jan, 6 days after exposure.

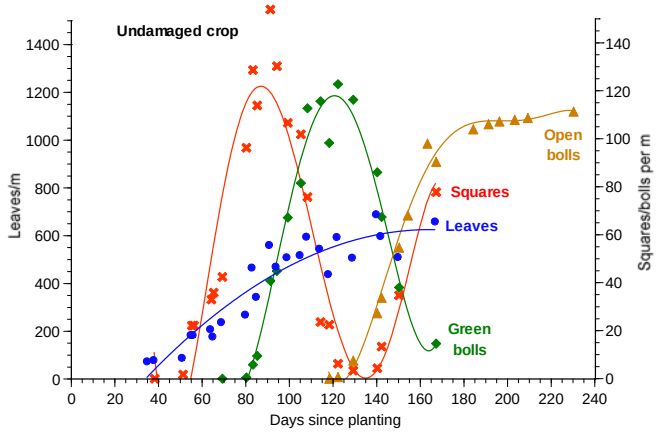
Mild plant distortion, with some petiole twisting and leaf mis-orientation was apparent soon after the exposure. Some leaf scorching was also apparent 6 days after exposure, with reddish patches on some upper leaves.

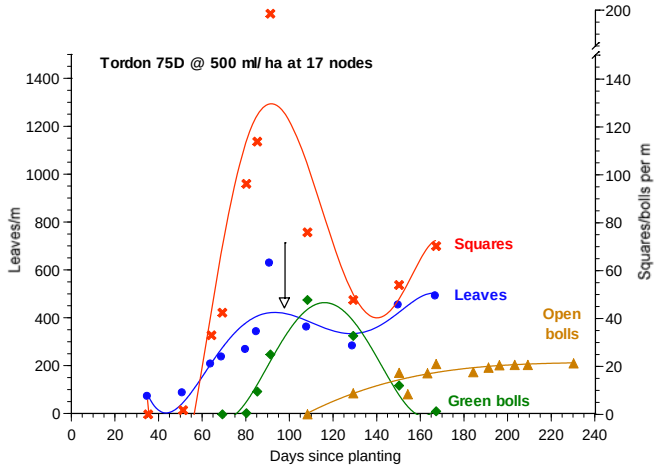
Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 17 node cotton. Photo taken on 10th Feb, 33 days after exposure.

Terminal damage with petiole reddening and twisting and leaf mis-orientation became more apparent with time. Some leaves had been lost and no new growth had emerged from the plant terminals 33 days after exposure.

Tordon 75D (2,4-D amine + picloram) applied broadcast at 500 ml/ha to 17 node cotton. Photo taken on 11th Mar, 62 days after exposure.

Highly distorted new growth was developing from the terminals of some plants, but must plants had not resumed growth. Normal growth was emerging from the lower lateral branches. The distorted leaves were a narrow wedge shape, ending in multiple narrow fingers. The leaf surface was lightly blistered and leathery in appearance.




## Impact on plant growth

**Plants:** exposure to the 50% rate of 2,4-D + picloram at 17 nodes caused extensive damage to the leaves and terminals which continued for more than 60 days post-exposure. Plants were 10.5 nodes and 47 cm shorter at picking.

**Leaves:** plants had 25% fewer leaves and 61% less leaf area at the final observation.

**Squares**: plants produced a flush of late squares to compensate for lost bolls.

**Bolls:** the herbicide exposure caused the shedding of many young bolls; very few bolls were retained and developed following the herbicide. Only 21 mature bolls/m were present at picking. These bolls were mainly on nodes 7 – 12, with most on nodes 8 and 9. The final boll count was reduced by 52% and boll weight was down by 58%. Crop maturity was delayed by more than 80 days.

**Lint:** the herbicide damaged the developing bolls and reduced seed size, increasing ginning turnout to 55%. Lint yield was reduced by 82%.

**Final plant count data**

| | undamaged crop | 2,4-D + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 20.4 |
| **Leaves/m*** | 656 | 490 |
| **Leaf area (cm²/m)*** | 21196 | 8330 |
| **Reduction in leaf area*** | | 61% |
| **Bolls/m** | 132 | 64 |
| **Boll weight (g/open boll)** | 5.3 | 2.2 |
| **Retention in posit's 1-3^** | 95% | 96% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 12 |
| **Days to 50% open bolls** | 157 | >237 |
| **Maturity delay (days)** | | >80 |
| **% Open bolls at picking** | 85% | 33% |
| **Lint yield/ha** | 2380 | 434 |

Exposure to 50% of a typical field rate of 2,4-D + picloram at 17 nodes caused major damage to the leaves and terminals. The damage resulted in the loss of nearly all bolls, with almost no bolls retained on the top 18 nodes. Some new bolls were retained on the lower branches, but these bolls were very late and small, resulting in a long delay in crop maturity. Every aspect of plant growth and development was affected. Lint yield was down 82%.

Note* Leaf number and leaf area were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1-3

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA + picloram** |
| **Rate:** | **42 g + 2.6 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **14th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group: I**

### MCPA

**Translocation:** readily absorbed by leaves and highly mobile within the plant

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots.

**Soil half-life:** 5 - 6 days, but will persist for up to 6 months in a dry soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** typically 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

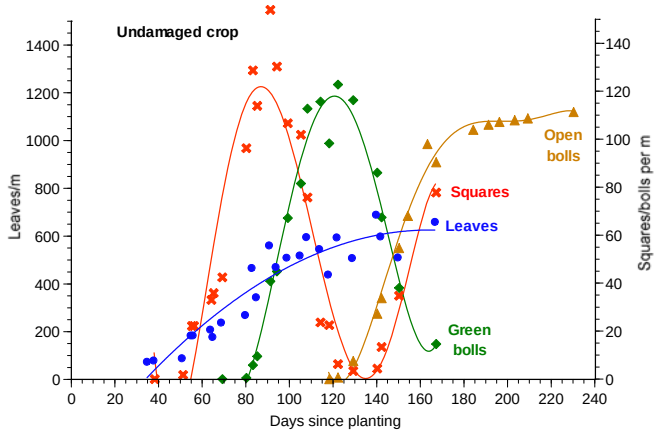
Plants showed no symptoms of herbicide damage at any stage.

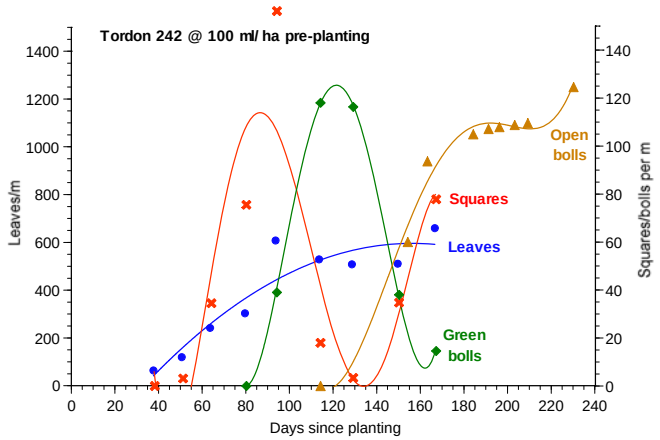
Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 10th Dec, 48 days after emergence.

Plants showed no symptoms of herbicide damage at any stage.

Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha and incorporated prior to planting cotton. Photo taken on 14th Jan, 83 days after emergence.

Plants showed no symptoms of herbicide damage at any stage.




## Impact on plant growth

**Plants:** exposure to the 10% rate of residual MCPA + picloram had no visible effect on the cotton, and no impact on plant size.

**Leaves:** the herbicide had no impact on leaf number but the exposed plants had 6% less leaf area at the final observation.

**Squares**: there was no observable effect on square production.

**Bolls:** there was no apparent effect on boll production, but plants retained 25% more bolls at harvest, with fewer late bolls There was no reduction in the size of the open bolls or delay in average crop maturity, but there were proportionally fewer bolls open at picking, down by10%.

**Lint:** ginning turnout and fibre quality were not affected by herbicide residues. There was a 9% **increase** in lint yield compared to the undamaged crop.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **MCPA + picloram** |
| **Nodes/plant** | 30.9 | 30.3 |
| **Leaves/m*** | 543 | 526 |
| **Leaf area (cm²/m)*** | 23764 | 22251 |
| **Reduction in leaf area*** | | 6% |
| **Bolls/m** | 132 | 164 |
| **Boll weight (g/open boll)** | 5.3 | 5.0 |
| **Retention in posit's 1-3^** | 95% | 96% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 16 |
| **Days to 50% open bolls** | 157 | 158 |
| **Maturity delay (days)** | | 1 |
| **% Open bolls at picking** | 85% | 76% |
| **Lint yield/ha** | 2380 | 2592 |

Exposure to 10% of a typical field rate of MCPA + picloram residues caused no observable damage to the cotton. There was a reduction in mid-season leaf area and the proportion of bolls open at picking, but no maturity delay, reduction in fibre quality or reduction in yield.

Nevertheless, damage from residual herbicides can be greatly influenced by early-season conditions. More damage may have occurred in a season with wetter and/or colder conditions following planting.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA + picloram** |
| **Rate:** | **210 g + 13 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **14th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### MCPA

**Translocation:** readily absorbed by leaves and highly mobile within the plant

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots.

**Soil half-life:** 5 - 6 days, but will persist for up to 6 months in a dry soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** typically 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

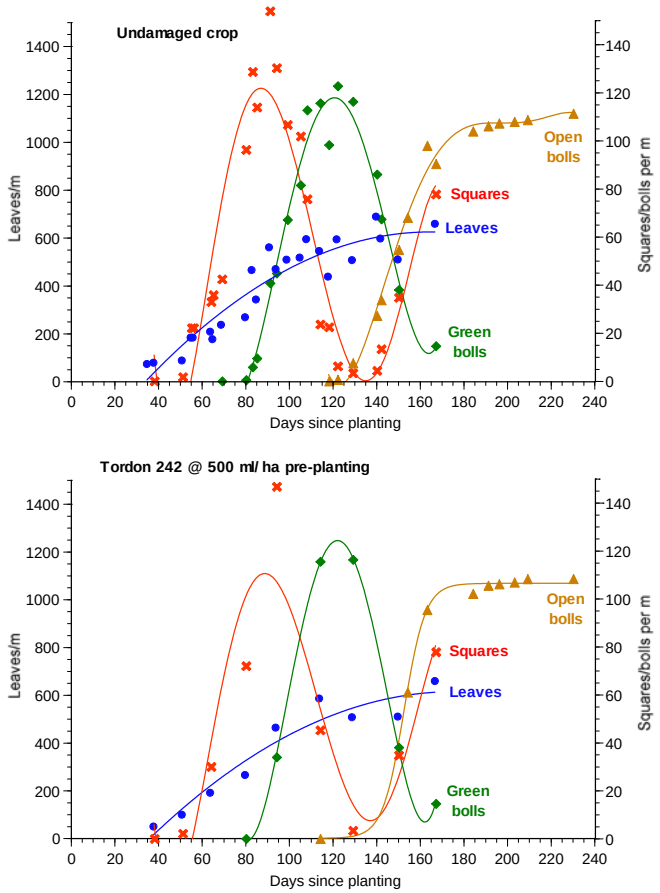
Most plants showed no symptoms of herbicide damage.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha and incorporated prior to planting cotton. Photo taken on 10th Dec, 48 days after emergence.

A few plants expressed symptoms more typical of Group I damage, with distorted leaves 48 days after emergence. These leaves had curved edges, a blistered, leathery appearance and were more pointed, ending in 'fingers'.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha and incorporated prior to planting cotton. Photo taken on 14th Jan, 83 days after emergence.

No symptoms of herbicide damage were apparent by this stage, 83 days after emergence.




## Impact on plant growth

**Plants:** exposure to the 50% rate of residual MCPA + picloram had no visible effect on most cotton plants. However, plants were 11 cm and 2.5 nodes shorter at the end of the season.

**Leaves:** the herbicide had no effect other than some early-season leaf damage on a few plants.

**Squares**: there was no apparent effect on square production.

**Bolls:** the herbicide affected boll retention and most later bolls were shed, with few bolls retained above node 16, 2 nodes lower than on the undamaged crop. There was a 16% reduction in the number of bolls retained at picking, but no reduction in the size of the open bolls or delay in crop maturity.

**Lint:** ginning turnout, fibre quality and lint yield were unaffected by the herbicide residues.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **MCPA + picloram** |
| **Nodes/plant** | 30.9 | 28.4 |
| **Leaves/m*** | 543 | 584 |
| **Leaf area (cm²/m)*** | 23764 | 22988 |
| **Reduction in leaf area*** | | 3% |
| **Bolls/m** | 132 | 111 |
| **Boll weight (g/open boll)** | 5.3 | 5.3 |
| **Retention in posit's 1-3^** | 95% | 99% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 17 |
| **Days to 50% open bolls** | 157 | 153 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 84% |
| **Lint yield/ha** | 2380 | 2350 |

Exposure to 50% of a typical field rate of MCPA + picloram residues caused little damage to the cotton, although plants were shorter with fewer nodes at picking.

The pattern of boll retention was affected, with few bolls retained above node 16 and fewer bolls retained at picking. There was no effect on boll size, delay in crop maturity or reduction in lint yield

Nevertheless, more damage may have occurred in another season.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA + picloram** |
| **Rate:** | **42 g + 2.6 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **25th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group: I**

### MCPA

**Translocation:** readily absorbed by leaves and highly mobile within the plant

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots.

**Soil half-life:** 5 - 6 days, but will persist for up to 6 months in a dry soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** typically 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

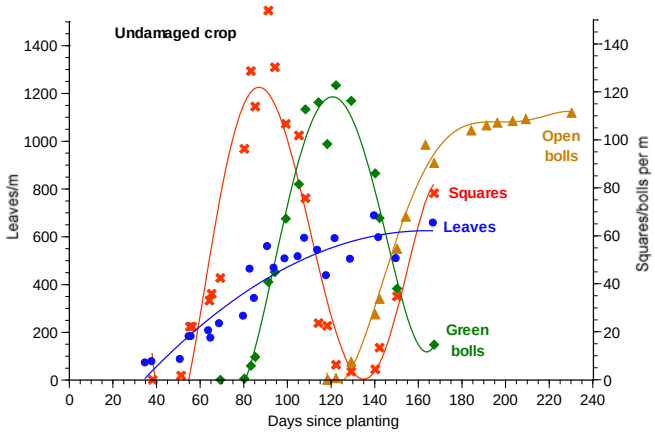
Damage symptoms were apparent as cupping, blistering and yellowing of expanding leaves 6 days after exposure.

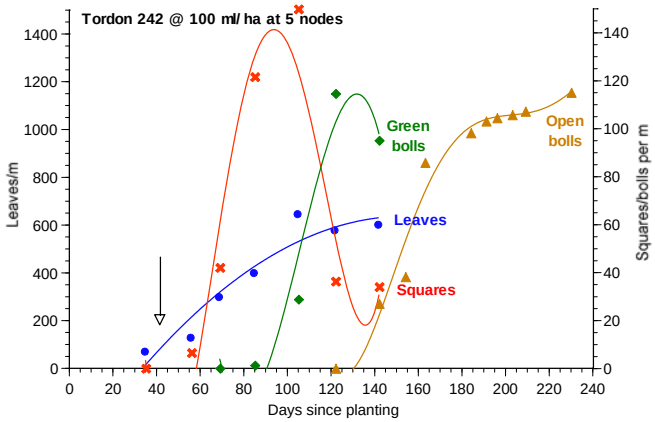
Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

New growth showed symptoms typical of Group I damage 20 days after exposure. Leaves were cupped and distorted, with crinkled edges and pointed margins ending in 'fingers'. Leaves varied in width from narrow to rounded.

Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 5 node cotton. Photo taken on 14th Jan, 50 days after exposure.

Few symptoms of herbicide damage were still apparent 50 days after exposure, although many of the top leaves are more crinkled than is normally the case.




## Impact on plant growth

**Plants:** exposure to the 10% rate of MCPA + picloram at 5 nodes damaged the expanding leaves and caused extensive distortion of the leaves which emerged soon after the exposure. There was a 60% increase in the proportion of tipped-out plants, and plants were 8 cm shorter at picking.

**Leaves:** there was no reduction in leaf number but plants had 16% less leaf area.

**Squares**: the herbicide damage had no obvious impact on square production.

**Bolls:** there was a 10 day delayed in the initial boll retention, with few bolls retained below the 9th node. There was no reduction in peak boll production but proportionally fewer of the bolls were open at picking (down by 7%), the open bolls were 8% lighter and crop maturity was delayed by 3 days.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide residues but lint yield was reduced by 11%.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **MCPA + picloram** |
| **Nodes/plant** | 30.9 | 32.2 |
| **Leaves/m*** | 595 | 598 |
| **Leaf area (cm²/m)*** | 24900 | 20863 |
| **Reduction in leaf area*** | | 16% |
| **Bolls/m** | 132 | 147 |
| **Boll weight (g/open boll)** | 5.3 | 4.9 |
| **Retention in posit's 1-3^** | 95% | 95% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 20 |
| **Days to 50% open bolls** | 157 | 160 |
| **Maturity delay (days)** | | 3 |
| **% Open bolls at picking** | 85% | 78% |
| **Lint yield/ha** | 2380 | 2115 |

Exposure to 10% of a typical field rate of MCPA + picloram at 5 nodes caused extensive leaf distortion. However, plant growth and development later in the season were largely unaffected.

Many early bolls were lost, but plants retained more later bolls, altering the pattern of boll retention. The herbicide damage resulted in no appreciable delay in crop maturity, but there was an 11% reduction in lint yield.

Note* These parameters were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA + picloram** |
| **Rate:** | **210 g + 13 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **25th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### MCPA

**Translocation:** readily absorbed by leaves and highly mobile within the plant

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots.

**Soil half-life:** 5 - 6 days, but will persist for up to 6 months in a dry soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** typically 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

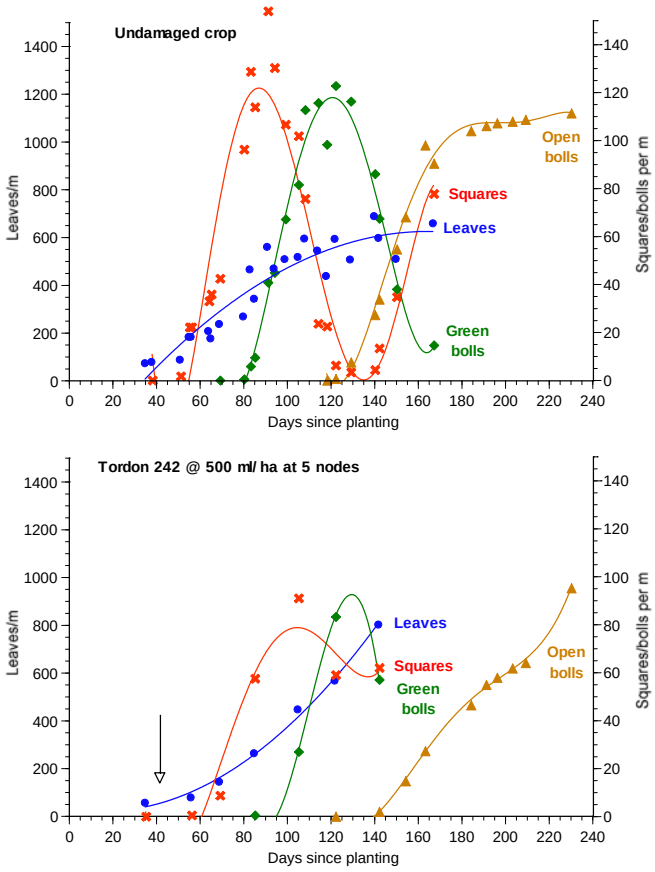
Damage symptoms were readily apparent as reddening and twisting of the petioles and main stems 6 days after exposure.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

New growth showed symptoms typical of Group I damage 20 days after exposure. Leaves were cupped and distorted, with crinkled edges and pointed margins ending in 'fingers'.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 5 node cotton. Photo taken on 14th Jan, 50 days after exposure.

Symptoms of herbicide damage were still apparent 50 days after exposure. Many of the newer leaves were distorted, leathery in appearance, with crinkled edges and prominent veins.




## Impact on plant growth

**Plants:** exposure to a 50% rate of MCPA + picloram caused severe stunting and distortion, delaying plant growth and development. Normal growth resumed more than 50 days after exposure. 70% of plants were tipped-out and were 18% smaller by weight at the final observation.

**Leaves:** plants responded with increased following exposure. Plants had 34% more leaves and 55% more leaf area.

**Squares**: peak square production was delayed by 10 days and reduced by 30%. Plants produced mid- and late-season squares.

**Bolls:** boll retention was delayed by 15 days, with few bolls retained below the node 9. Peak boll production was reduced by 33%, but more bolls were retained on later positions, with in no reduction in the final boll load. Open bolls were 10% lighter, 11% fewer bolls were open at picking and crop maturity was delayed by 41 days.

**Lint:** ginning turnout and fibre quality were unaffected but yield was reduced by 40%.

**Final plant count data**

| | undamaged crop | MCPA + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 29.9 |
| **Leaves/m*** | 595 | 800 |
| **Leaf area (cm²/m)*** | 24900 | 38580 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 127 |
| **Boll weight (g/open boll)** | 5.3 | 4.7 |
| **Retention in posit's 1-3^** | 95% | 77% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 5 - 22 |
| **Days to 50% open bolls** | 157 | 198 |
| **Maturity delay (days)** | | 41 |
| **% Open bolls at picking** | 85% | 75% |
| **Lint yield/ha** | 2380 | 1422 |

Exposure to 50% of a typical field rate of MCPA + picloram at 5 nodes severely damage the cotton plants, initially causing twisting and stunting, and later causing the production of distorted leaves.

Plant growth and development, square and boll production were all delayed. Many lower bolls were shed and fewer bolls were retained in the first 3 fruiting positions. There was a reduction in boll size, a delay in crop maturity and a 40% reduction in lint yield.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA + picloram** |
| **Rate:** | **42 g + 2.6 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group: I**

### MCPA

**Translocation:** readily absorbed by leaves and highly mobile within the plant

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots.

**Soil half-life:** 5 - 6 days, but will persist for up to 6 months in a dry soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** typically 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 10 node cotton. Photo taken on 15th Dec, 7 days after exposure.

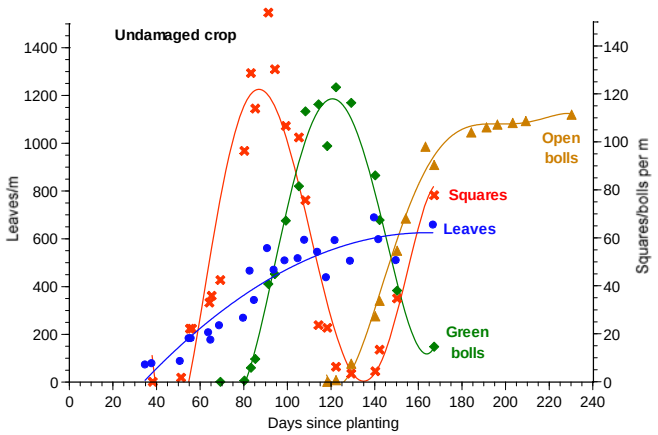
Damage symptoms were apparent soon after exposure as reddening and twisting of the leaf petioles, mis-orientating the leaves and causing the plants to have a wilted appearance. Leaf damage was also apparent 7 days after exposure, with patches of reddened tissue on the leaves, particularly along the veins.

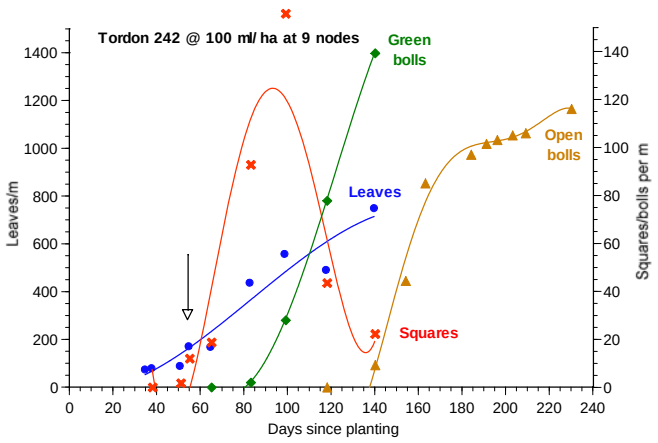
Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 10 node cotton. Photo taken on 5th Jan, 28 days after exposure.

New growth showed symptoms typical of Group I damage 28 days after exposure. Leaves were cupped and distorted, with crinkled edges and pointed margins ending in 'fingers'. Leaves varied in width from narrow to rounded. Some had a blistered, leathery appearance.

Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 10 node cotton. Photo taken on 14th Jan, 37 days after exposure.

Symptoms of herbicide damage were still readily apparent more than 50 days after exposure. Leaves were cupped and distorted, with crinkled edges and pointed margins ending in 'fingers'. Leaves varied in width from narrow to rounded. Some had a blistered, leathery appearance with prominent veins.




## Impact on plant growth

**Plants:** exposure to the 10% rate of MCPA + picloram at 10 nodes caused stunting and a delay in plant growth and development. There were 40% more tipped-out plants and plants remained 2.2 nodes and 12 cm shorter at picking.

**Leaves:** the herbicide damaged the expanding leaves and caused extensive distortion of the leaves which emerged soon after the exposure. Plants responded with increased late-season grown and had 9% more leaves and 20% more leaf area at picking.

**Squares**: the herbicide damage delayed peak square production by 10 days.

**Bolls:** the herbicide exposure delayed initial boll retention by 10 days, although plants compensated by producing more late bolls. Few bolls were retained above node 15, 3 nodes lower than the undamaged crop. There was a 15% reduction in boll weight but no impact on crop maturity.

**Lint:** ginning turnout and fibre quality were unaffected but yield was reduced by 18%.

**Final plant count data**

| | undamaged crop | MCPA + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 28.7 |
| **Leaves/m*** | 687 | 747 |
| **Leaf area (cm²/m)*** | 23830 | 28678 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 138 |
| **Boll weight (g/open boll)** | 5.3 | 4.5 |
| **Retention in posit's 1-3^** | 95% | 95% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 6 - 20 |
| **Days to 50% open bolls** | 157 | 159 |
| **Maturity delay (days)** | | 2 |
| **% Open bolls at picking** | 85% | 84% |
| **Lint yield/ha** | 2380 | 1955 |

Exposure to 10% of a typical field rate of MCPA + picloram at 10 nodes damaged the cotton plants, causing extensive leaf distortion and a delay in growth and development.

Initial boll retention, the pattern of boll retention and boll weight were affected, with few bolls retained above node 15, but there was no effect on fibre quality and no appreciable delay in crop maturity. Lint yield was reduced by 18%.

Note* These parameters were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA + picloram** |
| **Rate:** | **210 g + 13 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### MCPA

**Translocation:** readily absorbed by leaves and highly mobile within the plant

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots.

**Soil half-life:** 5 - 6 days, but will persist for up to 6 months in a dry soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** typically 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 10 node cotton. Photo taken on 15th Dec, 7 days after exposure.

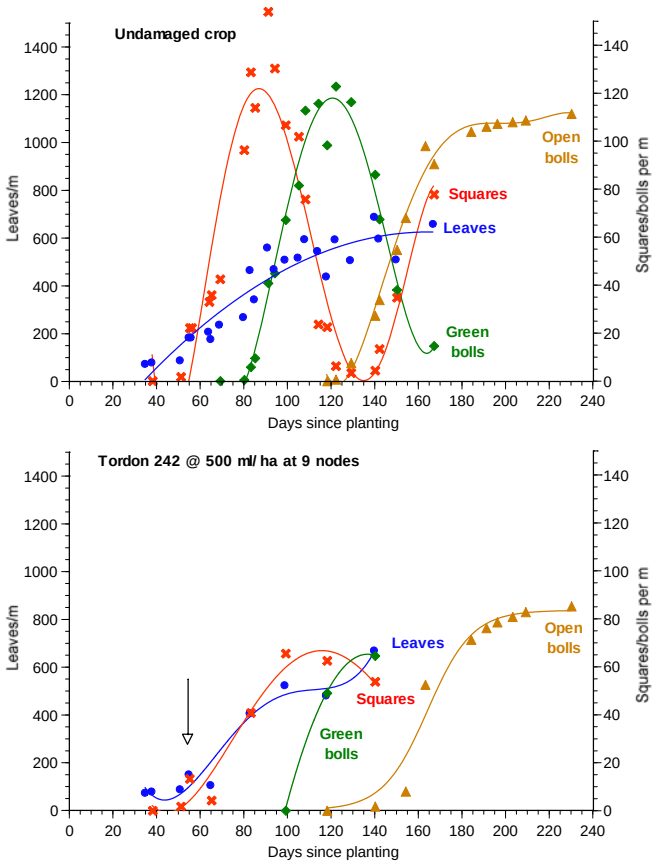
Damage symptoms were apparent soon after exposure as reddening and twisting of the leaf petioles, mis-orientating the leaves and causing the plants to have a wilted appearance. Leaf damage was also apparent 7 days after exposure, with patches of reddened tissue on the leaves, particularly along the veins.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 10 node cotton. Photo taken on 5th Jan, 28 days after exposure.

New growth showed symptoms typical of Group I damage 28 days after exposure. Leaves were cupped and distorted, with crinkled edges and pointed margins ending in 'fingers'. Leaves varied in width from narrow to rounded. Some had a blistered, leathery appearance.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 10 node cotton. Photo taken on 14th Jan, 37 days after exposure.

Symptoms of herbicide damage were still readily apparent more than 50 days after exposure. Leaves were cupped and distorted, with crinkled edges and pointed margins ending in 'fingers'. Leaves varied in width from narrow to rounded. Some had a blistered, leathery appearance with prominent veins.




## Impact on plant growth

**Plants:** exposure to the 50% rate of MCPA + picloram at 10 nodes caused stunting plants and delayed plant growth and development. Double the number of plants were tipped-out and plants were 33% smaller by weight and remained 3.4 nodes and 33 cm shorter at picking.

**Leaves:** the herbicide damaged the expanding leaves and caused extensive distortion of the leaves which emerged soon after the exposure. Plants had 6% less leaf area at the last observation.

**Squares**: peak square production was reduced by 58% and delayed by 35 days.

**Bolls:** the herbicide exposure delayed initial boll retention by 15 days, with the final boll load reduced by 25%. The pattern of boll retention was largely unaffected, but there was a 13% reduction in boll weight. Crop maturity was delayed by 9 days.

**Lint:** fibre quality was unaffected by the herbicide residues but ginning turnout was down by 5.4% and lint yield by 47%.

**Final plant count data**

| | undamaged crop | MCPA + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 27.5 |
| **Leaves/m*** | 687 | 667 |
| **Leaf area (cm²/m)*** | 23830 | 22348 |
| **Reduction in leaf area*** | | 6% |
| **Bolls/m** | 132 | 99 |
| **Boll weight (g/open boll)** | 5.3 | 4.6 |
| **Retention in posit's 1-3^** | 95% | 91% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 6 - 19 |
| **Days to 50% open bolls** | 157 | 166 |
| **Maturity delay (days)** | | 9 |
| **% Open bolls at picking** | 85% | 86% |
| **Lint yield/ha** | 2380 | 1260 |

Exposure to 50% of a typical field rate of MCPA + picloram at 10 nodes damaged the cotton plants, causing extensive leaf distortion and a delay in plant growth and development.

The herbicide damage delayed and reduced square and boll production and retention. Average boll weight was reduced. There was a 9 day delay in crop maturity and a 47% reduction in lint yield.

Note* These parameters were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA + picloram** |
| **Rate:** | **42 g + 2.6 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Jan (12 weeks post-emergence)** |
| **Growth stage at exposure:** | **17 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### MCPA

**Translocation:** readily absorbed by leaves and highly mobile within the plant

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots.

**Soil half-life:** 5 - 6 days, but will persist for up to 6 months in a dry soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** typically 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 17 node cotton. Photo taken on 14th Jan, 1 day after exposure.

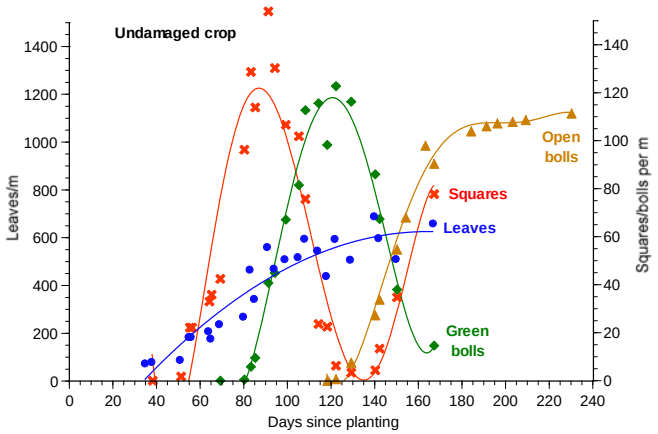
Damage symptoms were apparent soon after exposure with twisting of the leaf petioles, mis-orientating the leaves, giving the plant a wilted appearance.

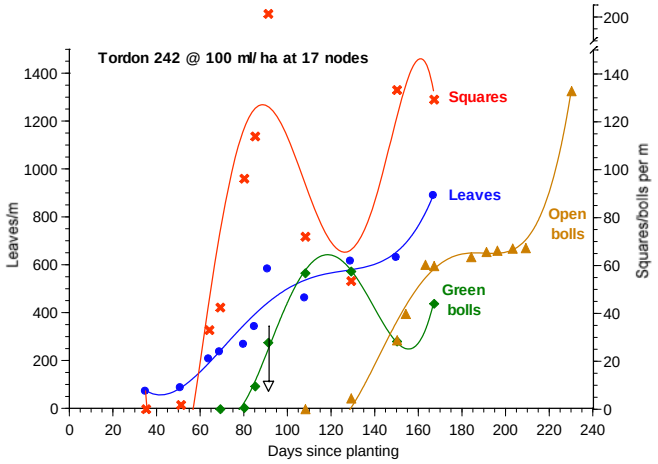
Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 17 node cotton. Photo taken on 20th Jan, 7 days after exposure.

As well as petiole twisting, the herbicide damage caused reddening of the petioles and yellow discolouration of some expanding leaves. This discolouration was most commonly on the leaf margins and often associated with a 'blistered' appearance, but the whole leaf was affected in this photo.

Tordon 242 (MCPA + picloram) applied broadcast at 100 ml/ha to 17 node cotton. Photo taken on 10th Feb, 33 days after exposure.

Symptoms of herbicide damage were apparent on most new leaves, which were generally cupped, with crinkled edges 33 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 10% rate of MCPA + picloram initially caused petiole twisting and mild damage to expanding leaves. Most new growth was distorted, with mild damage typical of phenoxy herbicides. There was no impact on plant size.

**Leaves:** plants produced a flush of new leaves late in the season, with 35% more leaves present at the last observation.

**Squares**: plants responded to the damage by producing a flush of late squares.

**Bolls:** the herbicide exposure caused many early bolls to be aborted. Plants compensated for the damage, setting a heavy late crop. Most bolls were retained on nodes 7 – 15 and 21 – 25, with few bolls between nodes 15 and 21. There was a 37 day delay in average crop maturity.

**Lint:** the herbicide residues affected seed size and lint development, resulting in smaller seeds and a 7% increase in ginning turnout. Fibre quality was reduced below base grade, with 1.094" staple length, 12.1% short fibres, and fibre strength o 26.1. Lint yield was reduced by 45%.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **MCPA + picloram** |
| **Nodes/plant** | 30.9 | 31.3 |
| **Leaves/m*** | 656 | 889 |
| **Leaf area (cm²/m)*** | 21196 | 21574 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 157 |
| **Boll weight (g/open boll)** | 5.3 | 5.4 |
| **Retention in posit's 1-3^** | 95% | 90% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 26 |
| **Days to 50% open bolls** | 157 | 194 |
| **Maturity delay (days)** | | 37 |
| **% Open bolls at picking** | 85% | 85% |
| **Lint yield/ha** | 2380 | 1317 |

Exposure to 10% of a typical field rate of MCPA + picloram at 17 nodes caused leaf mis-orientation and mild distortion of most new leaves. Plants responded with a late flush of vegetative growth.

The damage caused the loss of most small bolls between nodes 15 and 21, but there was a flush of late squares and bolls, with bolls retained to node 26. There was a delay in crop maturity, a reduction in fibre quality and a 45% reduction in lint yield.

Note* These parameters were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **MCPA + picloram** |
| **Rate:** | **210 g + 13 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (12 weeks post-emergence)** |
| **Growth stage at exposure:** | **17 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### MCPA

**Translocation:** readily absorbed by leaves and highly mobile within the plant

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** limited, although surface residues can be washed into the soil and are readily absorbed by roots and emerging shoots.

**Soil half-life:** 5 - 6 days, but will persist for up to 6 months in a dry soil

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** typically 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 17 node cotton. Photo taken on 19th Jan, 6 days after exposure.

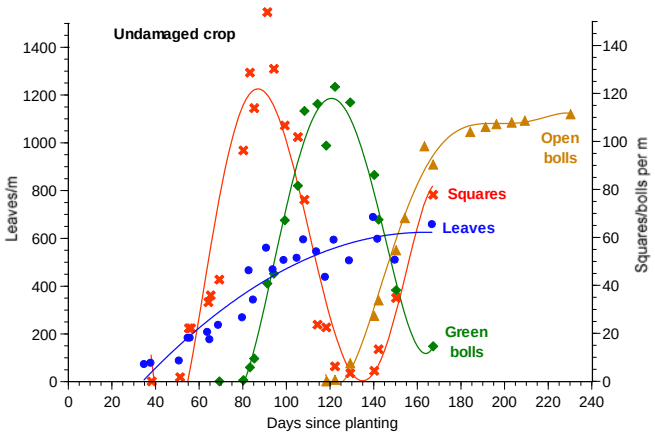
Damage symptoms were apparent soon after exposure as reddening and twisting of the leaf petioles, mis-orientating the leaves and causing the plants to have a wilted appearance. Leaf damage was also apparent, with patches of reddened tissue on the leaves, particularly along the veins 6 days after exposure.

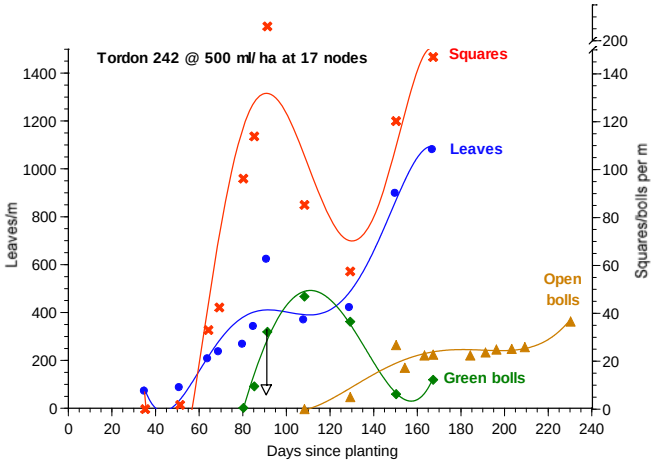
Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 17 node cotton. Photo taken on 10th Feb, 33 days after exposure.

Plants had still not recovered from the initial damage 33 days after exposure. The terminals of most plants were severely damaged and most upper leaves had dropped. New growth was confined largely to the lower lateral branches.

Tordon 242 (MCPA + picloram) applied broadcast at 500 ml/ha to 17 node cotton. Photo taken on 11th Mar, 62 days after exposure.

Severe symptoms of herbicide damage were still readily apparent more than 60 days after exposure. New leaves developing from the terminals were cupped and distorted, with crinkled edges and pointed margins ending in 'fingers', typical of Group I damage.




## Impact on plant growth

**Plants:** exposure to the 50% rate of MCPA + picloram caused extensive damage to expanding leaves and terminals. New growth was highly distorted, with damage typical of Group I herbicides. Plants remained 4.8 nodes and 32 cm shorter and 41% smaller by weight at picking.

**Leaves:** plants had 64% more leaves but 21% less leaf area at the last observation, indicating the high proportion of small and distorted leaves.

**Squares**: plants responded to the damage by producing a flush of late squares.

**Bolls:** many early bolls were aborted and crop maturity was delayed by 60 days. Most bolls were retained on nodes 7 – 10 and 21 – 26, but many of these bolls were not mature at picking. The boll weight was down 55% and final boll load by 42%.

**Lint:** seed size and lint development were affected, resulting in smaller seeds and a ginning turnout of 53%. Fibre quality was below base grade, with a staple length of 1.112", 11.1% short fibres and reduced fibre strength. Lint yield was down 76%.

**Final plant count data**

| | undamaged crop | MCPA + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 26.1 |
| **Leaves/m*** | 656 | 1080 |
| **Leaf area (cm²/m)*** | 21196 | 16693 |
| **Reduction in leaf area*** | | 21% |
| **Bolls/m** | 132 | 76 |
| **Boll weight (g/open boll)** | 5.3 | 2.4 |
| **Retention in posit's 1-3^** | 95% | 92% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 6 - 24 |
| **Days to 50% open bolls** | 157 | 217 |
| **Maturity delay (days)** | | 60 |
| **% Open bolls at picking** | 85% | 48% |
| **Lint yield/ha** | 2380 | 560 |

Exposure to 50% of a typical field rate of MCPA + picloram at 17 nodes causing extensive damage to the upper branches, leaf mis-orientation, and delaying upper-plant growth and development by around 40 days. New growth, when it did develop, was highly distorted.

The damage caused most of the middle bolls to be lost and delayed crop maturity by 60 days. Plants set a late crop of bolls, many of which were not mature at picking, resulting in reduced fibre quality and an 83% reduction in lint yield.

Note* These parameters were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** triclopyr + picloram
**Rate:** 15 g + 5 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 14th Oct (pre-planting)
**Growth stage at exposure:**

**Damage key:**

| | |
|---|---|
| Leaf loss | |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | |

## Herbicidal action

**Herbicide group:** I

### triclopyr

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** some activity. Translocated to the growing points following root absorption
**Soil half-life:** around 30 days

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha and incorporated prior to planting cotton. Photo taken on 28th Nov, 36 days after emergence.

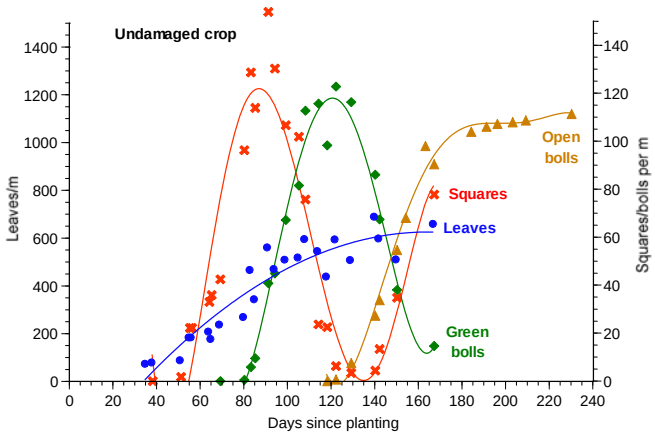
Plants showed no symptoms of herbicide damage at any stage.

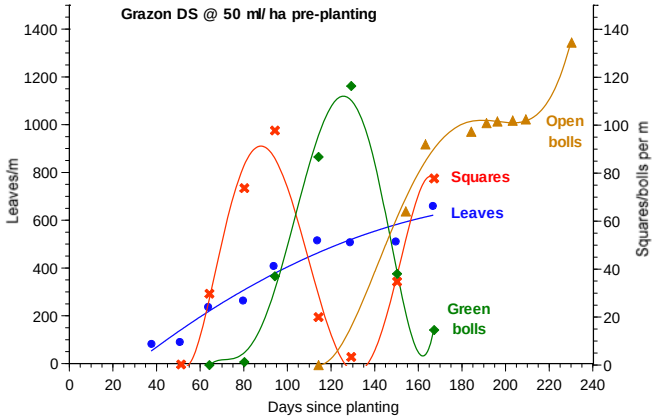
Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

Plants showed no symptoms of herbicide damage at any stage.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha and incorporated prior to planting cotton. Photo taken on 14th Jan, 83 days after emergence.

Plants showed no symptoms of herbicide damage at any stage.




## Impact on plant growth

**Plants:** exposure to the 10% rate of residual triclopyr + picloram had no visible effect on the cotton, but plants were 20 cm shorter, with 2.9 fewer nodes and 20% smaller by weight at the final observations.

**Leaves:** the herbicide caused no visible damage to the foliage, but plants had 6% fewer leaves and 29% less leaf area at the final observation.

**Squares**: there was a 36% reduction in peak square production.

**Bolls:** there were few negative effects on boll production, with the final boll count up by 20%, but plants retained fewer bolls on the main nodes. The changed retention pattern reduced the size (average weight) of the open bolls (down by 5%) but had no effect on the proportion of bolls open at picking or on crop maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton fell below base grade with 10.9% short fibres and a staple length of 1.118". Lint yield was reduced by 18%.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **triclopyr + picloram** |
| **Nodes/plant** | 30.9 | 28.0 |
| **Leaves/m*** | 543 | 513 |
| **Leaf area (cm²/m)*** | 23764 | 16842 |
| **Reduction in leaf area*** | | 29% |
| **Bolls/m** | 132 | 158 |
| **Boll weight (g/open boll)** | 5.3 | 5.0 |
| **Retention in posit's 1-3^** | 95% | 97% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 6 - 20 |
| **Days to 50% open bolls** | 157 | 156 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 85% |
| **Lint yield/ha** | 2380 | 1946 |

Exposure to 10% of a field rate of residual triclopyr + picloram resulted in a reduction in plant size and leaf area. Square production, boll retention and fibre quality were all affected. Lint yield was reduced by 18%

The extent of damage from residual herbicides is influenced by seasonal conditions and more damage may have occurred in a season with wetter and/or colder conditions following planting.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **triclopyr + picloram** |
| **Rate:** | **75 g + 25 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **14th Oct (pre-planting)** |
| **Growth stage at exposure:** | |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group: I**

### triclopyr

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** some activity. Translocated to the growing points following root absorption
**Soil half-life:** around 30 days

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

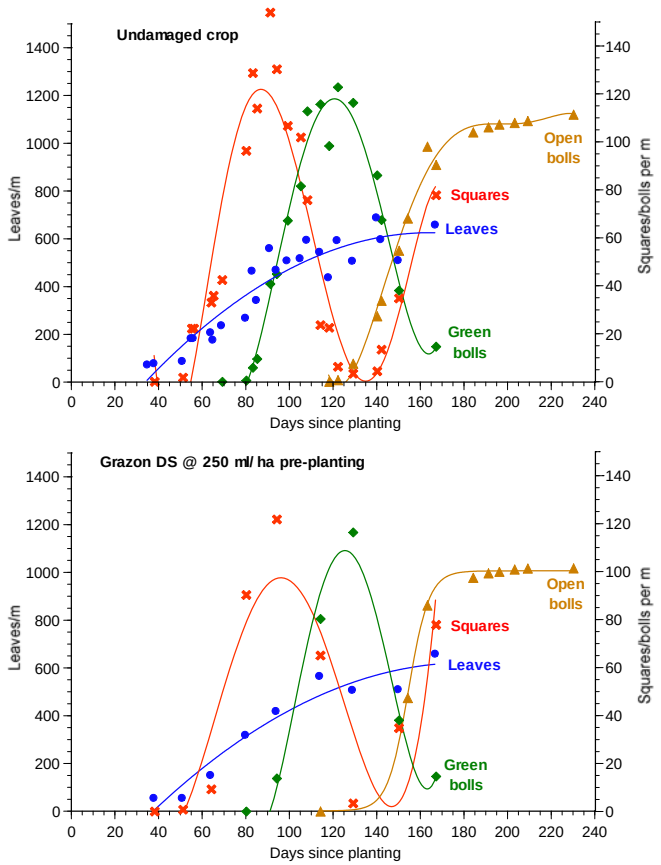
Most plants showed no symptoms of herbicide damage 42 days after emergence.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha and incorporated prior to planting cotton. Photo taken on 4th Dec, 42 days after emergence.

Symptoms of Grazon damage were apparent on some plants 42 days after emergence. Damaged plants had “leathery” leaves, with distorted leaf margins and some yellow discolouration.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha and incorporated prior to planting cotton. Photo taken on 31st Dec, 69 days after emergence.

Plants showed no obvious symptoms of herbicide damage at this stage 69 days after emergence, although there was still some crinkling of the leaf margins.




## Impact on plant growth

**Plants:** exposure to the 50% rate of residual triclopyr + picloram had no visible effect on most plants, but the plant stand was reduced by 37%. Plants were 8 cm and 2.3 nodes shorter and 9% smaller by weight at picking.

**Leaves:** the herbicide damage caused some leaf distortion. There was no change in leaf number but plants had 20% more leaf area at the last observation.

**Squares**: square production appeared to be largely unaffected, although there was a 21% reduction in peak square production.

**Bolls:** there was a 42% reduction in boll retention at picking. Most bolls were retained on the first 3 fruiting positions, with few bolls above 16 nodes. There was no reduction in boll size or delay in crop maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton fell below base grade with 11.1% short fibres and a staple length of 1.113". Lint yield was reduced by 7%.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **triclopyr + picloram** |
| **Nodes/plant** | 30.9 | 28.6 |
| **Leaves/m*** | 543 | 564 |
| **Leaf area (cm²/m)*** | 23764 | 28422 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 76 |
| **Boll weight (g/open boll)** | 5.3 | 5.3 |
| **Retention in posit's 1-3^** | 95% | 98% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 16 |
| **Days to 50% open bolls** | 157 | 154 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 85% |
| **Lint yield/ha** | 2380 | 2203 |

Exposure to 50% of a typical field rate of residual triclopyr + picloram caused minimal visible damage to the cotton, but affected crop growth and development. Plants were shorter and smaller, but had a larger leaf area mid-season.

Most retained bolls were on the first 3 fruiting positions, with few bolls above node 16. Boll number, fibre quality and lint yield were all reduced. There was no delay in crop maturity.

Note* These parameters were last recorded 114 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **triclopyr + picloram** |
| **Rate:** | **15 g + 5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **25th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group: I**

### triclopyr

**Translocation:** readily moves to the plant growth points

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** some activity. Translocated to the growing points following root absorption

**Soil half-life:** around 30 days

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

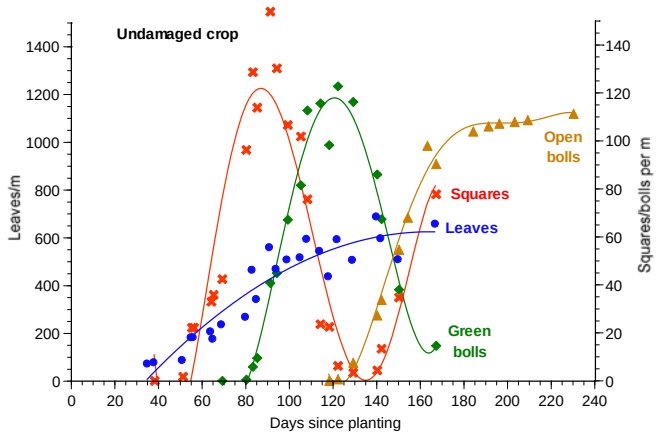
Some symptoms of Grazon damage were apparent 6 days after exposure as rolling and yellow/orange discolouration on the margins of newer leaves.

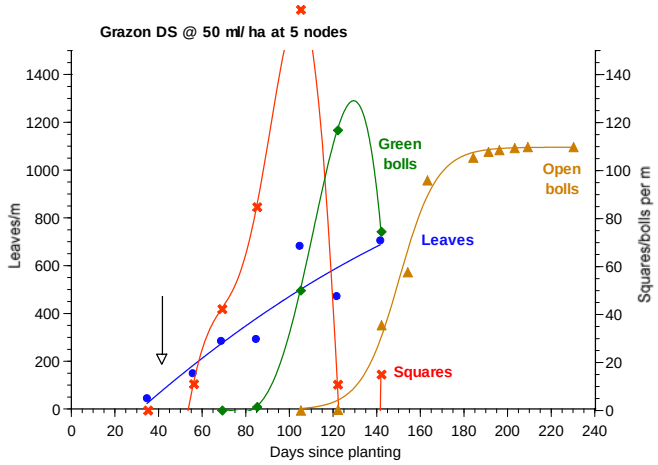
Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 5 node cotton. Photo taken on 15th Dec, 20 days after exposure.

Newly emerging leaves showed typical signs of phenoxy damage 20 days after exposure to Grazon. New leaves were very distorted, with long, narrow 'fingers'.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 5 node cotton. Photo taken on 14th Jan, 50 days after exposure.

Plants were showing few signs of damage by 50 days after exposure, although damage was apparent on some of the newer, fully expanded leaves. These leaves had a leathery appearance, with prominent white veins.




## Impact on plant growth

**Plants:** exposure to the 10% rate of triclopyr + picloram at 5 nodes had a minimal effect on plant growth and development. Plants were 12.5 cm shorter at picking.

**Leaves:** the herbicide caused some leaf discolouration and distortion. There was no effect on leaf number but leaf area was down by 16% at the final observation.

**Squares**: there was no apparent effect on square production.

**Bolls:** there was a 10 day delay in the start of boll production but no reduction in peak boll production or change in the pattern of boll retention. The average weight of open bolls was not reduced and there was no delay in crop maturity, but proportionally fewer bolls were open at picking, down by 7%.

**Lint:** ginning turnout, fibre quality and lint yield were unaffected by the herbicide damage.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **triclopyr + picloram** |
| **Nodes/plant** | 30.9 | 30.5 |
| **Leaves/m*** | 595 | 703 |
| **Leaf area (cm²/m)*** | 24900 | 21016 |
| **Reduction in leaf area*** | | 16% |
| **Bolls/m** | 132 | 127 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 100% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 17 |
| **Days to 50% open bolls** | 157 | 152 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 78% |
| **Lint yield/ha** | 2380 | 2264 |

Exposure to 10% of a typical field rate of triclopyr + picloram at 5 nodes caused some leaf discolouration and distortion, and a reduction in leaf area.

There were a few minor effects on boll production and retention, with proportionally fewer bolls open at picking. Boll weight, crop maturity, fibre quality and lint yield were unaffected by the herbicide exposure.

Note* These parameters were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **triclopyr + picloram** |
| **Rate:** | **75 g + 25 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **25th Nov** |
| | **(5 weeks post-emergence)** |
| **Growth stage at exposure:** | **5 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### triclopyr

**Translocation:** readily moves to the plant growth points
**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.
**Residual activity:** some activity. Translocated to the growing points following root absorption
**Soil half-life:** around 30 days

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points
**Mode of action:** an auxin-type herbicide
**Residual activity:** strong residual activity and readily absorbed by plant roots
**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 5 node cotton. Photo taken on 1st Dec, 6 days after exposure.

Symptoms of Grazon damage were obvious within 6 days of exposure. Stems and leaf petioles were very red and were beginning to distort.

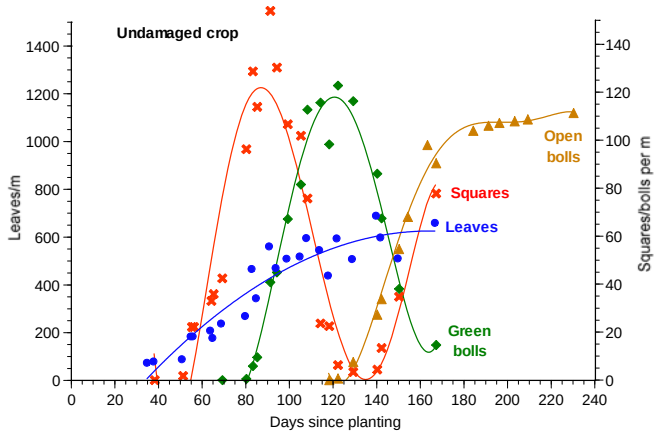
Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 5 node cotton. Photo taken on 17th Dec, 22 days after exposure.

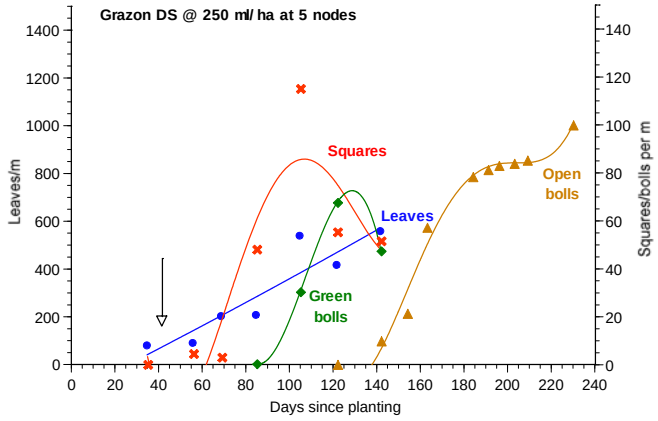
Plants were stunted and highly distorted 22 days after exposure. Some new leaves had emerged, but these were small and distorted, blistered, cupped and yellowish, with some orange to red discolouration on the margins.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 5 node cotton. Photo taken on 14th Jan, 50 days after exposure.

Plants had resumed growth by 36 days after exposure, but new leaves were distorted, roundish in shape and leathery in appearance, with prominent veins.

Distorted growth is readily apparent in this photo taken 50 days after exposure and was still apparent up to 60 days after exposure.




## Impact on plant growth

**Plants:** exposure to triclopyr + picloram at 5 nodes caused extensive damage. 50% of plants were tipped-out. Plants were initially stunted and were still 22 cm shorter and 26% lighter at picking.

**Leaves:** new leaves were distorted following exposure. Plants had 7% fewer leaves and 13% less leaf area at the last observation.

**Squares**: square production was delayed by about 15 days, and peak square production by around 10 days. Peak square production was down by 25%.

**Bolls:** there was a 20 days delay in the start of boll production, a 45% reduction in peak boll production and a 17% reduction in the final boll load. A proportion of mid-season bolls were shed, with bolls retained higher up the plant. These bolls were smaller, reducing average boll weight by 9% and there was a 7 days delay in crop maturity.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide damage, but lint yield was reduced by 31%.

**Final plant count data**

| | undamaged crop | triclopyr + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 31.1 |
| **Leaves/m*** | 595 | 556 |
| **Leaf area (cm²/m)*** | 24900 | 21717 |
| **Reduction in leaf area*** | | 13% |
| **Bolls/m** | 132 | 110 |
| **Boll weight (g/open boll)** | 5.3 | 4.8 |
| **Retention in posit's 1-3^** | 95% | 91% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 21 |
| **Days to 50% open bolls** | 157 | 164 |
| **Maturity delay (days)** | | 7 |
| **% Open bolls at picking** | 85% | 91% |
| **Lint yield/ha** | 2380 | 1631 |

Exposure to 50% of a typical field rate of triclopyr + picloram residues caused extensive damage. Plants were very stunted and distorted. Leaf distortion continued for 60 days after exposure.

The damage reduced plant size, leaf area, square production, boll retention and boll size. Late bolls were retained higher up the plant and on the outer fruiting positions. There was a 7 day delay in average crop maturity. Lint yield was reduced by 31%.

Note* These parameters were last recorded 142 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **triclopyr + picloram** |
| **Rate:** | **15 g + 5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group: I**

### triclopyr

**Translocation:** readily moves to the plant growth points

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** some activity. Translocated to the growing points following root absorption

**Soil half-life:** around 30 days

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 9 node cotton. Photo taken on 15th Dec, 7 days after exposure.

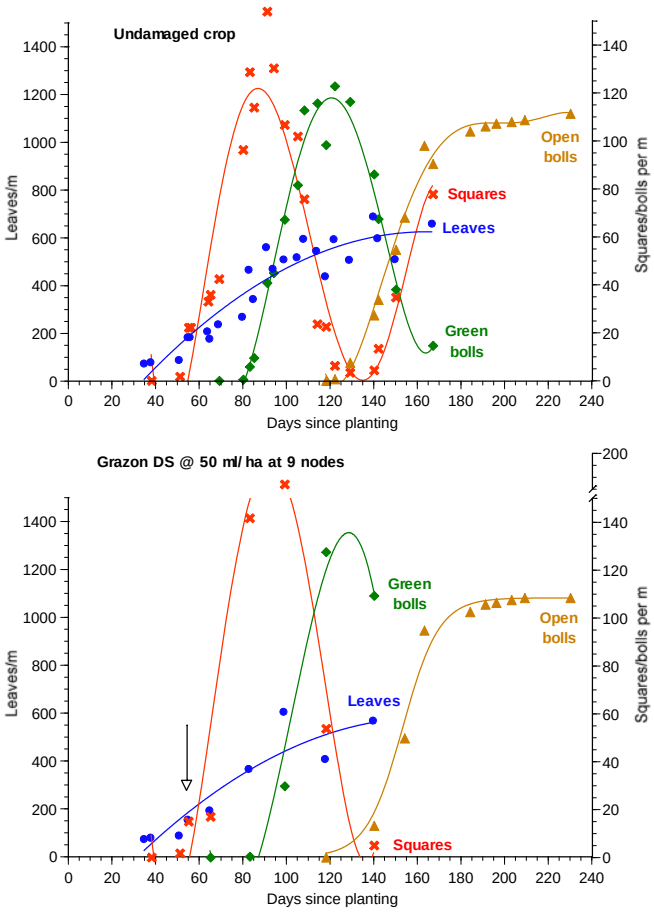
Some symptoms of Grazon damage were apparent 7 days after exposure as rolling and yellow discolouration on the margins of newer leaves.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

Newly emerging leaves are showing mild signs of Group I damage 28 days after exposure to Grazon. New leaves were mildly distorted, with curled edges, narrow 'fingers' and more prominent veins.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 9 node cotton. Photo taken on 14th Jan, 37 days after exposure.

Plants were showing few signs of damage 37 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 10% rate of triclopyr + picloram at 9 nodes appeared to have a minimal impact on plant growth and development. Nevertheless, there was a 40% increase in the proportion of tipped-out plants, and plants were 6.5 cm and 1.6 nodes shorter at picking.

**Leaves:** the herbicide caused some initial leaf distortion. There was no obvious effect later in the season, but plants had 21% fewer leaves and 17% less leaf area at the last observation.

**Squares**: plants produced a mass of small, distorted squares following the exposure.

**Bolls:** there was a 10 day delay in the start of boll production, but no impact on peak boll production, the pattern of boll retention or boll size. There was no delay in average crop maturity but there was a 6% reduction in the proportion of bolls open at picking.

**Lint:** ginning turnout and lint quality were unaffected by the herbicide damage, but lint yield was reduced by 10%.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **triclopyr + picloram** |
| **Nodes/plant** | 30.9 | 29.3 |
| **Leaves/m*** | 687 | 545 |
| **Leaf area (cm²/m)*** | 23830 | 19662 |
| **Reduction in leaf area*** | | 17% |
| **Bolls/m** | 132 | 129 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 94% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 18 |
| **Days to 50% open bolls** | 157 | 153 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 80% |
| **Lint yield/ha** | 2380 | 2133 |

Exposure to 10% of a typical field rate of triclopyr + picloram at 9 nodes caused some leaf discolouration and distortion, and a reduction in leaf number, leaf area and plant size.

Square and boll production were also affected but there was no delay in crop maturity. Fibre quality was unaffected but lint yield was reduced by 10%.

Note* These parameters were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **triclopyr + picloram** |
| **Rate:** | **75 g + 25 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **8th Dec** |
| | **(8 weeks post-emergence)** |
| **Growth stage at exposure:** | **9 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### triclopyr

**Translocation:** readily moves to the plant growth points

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** some activity. Translocated to the growing points following root absorption

**Soil half-life:** around 30 days

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 9 node cotton. Photo taken on 17th Dec, 9 days after exposure.

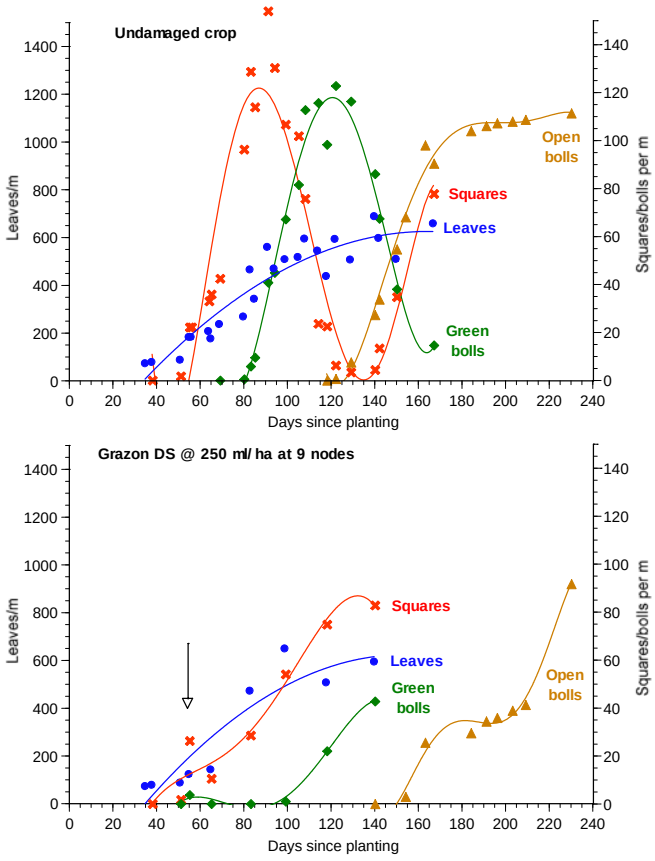
Symptoms of Grazon damage were apparent soon after exposure. Stems and leaf petioles were red and distorted, changing the leaf orientation and giving the crop a wilted appearance 9 days after exposure.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 9 node cotton. Photo taken on 5th Jan, 28 days after exposure.

Plants had resumed growth and appeared a more normal appearance by 28 days after exposure, but newly emerging leaves showed symptoms typical of Group I damage. New leaves were cupped and distorted, with curled edges, narrow 'fingers' and more prominent veins. Many expanded leaves were rounded in shape and leathery in appearance.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 9 node cotton. Photo taken on 20th Jan, 43 days after exposure.

Distorted and leathery leaves were still readily apparent 43 days after exposure, but symptoms had disappeared by 60 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 50% rate of triclopyr + picloram at 9 nodes caused petiole twisting, which was obvious within a few hours of exposure, giving the plants a wilted appearance. There was a 60% increase in the proportion of tipped-out plants. Plants were highly distorted and remained stunted for several weeks. Plants were 2.6 nodes and 18 cm shorter, and 27% smaller by weight at the last observations.

**Leaves:** plants had 14% fewer leaves but 11% more leaf area at the last observation.

**Squares**: peak square production was delayed by around 40 days and reduced by 46%.

**Bolls:** plants retained 23% fewer bolls, with fewer bolls on nodes 10 and 11, and in the first 3 positions of the other nodes. Bolls were retained to node 20, 2 nodes higher than the undamaged crop. There was a 48 day delay in crop maturity.

**Lint:** fibre quality was unaffected by the herbicide damage, but ginning turnout was reduced by 6% and lint yield by 65%.

**Final plant count data**

| | undamaged crop | triclopyr + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 28.3 |
| **Leaves/m*** | 687 | 592 |
| **Leaf area (cm²/m)*** | 23830 | 26509 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 101 |
| **Boll weight (g/open boll)** | 5.3 | 5.0 |
| **Retention in posit's 1-3^** | 95% | 88% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 20 |
| **Days to 50% open bolls** | 157 | 205 |
| **Maturity delay (days)** | | 48 |
| **% Open bolls at picking** | 85% | 91% |
| **Lint yield/ha** | 2380 | 843 |

Exposure to 50% of a typical field rate of triclopyr + picloram at 9 nodes caused almost immediate petiole twisting and later caused extensive leaf damage. Plant growth and development were delayed by around 50 days, with reductions in plant height, size and leaf number.

The damage delayed square and boll initiation, reduced boll retention, delayed crop maturity, reduced ginning turnout and reduced lint yield by 65%.

Note* These parameters were last recorded 140 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **triclopyr + picloram** |
| **Rate:** | **15 g + 5 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **13th Jan (12 weeks post-emergence)** |
| **Growth stage at exposure:** | **17 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### triclopyr

**Translocation:** readily moves to the plant growth points

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** some activity. Translocated to the growing points following root absorption

**Soil half-life:** around 30 days

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 17 node cotton. Photo taken on 16th Jan, 3 days after exposure.

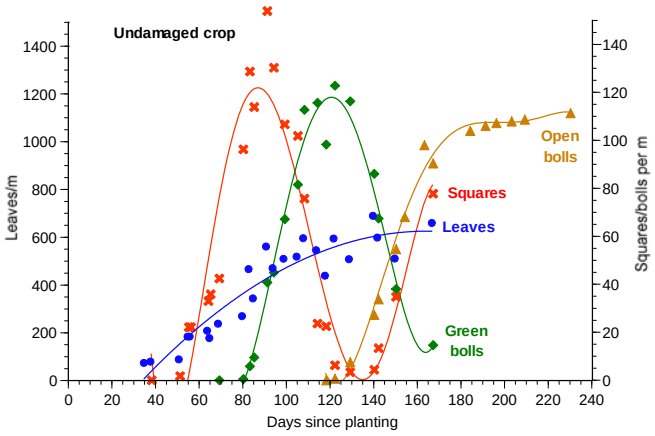
No symptoms of Grazon damage were apparent in the days immediately following exposure.

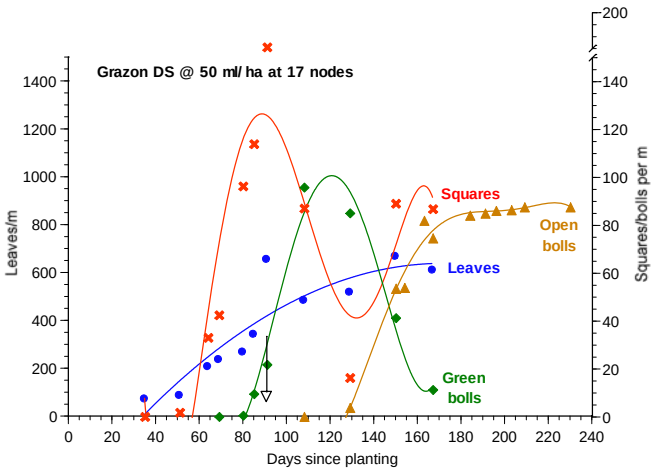
Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 17 node cotton. Photo taken on 20th Jan, 7 days after exposure.

Grazon damage become apparent on many of the newly expanding leaves a week after exposure. These leaves are cupped and distorted, with curled and blistered edges, and yellow discolouration.

Grazon DS (triclopyr + picloram) applied broadcast at 50 ml/ha to 17 node cotton. Photo taken on 10th Feb, 33 days after exposure.

The only signs of herbicide damage remained the discolouration of newly expanding leaves 33 days after exposure. These leaves are mildly cupped and distorted, with curled and blistered edges, and yellow discolouration. No symptoms typical of Group I damage were apparent on these plants.




## Impact on plant growth

**Plants:** exposure to the 10% rate of triclopyr + picloram at 17 nodes caused almost no visible symptoms of damage, other than mild distortion and discolouration of newly expanding leaves. However, plants were stunted by the exposure and remained 2.3 nodes and 9 cm shorter at picking.

**Leaves:** plants had 7% fewer leaves and 31% less leaf area at the last observations.

**Squares**: there was no apparent impact on square production.

**Bolls:** some bolls were shed following the herbicide exposure, with peak boll production reduced by 46%. Few bolls were retained above node 16, resulting in a 30% reduction in final boll retention. Plants did not compensate for this loss with late bolls. There was no impact on the average weight of open bolls or crop maturity.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide damage but lint yield was reduced by 21%.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **triclopyr + picloram** |
| **Nodes/plant** | 30.9 | 28.6 |
| **Leaves/m*** | 656 | 609 |
| **Leaf area (cm²/m)*** | 21196 | 14724 |
| **Reduction in leaf area*** | | 31% |
| **Bolls/m** | 132 | 92 |
| **Boll weight (g/open boll)** | 5.3 | 5.1 |
| **Retention in posit's 1-3^** | 95% | 99% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 7 - 16 |
| **Days to 50% open bolls** | 157 | 149 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 85% | 88% |
| **Lint yield/ha** | 2380 | 1876 |

Exposure to 10% of a typical field rate of triclopyr + picloram at 17 nodes caused little obvious damage. Nevertheless, plant growth and development were affected, with reductions in plant height, node number, leaf number and leaf area.

Many bolls were shed following the exposure, resulting in a reduction in final boll retention. Boll size, crop maturity and fibre quality were unaffected, but lint yield was reduced by 21%.

Note* These parameters were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **triclopyr + picloram** |
| **Rate:** | **75 g + 25 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **13th Jan (12 weeks post-emergence)** |
| **Growth stage at exposure:** | **17 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group: I**

### triclopyr

**Translocation:** readily moves to the plant growth points

**Mode of action:** an auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death.

**Residual activity:** some activity. Translocated to the growing points following root absorption

**Soil half-life:** around 30 days

### picloram

**Translocation:** readily absorbed by roots and foliage and moves to the growing points

**Mode of action:** an auxin-type herbicide

**Residual activity:** strong residual activity and readily absorbed by plant roots

**Soil half-life:** 90 days, but can be up to 200 days. Breakdown is slower in dry, cool conditions.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 17 node cotton. Photo taken on 14th Jan, 1 day after exposure.

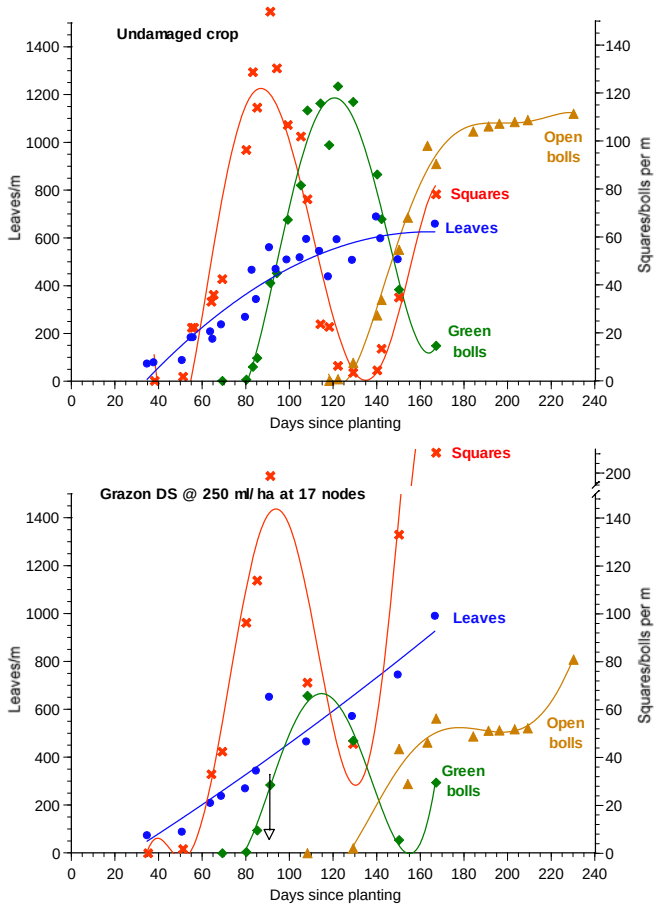
Symptoms of Grazon damage were apparent soon after exposure. Stems and leaf petioles were highly distorted, changing the leaf orientation and giving the crop a wilted appearance.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 17 node cotton. Photo taken on 19th Jan, 6 days after exposure.

Most leaves had resumed normal orientation by 6 days after exposure, although some petioles were still bent. However, damage had now become apparent on many of the newly expanding leaves. These leaves were cupped and distorted, with curled and blistered edges, and yellow discolouration.

Grazon DS (triclopyr + picloram) applied broadcast at 250 ml/ha to 17 node cotton. Photo taken on 10th Feb, 33 days after exposure.

More typical signs of Group I damage were apparent on newly emerging leaves by 33 days. These leaves were cupped and distorted, with curled edges and narrow 'fingers'.




## Impact on plant growth

**Plants:** exposure to the 50% rate of triclopyr + picloram at 17 nodes caused petiole twisting, within a few hours of the exposure, giving the plants a wilted appearance. Plant growth and development were delayed by the exposure, resulting in late-season vegetative growth and compensation. Plants remained 8 cm and 2.8 nodes shorter on average at picking.

**Leaves:** plants had 50% more leaves and 19% more leaf area at the last observation.

**Squares**: plants produced a large number of late squares.

**Bolls:** many bolls were shed following the herbicide exposure, causing a large delay in boll production and crop maturity. Few bolls were retained above node 13, with a late set of bolls on nodes 26 – 29. Average weight of open bolls was reduced by 36%, with only 59% of bolls open at picking.

**Lint:** the herbicide damage affected seed and lint development, resulting in small seeds and a ginning turnout of 56%. Lint yield was reduced by 61%.

**Final plant count data**

| | undamaged crop | triclopyr + picloram |
|---|---|---|
| **Nodes/plant** | 30.9 | 28.1 |
| **Leaves/m*** | 656 | 987 |
| **Leaf area (cm²/m)*** | 21196 | 25139 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 132 | 138 |
| **Boll weight (g/open boll)** | 5.3 | 3.4 |
| **Retention in posit's 1-3^** | 95% | 95% |
| **Nodes carrying >80% bolls#** | 7 - 18 | 8 - 27 |
| **Days to 50% open bolls** | 157 | 210 |
| **Maturity delay (days)** | | 53 |
| **% Open bolls at picking** | 85% | 59% |
| **Lint yield/ha** | 2380 | 939 |

Exposure to 50% of a typical field rate of triclopyr + picloram at 17 nodes caused almost immediate petiole twisting but only limited leaf damage.

The herbicide exposure had a large impact on square and boll production and retention, with most early bolls shed, and few bolls retained on the next 8 nodes. Crop maturity was delayed by 53 days and lint yield reduced by 61%.

Note* These parameters were last recorded 167 days after planting.

Note^ Percentage of retained bolls in positions 1-3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate + 2,4-D** |
| **Rate:** | **35 + 8 g a.i./ha** |
| **Date of exposure:** | **12th Dec (4 weeks post-emergence)** |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 6 node cotton. Photo taken on 5th Jan, 24 days after exposure.

New leaves on the main stem were severely affected by the 2,4-D, 24 days after exposure, with severe leaf distortion on all subsequent growth.

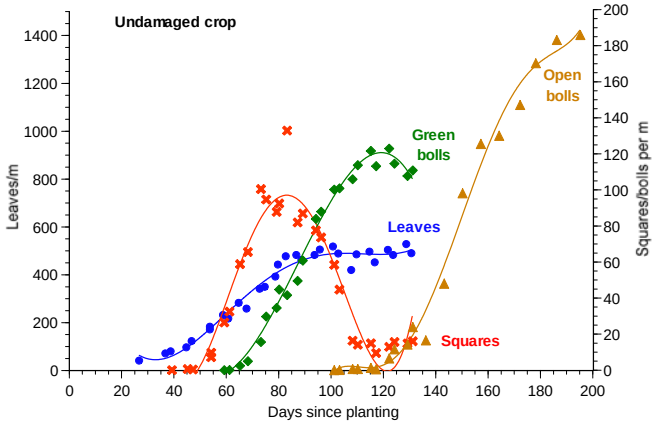
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 6 node cotton. Photo taken on 5th Jan, 24 days after exposure.

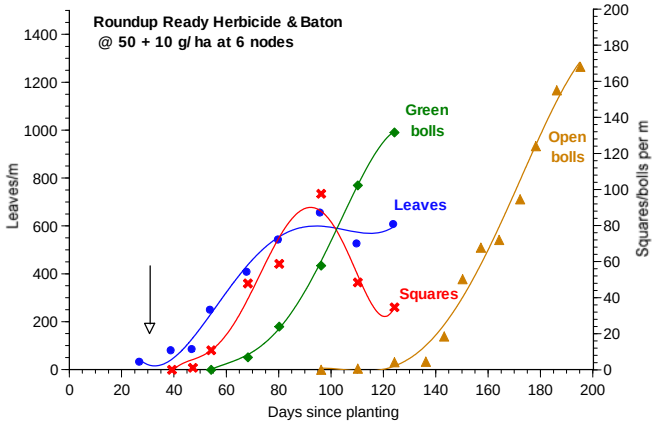
The new leaves on the main stem were severely distorted by the herbicide 24 days after exposure. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

There were no signs of glyphosate damage.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 6 node cotton. Photo taken on 24th Mar, 102 days after exposure.

This plate shows a close-up of a boll distorted by the herbicides (parrot-beaked) 102 days after exposure. The herbicides affected not only the leaves, but also squares, flowers and bolls.




## Impact on plant growth

**Plant:** exposure to the lighter rate of the glyphosate & 2,4-D combination at 6 nodes damaged the emerging leaves and growing tips, tipping out 15% of plants.

**Leaves:** leaves that developed following the exposure were highly distorted, narrow, cupped, twisted and leathery, with prominent veins. Plants had 15% more leaves but no additional leaf area at the final observation. Leaves which developed on the lateral branches were not affected.

**Squares**: some early squares were shed following the herbicide exposure and peak squaring was delayed 10 days. Later squares were retained and developed.

**Bolls:** some early bolls were shed, but later bolls were retained and developed on the outer fruiting positions and the lateral branches, with open bolls to node 26, 4 nodes above the undamaged plants. Nevertheless, plants retained 10% fewer open bolls at picking and there was a 16 day delay in average boll maturity.

**Lint**: ginning turnout was unaffected, but lint yield was down by 7%.

**Final plant count data**

| | undamaged comparison | Gly & 2,4-D @ 6 nodes |
|---|---|---|
| **Nodes/plant** | 25.0 | 25.9 |
| **Leaves/m*** | 526 | 605 |
| **Leaf area (cm²/m)*** | 22302 | 21765 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 188 | 178 |
| **Boll weight (g/open boll)** | 4.6 | 4.4 |
| **Retention posit' 1-3^** | 92% | 82% |
| **Nodes carrying >80% bolls#** | 9 - 19 | 8 - 23 |
| **Days to 50% open** | 152 | 168 |
| **Maturity delay (days)** | | 16 |
| **% Open bolls at picking** | 99% | 95% |
| **Lint yield (kg/ha)** | 1631 | 1524 |


## Summary

Exposure to 3% of a typical field rate of a glyphosate & 2,4-D combination at 6 nodes caused tipping out and extensive leaf deformation on the main stem. The damage was not distinguishable from the damage observed from 2,4-D alone.

Plants shed some early squares and bolls, setting bolls on the lateral branches and higher up the plant. There was a delay in average boll maturity, plants retained fewer open bolls at picking and lint yield was down by 7%.


**Note*** These parameters were last recorded 129 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **Glyphosate + 2,4-D** |
| **Rate:** | **173 + 80 g a.i./ha** |
| **Date of exposure:** | **12th Dec** (4 weeks post-emergence) |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 6 node conventional (not glyphosate tolerant) cotton. Photo taken on 5th Jan, 24 days after exposure.

Leaves on the main stem were severely affected by the 2,4-D, 24 days after exposure, with severe leaf distortion on all subsequent growth.

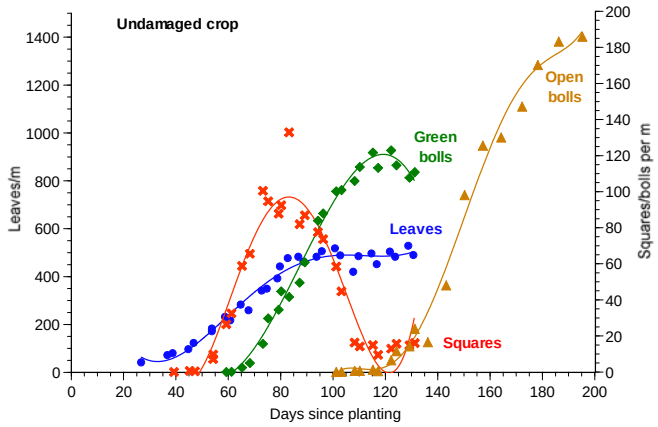
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 6 node conventional (not glyphosate tolerant) cotton. Photo taken on 5th Jan, 24 days after exposure.

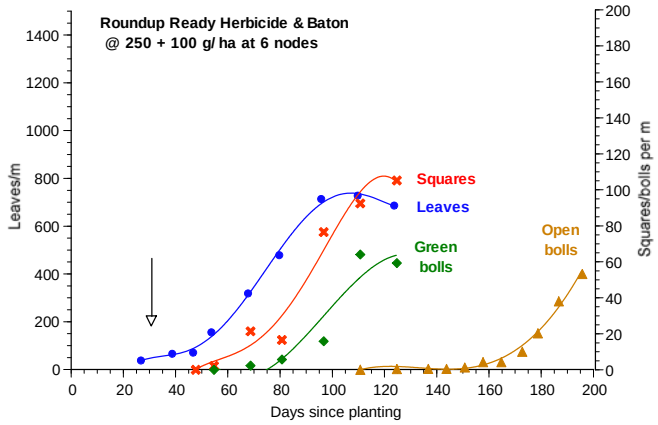
The new leaves on the main stem were severely distorted by the herbicide, 24 days after exposure. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

There were no obvious signs of glyphosate damage.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 6 node conventional (not glyphosate tolerant) cotton. Photo taken on 24th Mar, 102 days after exposure.

This plate shows a close-up of the main stem of the plant which continued to produce distorted leaves throughout the season. The growth on the lateral branches was largely unaffected by the herbicides, 102 days after exposure.




## Impact on plant growth

**Plant:** exposure to the glyphosate & 2,4-D combination at 6 nodes damaged the emerging leaves and growing tips, tipping out 20% of plants and reducing plant size (plant weight) by 52%.

**Leaves:** leaves that developed following the exposure were highly distorted, narrow, cupped, twisted and leathery, with prominent veins. Plants had 30% more leaves but 47% less leaf area at the final observation. Leaves which developed on the lateral branches were not affected.

**Squares**: most of the early squares were shed following the herbicide exposure, but later squares were retained and developed. Peak squaring was delayed by 30 days.

**Bolls:** many early bolls were shed, but later bolls were retained and developed, mainly on the outer fruiting positions and the lateral branches. Average boll size was unaffected, but plants retained 71% fewer open bolls at picking and average boll maturity was delayed by 50 days.

**Lint**: ginning turnout was unaffected, but lint yield was down by 62%.

**Final plant count data**

| | undamaged comparison | Gly & 2,4-D @ 6 nodes |
|---|---|---|
| **Nodes/plant** | 25.0 | 24.9 |
| **Leaves/m*** | 526 | 683 |
| **Leaf area (cm²/m)*** | 22302 | 11741 |
| **Reduction in leaf area*** | | 47% |
| **Bolls/m** | 188 | 149 |
| **Boll weight (g/open boll)** | 4.6 | 4.6 |
| **Retention posit' 1-3^** | 92% | 71% |
| **Nodes carrying >80% bolls#** | 9 - 19 | 1 - 16 |
| **Days to 50% open** | 152 | 202 |
| **Maturity delay (days)** | | 50 |
| **% Open bolls at picking** | 99% | 36% |
| **Lint yield (kg/ha)** | 1631 | 623 |


## Summary

Exposure to 17% of a typical field rate of a glyphosate & 2,4-D combination at 6 nodes caused tipping out and extensive leaf deformation on the main stem. The damage was not distinguishable from the damage observed from 2,4-D alone.

Plants shed many early squares and bolls, setting bolls on the lateral branches. There was a long delay in average boll maturity, plants retained fewer open bolls at picking and lint yield was down by 62%.


**Note*** These parameters were last recorded 129 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate + 2,4-D** |
| **Rate:** | **35 + 8 g a.i./ha** |
| **Date of exposure:** | **21st Dec (5½ weeks post-emergence)** |
| **Growth stage at exposure:** | **8 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 8 node conventional (not glyphosate tolerant) cotton. Photo taken on 5th Jan, 15 days after exposure.

New leaves on the main stem were severely affected by the 2,4-D, 15 days after exposure, with severe leaf distortion on all subsequent growth.

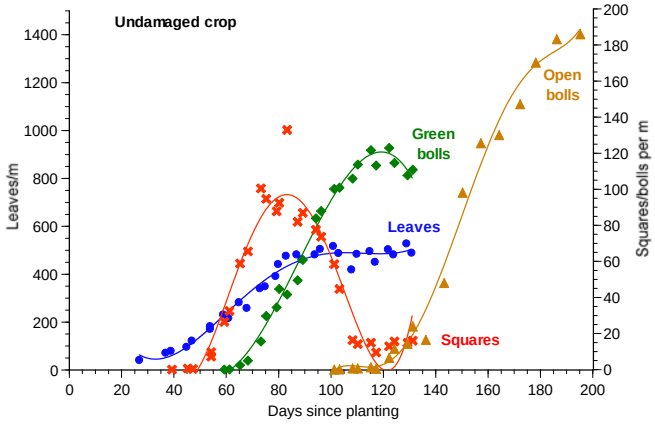
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 8 node conventional (not glyphosate tolerant) cotton. Photo taken on 25th Jan, 35 days after exposure.

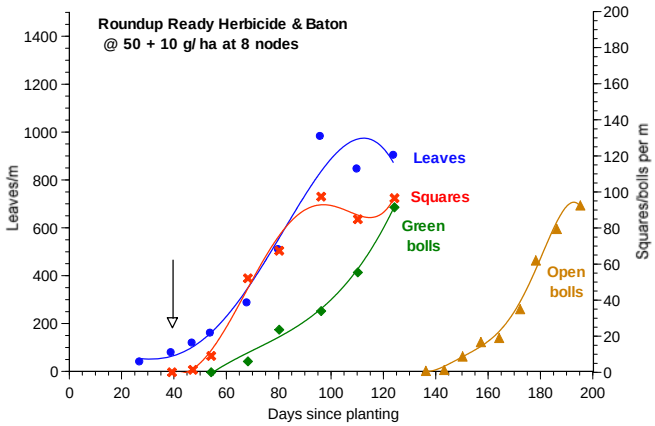
All new leaves were severely distorted by the herbicide,35 days after exposure. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

No obvious signs of glyphosate damage were apparent.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 8 node conventional (not glyphosate tolerant) cotton. Photo taken on 24th Mar, 93 days after exposure.

The plant produced distorted growth on the main stem and most lateral branches throughout the season. Leaves, squares, flowers and bolls were all distorted by the herbicides, 93 days after exposure.




## Impact on plant growth

**Plant:** exposure to the lighter rate of the glyphosate & 2,4-D combination at 8 nodes damaged the emerging leaves and growing tips, tipping out 45% of plants and reducing plant size (by plant weight) by 32%, although plants were 10 cm and 2 nodes taller at picking.

**Leaves:** leaves that developed following the exposure were highly distorted, narrow, cupped, twisted and leathery, with prominent veins. Plants had 72% more leaves but no more leaf area at the final observation.

**Squares**: some of the early squares were shed following the herbicide exposure, but plants produced additional squares later in the season.

**Bolls:** many early bolls were shed, but some later bolls were retained and developed on the outer fruiting positions. Average boll size was down by 10%, plants retained 50% fewer open bolls at picking and boll maturity was delayed by 33 days.

**Lint**: ginning turnout was unaffected, but lint yield was down by 28%.

**Final plant count data**

| | undamaged comparison | Gly & 2,4-D @ 8 nodes |
|---|---|---|
| **Nodes/plant** | 25.0 | 27.3 |
| **Leaves/m*** | 526 | 902 |
| **Leaf area (cm²/m)*** | 22302 | 22485 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 188 | 162 |
| **Boll weight (g/open boll)** | 4.6 | 4.1 |
| **Retention posit' 1-3^** | 92% | 66% |
| **Nodes carrying >80% bolls#** | 9 - 19 | 1 – 18 |
| **Days to 50% open** | 152 | 185 |
| **Maturity delay (days)** | | 33 |
| **% Open bolls at picking** | 99% | 57% |
| **Lint yield (kg/ha)** | 1631 | 1175 |


## Summary

Exposure to 3% of a typical field rate of a glyphosate & 2,4-D combination at 8 nodes caused tipping out and extensive leaf deformation on the main stem. The damage was not distinguishable from the damage observed from 2,4-D alone.

Plants shed many early squares and bolls, setting bolls on the lateral branches. There was a long delay in average boll maturity, plants retained fewer open bolls at picking and lint yield was down by 62%.


**Note*** These parameters were last recorded 124 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **Glyphosate + 2,4-D** |
| **Rate:** | **173 + 80 g a.i./ha** |
| **Date of exposure:** | **21st Dec (5½ weeks post-emergence)** |
| **Growth stage at exposure:** | **8 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 8 node conventional (not glyphosate tolerant) cotton. Photo taken on 5th Jan, 15 days after exposure.

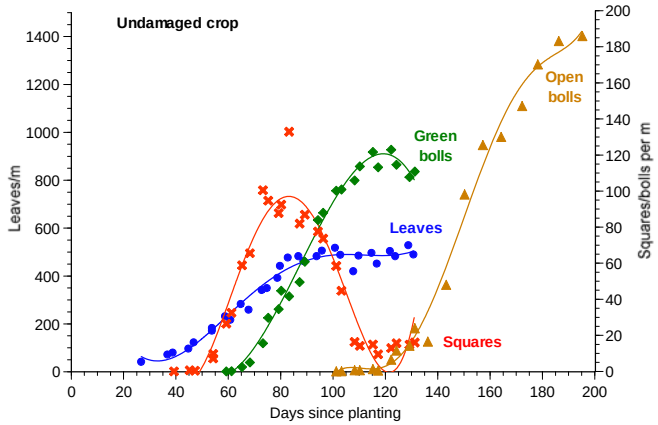
New leaves were severely affected by the 2,4-D, 15 days after exposure, with severe leaf distortion on all subsequent growth. The stems and petioles were bent and distorted.

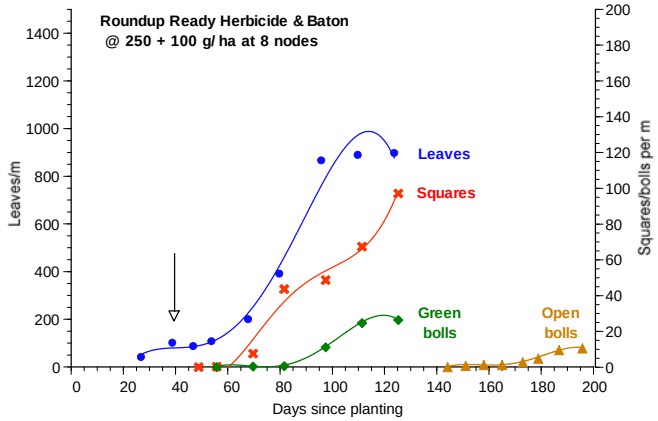
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 8 node conventional (not glyphosate tolerant) cotton. Photo taken on 25th Jan, 35 days after exposure.

All new leaves were severely distorted by the herbicide, 35 days after exposure. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage. Glyphosate damage was not apparent at any stage.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 8 node conventional (not glyphosate tolerant) cotton. Photo taken on 24th Mar, 93 days after exposure.

The plant produced distorted growth on the main stem and most lateral branches throughout the season, but the growth on the later lateral branches was largely unaffected by the herbicides.




## Impact on plant growth

**Plant:** exposure to the glyphosate & 2,4-D combination at 8 nodes damaged the emerging leaves and growing tips, tipping out 20% of plants and reducing plant size (plant weight) by 67% at the last observation.

**Leaves:** leaves that developed following the exposure were highly distorted, narrow, cupped, twisted and leathery, with prominent veins. Plants had 70% more leaves but 41% less leaf area at the final observation.

**Squares**: many of the early squares were shed following the herbicide exposure, but plants produced additional squares later in the season.

**Bolls:** many early bolls were shed, but a few later bolls were retained and developed on the outer fruiting positions. Average boll size was down by 10%, plants retained 94% fewer open bolls at picking and average boll maturity was delayed by more than 50 days, with only 12% of bolls open at picking.

**Lint**: ginning turnout was unaffected, but lint yield was down by 82%.

**Final plant count data**

| | undamaged comparison | Gly & 2,4-D @ 8 nodes |
|---|---|---|
| **Nodes/plant** | 25.0 | 25.0 |
| **Leaves/m*** | 526 | 895 |
| **Leaf area (cm²/m)*** | 22302 | 13132 |
| **Reduction in leaf area*** | | 41% |
| **Bolls/m** | 188 | 89 |
| **Boll weight (g/open boll)** | 4.6 | 4.1 |
| **Retention posit' 1-3^** | 92% | 57% |
| **Nodes carrying >80% bolls#** | 9 - 19 | 1 - 15 |
| **Days to 50% open** | 152 | >202 |
| **Maturity delay (days)** | | >50 |
| **% Open bolls at picking** | 99% | 12% |
| **Lint yield (kg/ha)** | 1631 | 297 |

## Summary

Exposure to 17% of a typical field rate of a glyphosate & 2,4-D combination at 8 nodes caused tipping out and extensive leaf deformation. The damage was not distinguishable from the damage observed from 2,4-D alone.

Plants shed many early squares and bolls, setting some late bolls on the lateral branches. There was a long delay in average boll maturity, plants retained few open bolls at picking and lint yield was reduced by 82%.

**Note*** These parameters were last recorded 124 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **Glyphosate + 2,4-D** |
| **Rate:** | **35 + 8 g a.i./ha** |
| **Date of exposure:** | **4th Jan (7½ weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 12 node conventional (not glyphosate tolerant) cotton. Photo taken on 25th Jan, 21 days after exposure.

All new leaves were severely distorted 21 days after exposure. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

Glyphosate damage was not apparent on these plants at any stage.

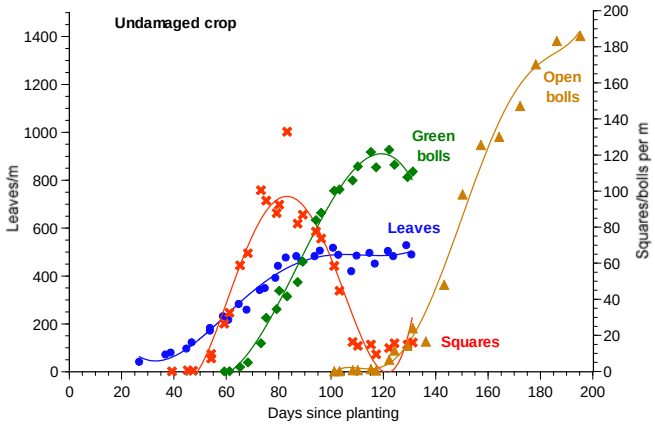
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 12 node conventional (not glyphosate tolerant) cotton. Photo taken on 25th Jan, 21 days after exposure.

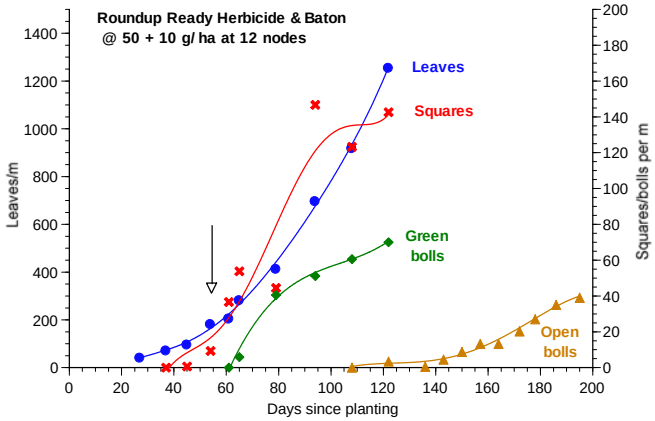
A close-up of the plants in the previous photo, taken 21 days after exposure.

Older leaves showed some damage, with cupping and distorted edges. Newly emerging leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 12 node conventional (not glyphosate tolerant) cotton. Photo taken on 8th Mar, 63 days after exposure.

The plant continued to produce distorted growth throughout the remainder of the season. This growth was still obvious at picking.




## Impact on plant growth

**Plant:** exposure to the lighter rate of glyphosate & 2,4-D combination at 12 nodes damaged the emerging leaves and growing tips, reducing plant size (plant weight) by 25%, although plants were 16 cm and 3.3 nodes taller at picking.

**Leaves:** leaves that developed following the exposure were highly distorted, narrow, cupped, twisted and leathery, with prominent veins. Plants had 138% more leaves but only 10% more leaf area at the final observation.

**Squares**: many of the early squares were shed following the herbicide exposure, but plants produced additional squares later in the season.

**Bolls:** many early bolls were shed, but some later bolls were retained and developed, often on the outer fruiting positions. Average boll size was down by 12%, plants retained 79% fewer open bolls at picking and average boll maturity was delayed by 22 days.

**Lint**: ginning turnout was unaffected, but lint yield was reduced by 64%.

**Final plant count data**

| | undamaged comparison | Gly & 2,4-D @ 12 nodes |
|---|---|---|
| **Nodes/plant** | 25.0 | 28.3 |
| **Leaves/m*** | 526 | 1252 |
| **Leaf area (cm²/m)*** | 22302 | 24422 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 188 | 47 |
| **Boll weight (g/open boll)** | 4.6 | 4.1 |
| **Retention posit' 1-3^** | 92% | 61% |
| **Nodes carrying >80% bolls#** | 9 - 19 | 7 - 21 |
| **Days to 50% open** | 152 | 174 |
| **Maturity delay (days)** | | 22 |
| **% Open bolls at picking** | 99% | 83% |
| **Lint yield (kg/ha)** | 1631 | 581 |


## Summary

Exposure to 3% of a typical field rate of a glyphosate & 2,4-D combination at 12 nodes damaged growing points and caused extensive leaf deformation. The damage from the combination was not distinguishable from 2,4-D alone.

Plants shed many early squares and bolls. There was a delay in average boll maturity, boll size was reduced, plants retained few open bolls at picking and lint yield was reduced by 64%.


**Note*** These parameters were last recorded 122 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **Glyphosate + 2,4-D** |
| **Rate:** | **173 + 80 g a.i./ha** |
| **Date of exposure:** | **4th Jan (7½ weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**

| | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 12 node conventional (not glyphosate tolerant) cotton. Photo taken on 25th Jan, 21 days after exposure.

All new leaves were severely distorted, 21 days after exposure. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

Glyphosate damage was not apparent on these plants at any stage.

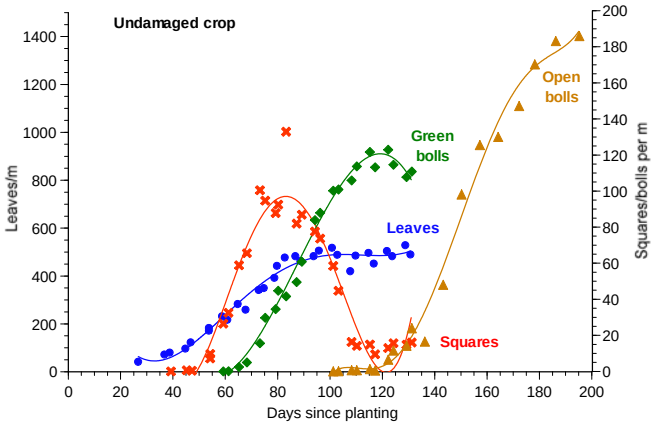
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 12 node conventional (not glyphosate tolerant) cotton. Photo taken on 25th Jan, 21 days after exposure.

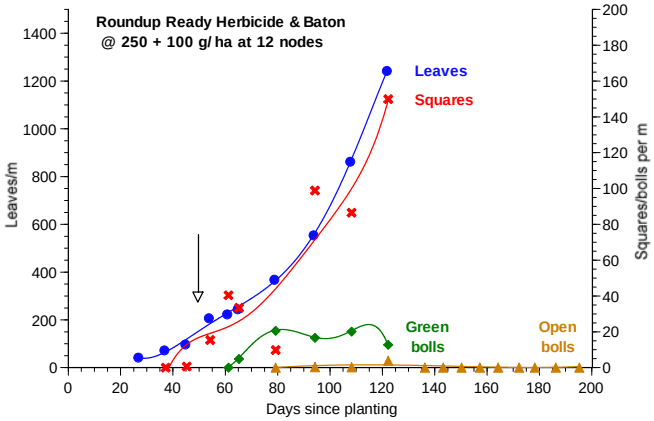
A close-up of the plants in the previous photo, taken 21 days after exposure.

Older leaves showed some damage, with cupping and distorted edges. Newly emerging leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 12 node conventional (not glyphosate tolerant) cotton. Photo taken on 8th Mar, 63 days after exposure.

The plant continued to produce distorted growth throughout the remainder of the season. This growth was still obvious at picking.




## Impact on plant growth

**Plant:** exposure to the glyphosate & 2,4-D combination at 12 nodes damaged the emerging leaves and growing tips, reducing plant size (plant weight) by 64%, plant height by 8 cm.

**Leaves:** leaves that developed following the exposure were highly distorted, narrow, cupped, twisted and leathery, with prominent veins. Plants had 136% more leaves but 39% less leaf area at the final observation.

**Squares**: many of the early squares were shed following the herbicide exposure, but plants produced additional squares later in the season.

**Bolls:** most early bolls were shed and bolls continued to be shed throughout the season. No bolls were retained above node 11, the point of exposure. Plants only retained 6 bolls/m at picking, with no open bolls.

**Lint**: no machine harvestable lint was picked from these plots.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **Gly & 2,4-D @ 12 nodes** |
| **Nodes/plant** | 25.0 | 26.9 |
| **Leaves/m*** | 526 | 1252 |
| **Leaf area (cm²/m)*** | 22302 | 13609 |
| **Reduction in leaf area*** | | 39% |
| **Bolls/m** | 188 | 6 |
| **Boll weight (g/open boll)** | 4.6 | - |
| **Retention posit' 1-3^** | 92% | 85% |
| **Nodes carrying >80% bolls#** | 9 - 19 | 7 - 10 |
| **Days to 50% open** | 152 | 190 |
| **Maturity delay (days)** | | 38 |
| **% Open bolls at picking** | 99% | 0% |
| **Lint yield (kg/ha)** | 1631 | 0 |


## Summary

Exposure to 17% of a typical field rate of a glyphosate & 2,4-D combination at 12 nodes damaged growing points and caused extensive leaf deformation. The damage from the combination was not distinguishable from 2,4-D alone.

Plants shed most early squares and bolls, and no new bolls were retained following the exposure. No machine harvestable lint was picked from this treatment.


**Note*** These parameters were last recorded 122 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **Glyphosate + 2,4-D** |
| **Rate:** | **35 + 8 g a.i./ha** |
| **Date of exposure:** | **24th Jan (10 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 16 node conventional (not glyphosate tolerant) cotton. Photo taken on 6th Feb, 13 days after the exposure.

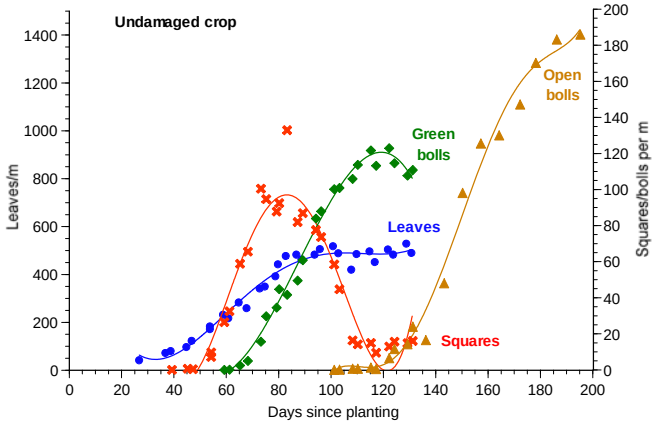
Plants appeared to be undamaged but closer examination revealed that the new leaves which had emerged after the herbicide exposure were severely distorted. Leaves were narrow, cupped, twisted and leathery 13 days after the exposure. No glyphosate damage was apparent on these plants at any stage.

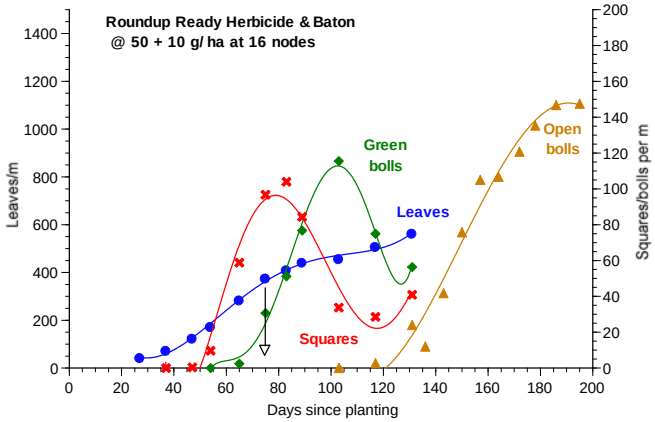
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 16 node conventional (not glyphosate tolerant) cotton. Photo taken on 22nd Feb, 29 days after the exposure.

The plant produce distorted growth 29 days after the exposure. Leaves were narrow, cupped, twisted and leathery, symptoms typical of phenoxy damage.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 16 node conventional (not glyphosate tolerant) cotton. Photo taken on 5th April, 72 days after the exposure.

The plant continued to produce distorted growth, although by 72 days some normal leaves had emerged at the top of the plant.




## Impact on plant growth

**Plant:** exposure to the lighter rate of the glyphosate & 2,4-D combination at 16 nodes damaged the emerging leaves and growing tips at the top of the plants. Plants developed vegetative top growth and were 3.3 nodes taller at picking, but plant size (plant weight) was down 16%.

**Leaves:** leaves that developed following the exposure were highly distorted, narrow, cupped, twisted and leathery, with prominent veins. Plants had 16% less leaf area at the final observation.

**Squares**: many of the late squares were shed following the herbicide exposure, but this had little effect on yield.

**Bolls:** some small bolls were shed following the exposure, with plants retaining 21% fewer open bolls at picking. Older bolls were retained and there was no change in the pattern of boll retention or delay in average boll maturity.

**Lint**: ginning turnout was unaffected by the herbicide exposure, but lint yield was down by 17%.

| Final plant count data | | |
|---|---|---|
| | **undamaged comparison** | **Gly & 2,4-D @ 16 nodes** |
| **Nodes/plant** | 25.0 | 28.3 |
| **Leaves/m*** | 526 | 559 |
| **Leaf area (cm²/m)*** | 22302 | 18760 |
| **Reduction in leaf area*** | | 16% |
| **Bolls/m** | 188 | 156 |
| **Boll weight (g/open boll)** | 4.6 | 4.6 |
| **Retention posit' 1-3^** | 92% | 93% |
| **Nodes carrying >80% bolls#** | 9 - 19 | 9 - 19 |
| **Days to 50% open** | 152 | 152 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 99% | 95% |
| **Lint yield (kg/ha)** | 1631 | 1354 |


### Summary

Exposure to 3% of a typical field rate of a glyphosate + 2,4-D combination at 16 nodes damaged growing points and caused extensive leaf deformation. The damage was not distinguishable from 2,4-D damage alone.

Plants shed many late squares and small bolls, retaining fewer open bolls at picking. There was no change in the pattern of boll retention or delay in average boll maturity. Lint yield was reduced by 17%.


**Note*** These parameters were last recorded 131 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate + 2,4-D** |
| **Rate:** | **173 + 80 g a.i./ha** |
| **Date of exposure:** | **24th Jan (10 weeks post-emergence)** |
| **Growth stage at exposure:** | **16 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | |
| **Leaf distortion** | **x** |
| **Petiole distortion** | **x** |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide that affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause uncontrolled cell division & growth, leading to plant death
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 16 node cotton. Photo taken on 10th Feb, 17 days after exposure.

All new leaves were severely distorted 17 days after exposure. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage. Glyphosate damage was not apparent on these plants at any stage.

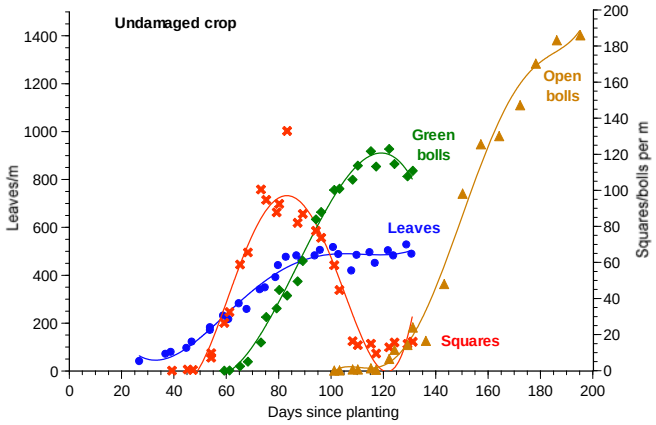
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 16 node cotton. Photo taken on 10th Feb, 17 days after exposure.

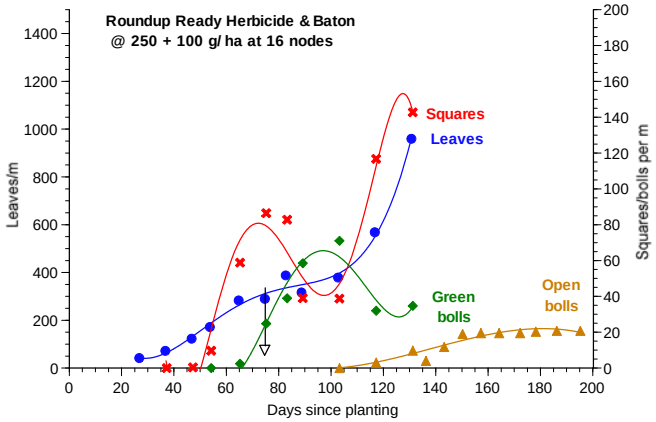
A close-up of the plants in the previous photo.

Some older leaves showed damage, with cupping and distorted edges. Newly emerging leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins. Petioles and stems at the top of the plant were twisted.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 16 node cotton. Photo taken on 24th Mar, 59 days after exposure.

The plant continued to produce distorted growth throughout the remainder of the season. This growth was still obvious at picking. Few fruit were retained above 11 nodes.




## Impact on plant growth

**Plant:** exposure to the combination of 2,4-D & glyphosate at 16 nodes damaged the emerging leaves and growing tips at the top of the plants. Plants developed vegetative top growth and were 6.4 cm and 3.3 nodes taller at picking, but plant size (plant weight) was down by 27%.

**Leaves:** that developed following the exposure were highly distorted, narrow, cupped, twisted and leathery, with prominent veins. Plants had 82% more leaves but 10% less leaf area at the final observation.

**Squares**: many squares were shed following the herbicide exposure. The plant produced masses of later squares, but many were distorted, failed to develop normally and didn't contribute to yield.

**Bolls:** plants shed most smaller bolls and retained few later bolls following the exposure. Plants retained 89% fewer open bolls at picking, with fewer bolls retained in fruiting positions 1 - 3 and almost no bolls retained above node 11. There was no delay in average boll maturity.

**Lint**: ginning turnout was unaffected, but lint yield was down by 57%.

**Final plant count data**

| | undamaged comparison | Gly & 2,4-D @ 16 nodes |
|---|---|---|
| **Nodes/plant** | 25.0 | 28.3 |
| **Leaves/m*** | 526 | 956 |
| **Leaf area (cm²/m)*** | 22302 | 20155 |
| **Reduction in leaf area*** | | 10% |
| **Bolls/m** | 188 | 30 |
| **Boll weight (g/open boll)** | 4.6 | 3.9 |
| **Retention posit' 1-3^** | 92% | 77% |
| **Nodes carrying >80% bolls#** | 9 - 19 | 8 - 11 |
| **Days to 50% open** | 152 | 149 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 99% | 68% |
| **Lint yield (kg/ha)** | 1631 | 701 |


**Summary**

Exposure to 17% of a typical field rate of a glyphosate + 2,4-D combination at 16 nodes damaged growing points and caused extensive leaf deformation. The damage from the combination was not distinguishable from 2,4-D damage alone.

Plants shed many late squares and small bolls, retaining fewer open bolls at picking, with almost no bolls retained above node 11. Lint yield was reduced by 57%.


**Note*** These parameters were last recorded 131 days after planting.
**Note^** Percentage of retained bolls in positions 1 – 3.
**Note#** The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **paraquat + diquat** |
| **Rate:** | **43 + 37 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **12th Nov** (6 weeks post-emergence) |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | |

## Herbicidal action

**Herbicide group:** **L**
**Translocation:** paraquat & diquat are contact herbicides with minimal translocation
**Mode of action:** inhibit photosynthesis at photosystem 1 and react to destroy unsaturated lips, fatty acids and chlorophyll
**Residual activity:** none
**Soil half-life:** 1000 days, but are strongly adsorbed to soil and are biologically inactive

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

Symptoms of paraquat + diquat damage were apparent soon after exposure, with dead spots on the leaves. Neither paraquat nor diquat are translocated within the plant. Some leaves were completely unaffected, as they were shielded by other plant material and not exposed to the herbicides.

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

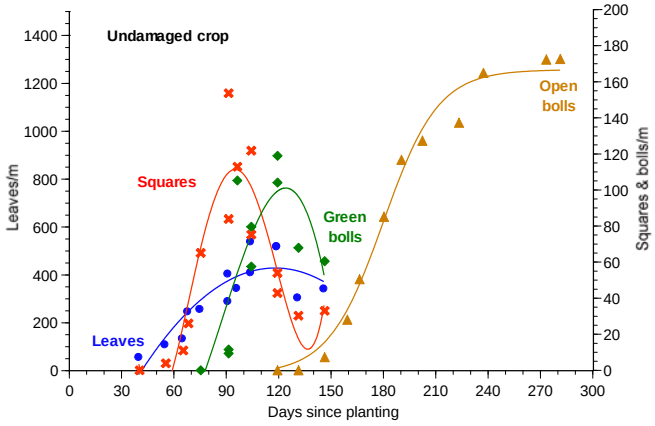
Plants had resumed normal growth 10 days after exposure. Some herbicide damage (dead spots) were still apparent on older leaves.

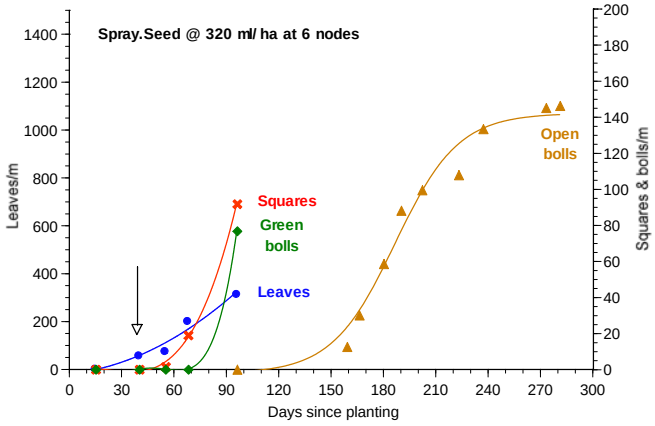
Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

Plants were growing normally by 29 days after exposure with little delay in crop development.

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Plants were growing normally 51 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 10% rate of paraquat + diquat damaged leaves and shoots, causing a 52% increase in the proportion of tipped-out plants. Plant growth and development was delayed. Plants were 15% smaller by weight at the last observation.

**Leaves:** plants had 9% fewer leaves and 15% less leaf area at the last observation.

**Squares**: square production was largely unaffected by the herbicide exposure.

**Bolls:** boll production and retention were largely unaffected by the herbicide exposure, although more bolls were retained on the lateral branches due to the high proportion of tipped-out plants. There was an 8% reduction in the number of bolls retained at picking and a 7% reduction in the proportion of mature bolls. There was a 10 day delay in average boll maturity.

**Lint:** the herbicide damage didn't reduce ginning turnout, fibre quality or lint yield.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **paraquat + diquat** |
| **Nodes/plant** | 27.8 | 27.3 |
| **Leaves/m*** | 342 | 313 |
| **Leaf area (cm²/m)*** | 17713 | 15002 |
| **Reduction in leaf area*** | | 15% |
| **Bolls/m** | 200 | 184 |
| **Boll weight (g/open boll)** | 4.2 | 4.2 |
| **Retention in posit's 1-3^** | 88% | 74% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 2 - 21 |
| **Days to 50% open** | 187 | 197 |
| **Maturity delay (days)** | | 10 |
| **% Open bolls at picking** | 86% | 80% |
| **Lint yield/ha** | 2246 | 2166 |

Exposure to 10% of a typical field rate of paraquat + diquat at 6 nodes damaged the growing tips and many of the leaves but did not defoliate or kill the plants. Plants quickly recovered from this damage, although a large proportion of plants were tipped-out.

The herbicide exposure had little impact on square and boll production and retention. Crop maturity was delayed, but there were no impacts on fibre quality or lint yield.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **paraquat + diquat** |
| **Rate:** | **216 + 184 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **12th Nov** (6 weeks post-emergence) |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **L**
**Translocation:** paraquat & diquat are contact herbicides with minimal translocation
**Mode of action:** they inhibit photosynthesis at photosystem 1 and react to destroy unsaturated lips, fatty acids and chlorophyll
**Residual activity:** none
**Soil half-life:** 1000 days, but are strongly adsorbed to soil and are biologically inactive

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

Symptoms of paraquat + diquat damage became apparent almost immediately after exposure, with rapid burning of the leaf and stem tissues. There was some petiole twisting and death of most leaves at this relatively high rate. However, neither paraquat nor diquat are translocated within the plant. Some leaves were completely unaffected as they were shielded by other plant material and not directly exposed to the herbicide.

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

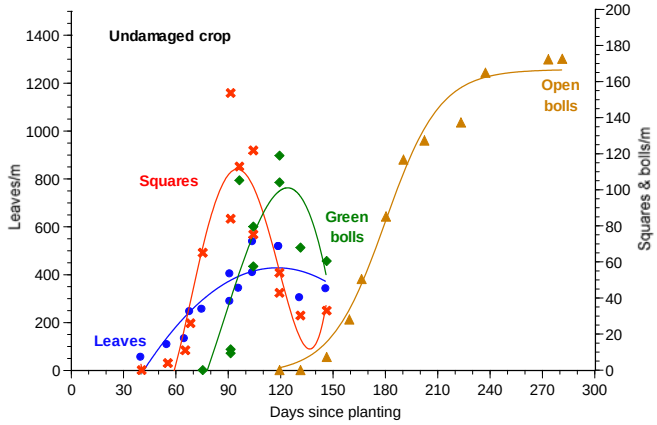
Surviving plants had resumed normal growth 10 days after exposure, although herbicide damage (dead leaves) was still obvious.

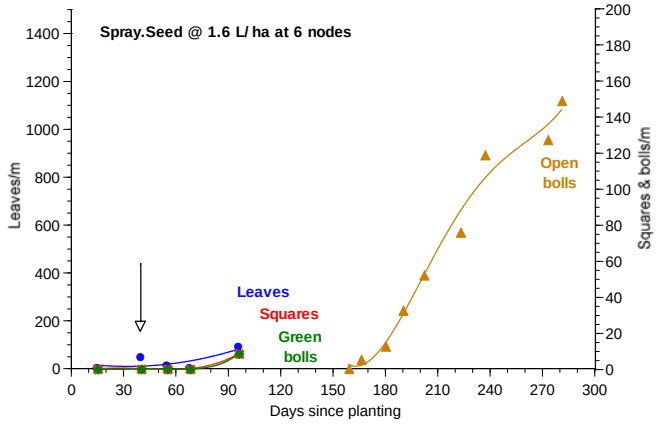
Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 6 node cotton.. Photo taken on 11th Dec, 29 days after exposure.

Plants where all leaf material was killed, died soon after exposure. Plants which had some unaffected leaf material generally survived and were growing normally 29 days after exposure.

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Plants were growing completely normally 51 days after exposure.




## Impact on plant growth

**Plants:** exposure to the 50% rate of paraquat + diquat killed most plants, halving the plant stand and delaying the growth of surviving plants by around 60 days. The proportion of tipped-out plants increased by 52% and plants were 95% smaller by weight at the last observation.

**Leaves:** plants had 74% fewer leaves and 95% less leaf area mid-season.

**Squares**: square production was delayed by 20 days or more.

**Bolls:** boll production was also delayed, but surviving plants retained a large number of bolls, with a large proportion of bolls retained on the laterals and outer fruiting positions. Final boll number and weight were reduced, and there was a 33 day delay in the average boll maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.1) and 1.1% more short fibres. Lint yield was reduced by 73%.

**Final plant count data**

| | undamaged crop | paraquat + diquat |
|---|---|---|
| **Nodes/plant** | 27.8 | 29.7 |
| **Leaves/m*** | 342 | 89 |
| **Leaf area (cm²/m)*** | 17713 | 920 |
| **Reduction in leaf area*** | | 95% |
| **Bolls/m** | 200 | 168 |
| **Boll weight (g/open boll)** | 4.2 | 3.9 |
| **Retention in posit's 1-3^** | 88% | 49% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 15 |
| **Days to 50% open** | 187 | 220 |
| **Maturity delay (days)** | | 33 |
| **% Open bolls at picking** | 86% | 88% |
| **Lint yield/ha** | 2246 | 596 |

Exposure to 50% of a typical field rate of paraquat + diquat at 6 nodes defoliated and killed a high proportion of plants, leaving most surviving plants tipped-out, delaying crop growth and maturity.

The surviving plants grew normally but were unable to fully compensate for the early damage. A large proportion of bolls were retained on the lateral branches and outer fruiting positions. Boll number, boll weight, crop maturity and fibre quality were reduced. Lint yield was reduced by 73%.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **paraquat + diquat** |
| **Rate:** | **43 + 37 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **5th Dec (9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **L**
**Translocation:** paraquat & diquat are contact herbicides with minimal translocation
**Mode of action:** inhibit photosynthesis at photosystem 1 and react to destroy unsaturated lips, fatty acids and chlorophyll
**Residual activity:** none
**Soil half-life:** 1000 days, but are strongly adsorbed to soil and are biologically inactive

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Symptoms of paraquat + diquat damage were apparent soon after exposure, with necrotic spots on many leaves and many completely dead leaves. Some leaves were unaffected as they were shielded by other plant material and not exposed to the herbicide.

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

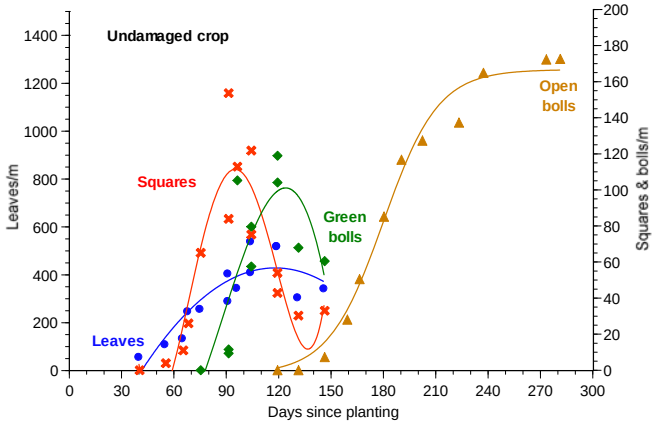
Plants had resumed normal growth 16 days after exposure. Some herbicide damage, necrotic spots and dead leaves were still apparent.

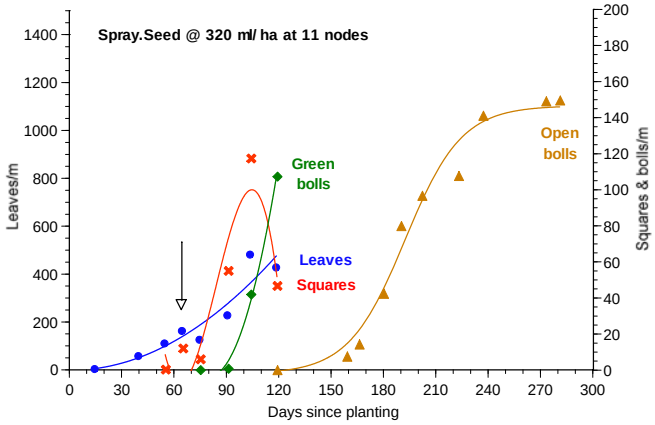
Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

Plants were growing normally 28 days after exposure, with little delay in crop development.

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Plants were growing normally 40 days after exposure.




## Impact on plant growth

**Plants:** the 10% rate of paraquat + diquat desiccated many of the exposed leaves and delayed growth and development. Plants were 8 cm and 3.5 nodes shorter and 19% smaller by weight mid-season.

**Leaves:** plants rapidly recovered from the herbicide damage but still had 18% fewer leaves mid-season.

**Squares**: square production was delayed by about 10 days.

**Bolls:** there appeared to be minimal impact on boll production and retention, with a 6% reduction in retention in the first 3 fruiting positions and no reduction in the final boll number. However, mature bolls were only retained to node 20, six nodes fewer than on undamaged plants. There was a 13% reduction in boll size, 10% fewer bolls were open at picking and there was an 18 day delay in boll maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.15). Lint yield was reduced by 48%.

| Final plant count data | | |
|---|---|---|
| | **undamaged crop** | **paraquat + diquat** |
| **Nodes/plant** | 27.8 | 24.4 |
| **Leaves/m*** | 342 | 424 |
| **Leaf area (cm²/m)*** | 13541 | 13201 |
| **Reduction in leaf area*** | | 3% |
| **Bolls/m** | 200 | 193 |
| **Boll weight (g/open boll)** | 4.2 | 3.7 |
| **Retention in posit's 1-3^** | 88% | 83% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 4 - 21 |
| **Days to 50% open** | 187 | 205 |
| **Maturity delay (days)** | | 18 |
| **% Open bolls at picking** | 86% | 78% |
| **Lint yield/ha** | 2246 | 1177 |

Exposure to 10% of a typical field rate of paraquat + diquat at 11 nodes damaged or killed many of the exposed leaves. There was an initial reduction in leaf number and leaf area, but plants quickly compensated for this damage, albeit with a delay in crop growth and development.

A few early bolls were lost from the first 3 fruiting positions, but plants retained a full boll load at picking. There were reductions in boll weight, boll maturity and fibre quality. Lint yield was down 48%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **paraquat + diquat** |
| **Rate:** | **216 + 184 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **5th Dec** |
| | **(9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **L**
**Translocation:** paraquat & diquat are contact herbicides with minimal translocation
**Mode of action:** they inhibit photosynthesis at photosystem 1 and react to destroy unsaturated lips, fatty acids and chlorophyll
**Residual activity:** none
**Soil half-life:** 1000 days, but are strongly adsorbed to soil and are biologically inactive

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 11 node cotton. Photo on 11th Dec, 6 days after exposure.

Symptoms of spray damage become apparent almost immediately after exposure, with rapid burning of the leaf and stem tissues. Most leaves were killed at this rate. However, neither paraquat nor diquat are translocated within the plant. Some leaves were unaffected as they were shielded by other plant material and not exposed to the herbicide.

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

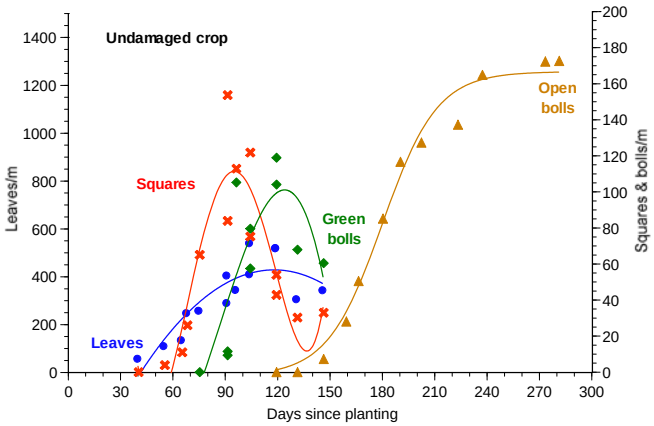
Many plants were killed by the herbicide. Surviving plants were resuming normal growth 16 days after exposure, although herbicide damage (dead leaves) were still obvious. Growth was generally coming from the lower nodes, which were less affected by the herbicide.

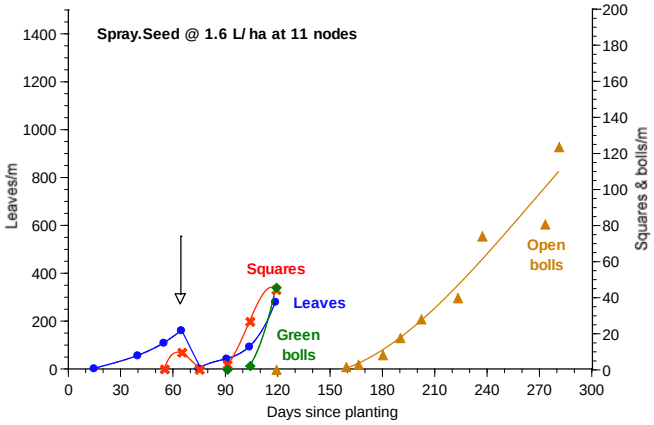
Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

Plants where all leaf material was killed died soon after exposure. Plants which had some unaffected leaf material generally survived and were growing normally 28 days after exposure.

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 11 node cotton. Photo taken on 14th Jan, 40 days after exposure.

Surviving plants were growing normally 40 days after exposure.




## Impact on plant growth

**Plants:** the 50% rate of paraquat + diquat killed most leaves and many plants, with large gaps in the plant stand and a delay in the growth of surviving plants. Of the surviving plants, 95% were tipped-out and stunted, 48 cm and 5.5 nodes shorter and 65% smaller by weight.

**Leaves:** most leaves were shed following the herbicide exposure. Plants had 46% fewer leaves and 77% less leaf area mid-season.

**Squares**: most squares were shed following the herbicide exposure and square production was delayed by 30 days.

**Bolls:** most early bolls were shed, with later bolls retained on the lateral branches and outer fruiting positions. Plants retained 14% fewer bolls, boll size was down 16% and 17% fewer bolls were open at picking. Crop maturity was delayed by 74 days.

**Lint:** ginning turnout was unaffected, but the cotton was immature, with low micronare (3.05) and 0.7% more short fibres. Lint yield was reduced by 85%.

**Final plant count data**

| | undamaged crop | paraquat + diquat |
|---|---|---|
| **Nodes/plant** | 27.8 | 22.4 |
| **Leaves/m*** | 342 | 278 |
| **Leaf area (cm²/m)*** | 13541 | 3048 |
| **Reduction in leaf area*** | | 77% |
| **Bolls/m** | 200 | 173 |
| **Boll weight (g/open boll)** | 4.2 | 3.6 |
| **Retention in posit's 1-3^** | 88% | 54% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 18 |
| **Days to 50% open** | 187 | 261 |
| **Maturity delay (days)** | | 74 |
| **% Open bolls at picking** | 86% | 71% |
| **Lint yield/ha** | 2246 | 326 |

Exposure to 50% of a typical field rate of paraquat + diquat at 11 nodes defoliated and killed a high proportion of plants. Surviving plants recovered and grew normally, but crop growth and development were delayed. Most surviving plants were tipped-out.

Most early bolls were shed, with later bolls retained on the lateral branches and outer fruiting positions. There was a reduction in boll number, boll weight, crop maturity and fibre quality. Lint yield was reduced by 85%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **paraquat + diquat** |
| **Rate:** | **43 + 37 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **2nd Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **L**
**Translocation:** paraquat & diquat are contact herbicides with minimal translocation
**Mode of action:** they inhibit photosynthesis at photosystem 1 and react to destroy unsaturated lips, fatty acids and chlorophyll
**Residual activity:** none
**Soil half-life:** 1000 days, but are strongly adsorbed to soil and are biologically inactive

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 15 node cotton. Photo taken on 4th Jan, 2 days after exposure.

Symptoms of paraquat + diquat damage become apparent soon after exposure, with necrotic spots on most leaves and some completely dead leaves. Some leaves remained unaffected as they were shielded by other plant material and not exposed to the herbicide.

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 15 node cotton. Photo taken on 7th Jan, 5 days after exposure.

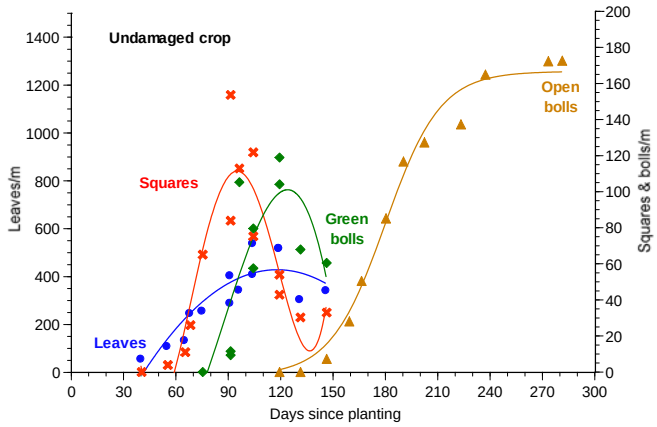
Many of the worst affected leaves had died and some had fallen from the plants 5 days after exposure. Most remaining leaves had developed necrotic spots.

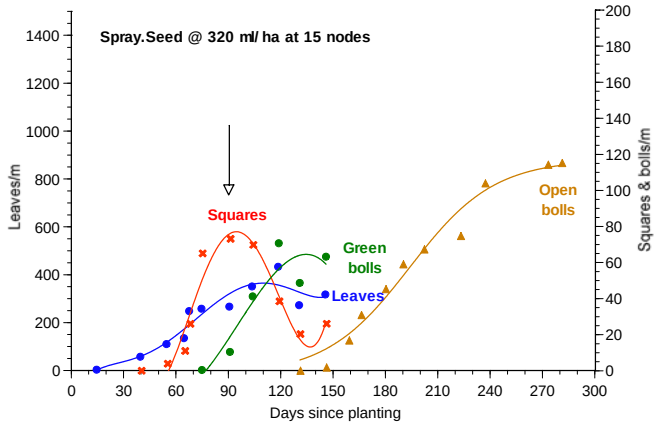
Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 15 node cotton. Photo taken on 14th Jan, 12 days after exposure.

Plants had largely resumed normal growth within 2 weeks of the herbicide exposure, although some dead leaves and necrotic spots were still evident.

Spray.Seed® (paraquat + diquat) applied broadcast at 320 ml/ha to 15 node cotton. Photo taken on 25th Jan, 23 days after exposure.

Plants were growing normally 23 days after exposure, although necrotic spots were still obvious on some of the lower leaves.




## Impact on plant growth

**Plants:** the 10% rate of paraquat + diquat desiccated many of the exposed leaves and delayed crop growth and development.

**Leaves:** plants rapidly recovered from the herbicide damage, and had only 8% fewer leaves and 7% less leaf area mid-season.

**Squares**: peak square production was reduced by the herbicide exposure.

**Bolls:** some early bolls were shed following the herbicide exposure, reducing peak boll production by 41% and retention in the first 3 fruiting positions by 6%. There was little change in the pattern of boll retention, with mature bolls retained to node 26, although 10% fewer bolls were open at picking. Final boll retention was down 26%, boll weight was down 15% and crop maturity was delayed by 23 days.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (3.2) and 12.1% short fibres. Lint yield was reduced by 26%.

**Final plant count data**

| | undamaged crop | paraquat + diquat |
|---|---|---|
| **Nodes/plant** | 27.8 | 29.4 |
| **Leaves/m*** | 342 | 314 |
| **Leaf area (cm²/m)*** | 22084 | 20562 |
| **Reduction in leaf area*** | | 7% |
| **Bolls/m** | 200 | 148 |
| **Boll weight (g/open boll)** | 4.2 | 3.6 |
| **Retention in posit's 1-3^** | 88% | 83% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 4 - 24 |
| **Days to 50% open** | 187 | 210 |
| **Maturity delay (days)** | | 23 |
| **% Open bolls at picking** | 86% | 78% |
| **Lint yield/ha** | 2246 | 1651 |

Exposure to 10% of a typical field rate of paraquat + diquat at 15 nodes killed some leaves. However, plants recovered quickly from this damage.

Some early-season squares and bolls were shed, with fruit lost from the first 3 fruiting positions. There was little change in the pattern of boll retention, but there was a reduction in boll number, boll weight, the percentage of open bolls, crop maturity and fibre quality. There was a 26% reduction in lint yield.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **paraquat + diquat** |
| **Rate:** | **216 + 184 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **2nd Jan (13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | **x** |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **L**
**Translocation:** paraquat & diquat are contact herbicides with minimal translocation
**Mode of action:** they inhibit photosynthesis at photosystem 1 and react to destroy unsaturated lips, fatty acids and chlorophyll
**Residual activity:** none
**Soil half-life:** 1000 days, but are strongly adsorbed to soil and are biologically inactive

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 16 node cotton. Photo on 4th Jan, 2 days after exposure.

Symptoms of spray damage become apparent almost immediately after exposure, with rapid burning of the leaves and stem tips. Most leaves had necrotic spots or patches and some leaves were killed. However, neither paraquat nor diquat are translocated within the plant. Some leaves remained largely unaffected as they were shielded by other plant material and not exposed to the herbicide.

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 15 node cotton. Photo taken on 7th Jan, 5 days after exposure.

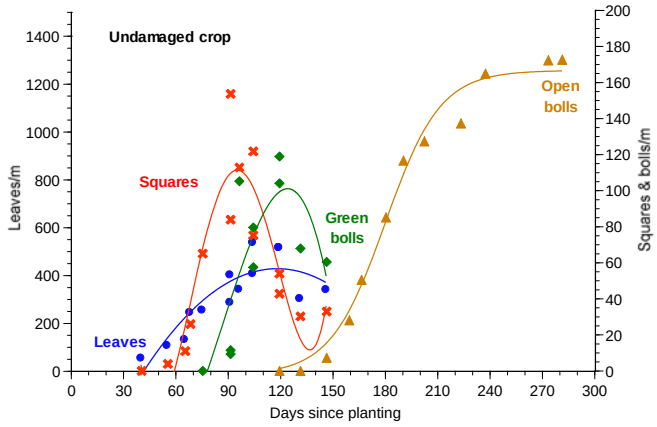
Most leaves and squares had been killed and many have fallen 5 days after exposure. Some stem tips were also killed. A few green leaves remained, often on the surviving stem tips.

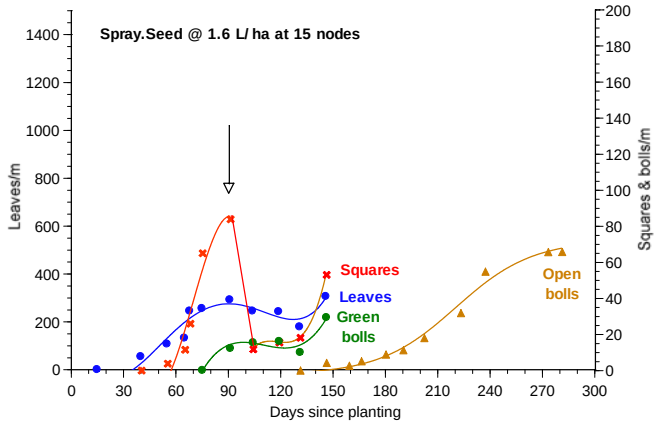
Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 15 node cotton.. Photo taken on 14th Jan, 12 days after exposure.

Plants were beginning to produce new leaves from the stem tips 12 days after exposure. These leaves were completely normal and showed no symptoms of herbicide damage.

Spray.Seed® (paraquat + diquat) applied broadcast at 1.6 L/ha to 15 node cotton. Photo taken on 11th Feb, 40 days after exposure.

Surviving plants were growing normally 40 days after exposure, although many "twigs" were still apparent poking through the canopy. These were the ends of the stems which were killed by the herbicide. Necrotic spots remained visible on many of the lower leaves.




## Impact on plant growth

**Plants:** the 50% rate of paraquat + diquat killed most leaves and some stem tips. Plants were stunted, 55 cm and 6.4 nodes shorter and 47% smaller by weight.

**Leaves:** new leaves were emerging within 14 days of the herbicide exposure, but plants had 10% fewer leaves and 34% less leaf area at the last observation.

**Squares**: most squares were shed following the herbicide exposure, delaying square production by around 50 days.

**Bolls:** many early bolls were shed, with 41% fewer bolls retained in positions 1 – 3. Plants compensated, but the final boll number was down by 46% and only 60% of these bolls were open at picking. Few mature bolls were retained above node 17, nine nodes fewer than the undamaged crop. Boll weight was down by 32% and crop maturity was delayed by 62 days.

**Lint:** ginning turnout was reduced by 6%. The cotton was immature, with low micronare (2.85), reduced fibre length and 10.9% short fibres. Yield was down 83%.

**Final plant count data**

| | undamaged crop | paraquat + diquat |
|---|---|---|
| **Nodes/plant** | 27.8 | 21.5 |
| **Leaves/m*** | 342 | 306 |
| **Leaf area (cm²/m)*** | 22084 | 14644 |
| **Reduction in leaf area*** | | 34% |
| **Bolls/m** | 200 | 109 |
| **Boll weight (g/open boll)** | 4.2 | 2.9 |
| **Retention in posit's 1-3^** | 88% | 52% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 3 - 20 |
| **Days to 50% open** | 187 | 249 |
| **Maturity delay (days)** | | 62 |
| **% Open bolls at picking** | 86% | 60% |
| **Lint yield/ha** | 2246 | 371 |

Exposure to 50% of a typical field rate of paraquat + diquat at 15 nodes defoliated most plants and killed most squares. Plants were slow to resume normal growth, with square and boll production delayed by up to 50 days.

Plants did set a late crop, but boll number, boll weight, crop maturity and fibre quality were all reduced. Many bolls were still immature at picking and lint yield was reduced by 83%, ever though picking was delayed till early June.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

**Herbicide:** **Glyphosate + 2,4-D**
**Rate:** **35 + 8 g a.i./ha**
**Date of exposure:** **12th Dec**
**(4 weeks post-emergence)**
**Growth stage at exposure:** **6 nodes**

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide groups:** **M + I**

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 6 node cotton. Photo taken on 5th Jan, 24 days after exposure.

New leaves on the main stem were severely affected by the 2,4-D, with severe leaf distortion on all subsequent growth.

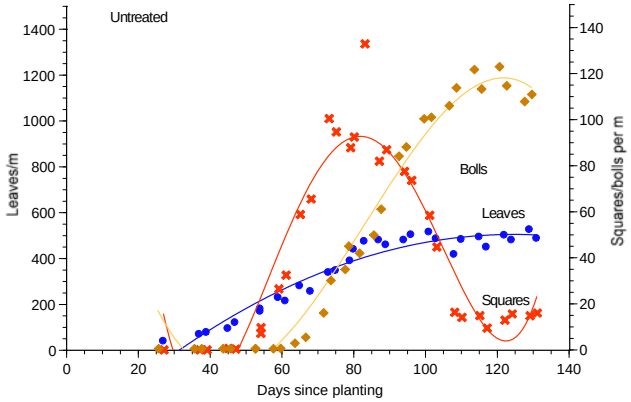
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 6 node cotton. Photo taken on 5th Jan, 24 days after exposure.

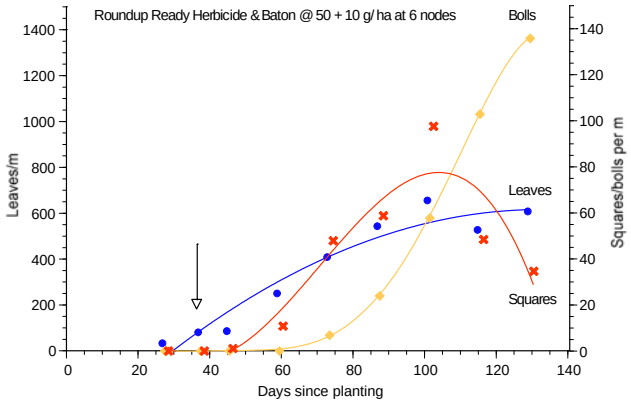
The new leaves on the main stem were severely distorted by the herbicide. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

There were no signs of glyphosate damage.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 6 node cotton. Photo taken on 24th Mar, 102 days after exposure.

This plate shows a close-up of a boll distorted by the herbicides. The herbicides affected not only the leaves, but also squares, flowers and bolls.




## Impact on plant growth

**Leaves:** the primary effect of the herbicide was on the leaves that developed following the exposure, causing an increase in leaf production, mainly through the production of small, distorted leaves on the main stem.

Leaves which developed on the vegetative branches were not affected by the herbicides.

**Squares**: many of the early squares were shed following the herbicide exposure and peak squaring was delayed by 23 days. Later squares were retained and developed.

**Bolls:** most early bolls were shed, but later bolls on the vegetative branches were retained and developed. The plant produced a large number of late bolls, many of which didn't reach maturity.

**Plant:** growth on the main stem responded vegetatively, with the plant producing an additional 1.5 nodes.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Height (cm)** | 73.9 | 78.9 |
| **Nodes/plant** | 21.5 | 22.9 |
| **Internode length** (post-spray) | 4.1 | 3.9 |
| **Leaves/m** | 502 | 605 |
| **Light interception** | 87% | 87% |
| **Leaf area (cm²/m)** | 22921 | 21765 |
| **Bolls/m** | 114 | 136 |
| **Boll weight (g/boll)** | 4.4 | 3.1 |
| **Days to 50% open** | 154 | - |
| **% Open bolls at picking** | 82% | 48% |
| **Lint yield/ha** | 1649 | 1572 |

Glyphosate + 2,4-D exposure at 6 nodes caused extensive leaf deformation on the main stem and a loss of fruit from the main stem.

The plant compensated for this damage, setting the crop on the vegetative branches, producing a late crop, with a delay in crop maturity. Many of the late bolls were small and still green at harvest.

The herbicide damage did not cause a yield loss.

**Herbicide:** Glyphosate + 2,4-D
**Rate:** 173 + 80 g a.i./ha
**Date of exposure:** 12th Dec (4 weeks post-emergence)
**Growth stage at exposure:** 6 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide groups:** M + I

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 6 node cotton. Photo taken on 5th Jan, 24 days after exposure.

Leaves on the main stem were severely affected by the 2,4-D, with severe leaf distortion on all subsequent growth.

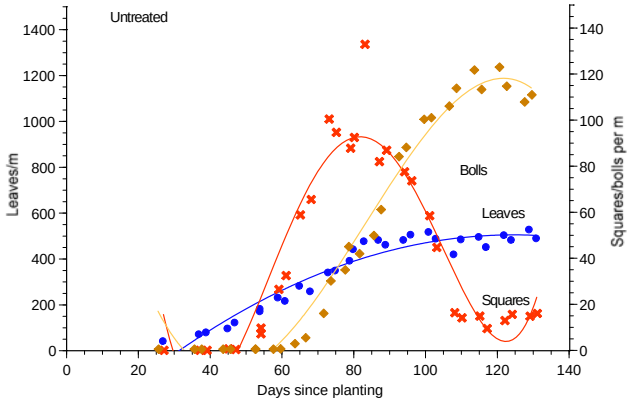
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 6 node cotton. Photo taken on 5th Jan, 24 days after exposure.

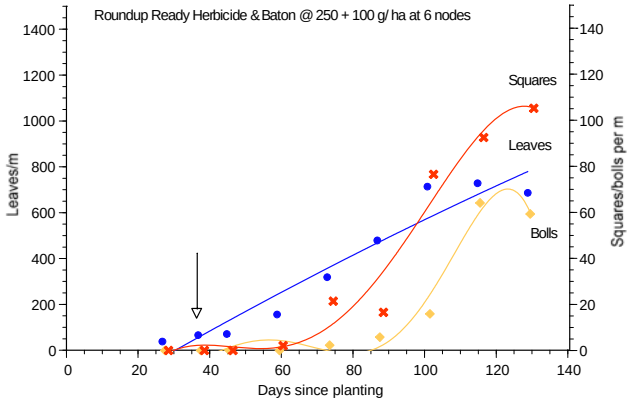
The new leaves on the main stem were severely distorted by the herbicide. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

There were no obvious signs of glyphosate damage.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 6 node cotton. Photo taken on 24th Mar, 102 days after exposure.

This plate shows a close-up of the main stem of the plant which continued to produce distorted leaves throughout the season The growth on the vegetative branches was largely unaffected by the herbicides.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing an increase in leaf production, mainly through the production of small, distorted leaves on the main stem.

Leaves which developed on the vegetative branches were not affected by the herbicides.

**Squares**: most of the early squares were shed following the herbicide exposure, but later squares were retained and developed.

**Bolls:** most early bolls were shed, but later bolls were retained and developed. The plant produced a large number of these late bolls, but most didn't reach maturity.

**Plant:** growth on the main stem responded vegetatively, producing an additional 2 nodes, but plant height was reduced due to a decrease in internode length.

**Final plant count data**

| | Untreated | 2,4-D |
|---|---|---|
| **Height (cm)** | 73.9 | 71.7 |
| **Nodes/plant** | 21.5 | 23.2 |
| **Internode length** (post-spray) | 4.1 | 3.4 |
| **Leaves/m** | 502 | 683 |
| **Light interception** | 87% | 87% |
| **Leaf area (cm²/m)** | 22921 | 11741 |
| **Bolls/m** | 114 | 60 |
| **Boll weight (g/boll)** | 4.4 | 1.3 |
| **Days to 50% open** | 154 | - |
| **% Open bolls at picking** | 82% | 27% |
| **Lint yield/ha** | 1649 | 747 |

Heavy glyphosate + 2,4-D exposure at 6 nodes caused extensive leaf deformation on the main stem and a loss of fruit from the main stem.

The plant compensated for this damage, setting the crop on the vegetative branches, producing a late crop, with a delay in crop maturity. Most of these bolls were small and still green at harvest.

The damage caused a 55% reduction in lint yield, with only 27% of bolls mature at picking.

**Herbicide:** Glyphosate + 2,4-D
**Rate:** 35 + 8 g a.i./ha
**Date of exposure:** 21st Dec (5½ weeks post-emergence)
**Growth stage at exposure:** 8 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide groups:** M + I

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 8 node cotton. Photo taken on 5th Jan, 15 days after exposure.

New leaves on the main stem were severely affected by the 2,4-D, with severe leaf distortion on all subsequent growth.

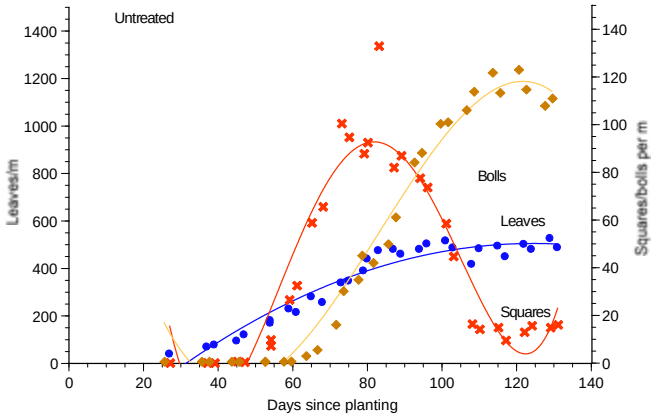
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 8 node cotton. Photo taken on 25th Jan, 35 days after exposure.

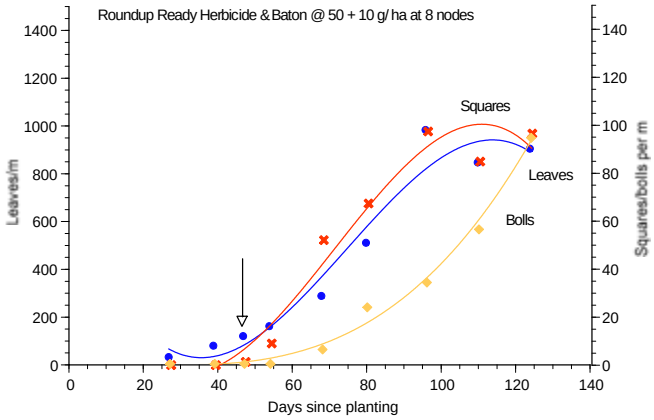
All new leaves were severely distorted by the herbicide. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

No obvious signs of glyphosate damage were apparent.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 8 node cotton. Photo taken on 24th Mar, 93 days after exposure.

The plant produced distorted growth on the main stem and most vegetative branches throughout the season. Leaves, squares, flowers and bolls were all distorted by the herbicides.




## Impact on plant growth

**Leaves:** the primary effect of the herbicide was on the leaves which developed following the exposure, causing an 80% increase in leaf production, mainly through the production of small, distorted leaves. Total leaf area and light interception were not affected.

Normal leaves developed on some of the later vegetative branches.

**Squares**: many of the early squares were shed following the herbicide exposure, but later squares were retained and developed. Peak squaring was delayed by 40 days.

**Bolls:** most early bolls were shed. Many later bolls were retained and developed, but these bolls were small and few reached maturity.

**Plant:** growth responded vegetatively to the herbicide damage, producing an additional 4 nodes, and 20 cm in height.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Height (cm)** | 73.9 | 93.9 |
| **Nodes/plant** | 21.5 | 25.3 |
| **Internode length** (post-spray) | 4.2 | 4.3 |
| **Leaves/m** | 502 | 902 |
| **Light interception** | 87% | 91% |
| **Leaf area (cm²/m)** | 22921 | 22485 |
| **Bolls/m** | 114 | 94 |
| **Boll weight (g/boll)** | 4.4 | 1.6 |
| **Days to 50% open** | 154 | - |
| **% Open bolls at picking** | 82% | 35% |
| **Lint yield/ha** | 1649 | 1256 |

Glyphosate + 2,4-D exposure at 8 nodes caused extensive leaf deformation on the main stem and most vegetative branches, and a loss of many early fruit.

The plant compensated for this damage by setting a late crop. Most of these bolls were small and green at harvest.

The damage caused a 24% reduction in lint yield, with only 35% of bolls mature at picking.

**Herbicide:** Glyphosate + 2,4-D
**Rate:** 173 + 80 g a.i./ha
**Date of exposure:** 21st Dec (5½ weeks post-emergence)
**Growth stage at exposure:** 8 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide groups:** M + I

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 8 node cotton. Photo taken on 5th Jan, 15 days after exposure.

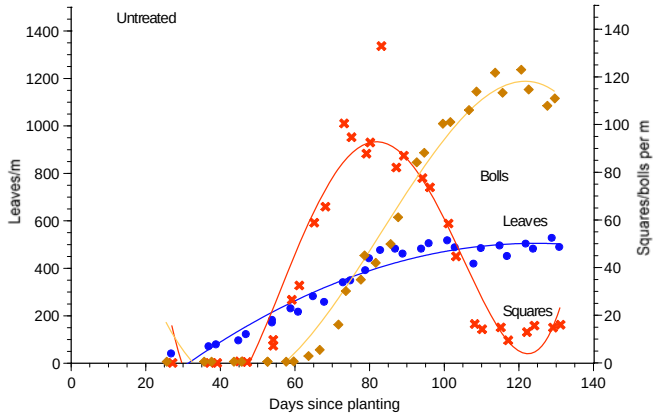
New leaves were severely affected by the 2,4-D, with severe leaf distortion on all subsequent growth. The stems and petioles were bent and distorted.

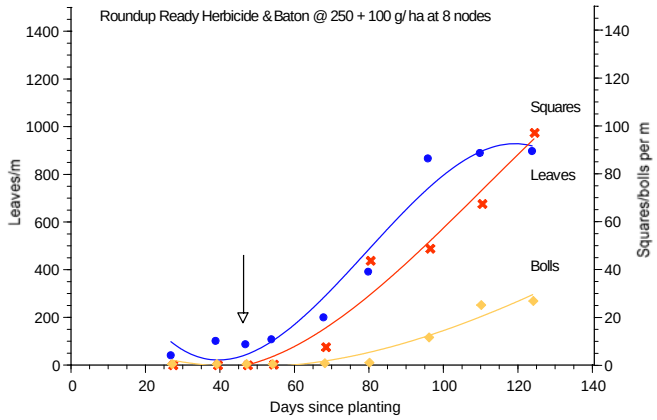
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 8 node cotton. Photo taken on 25th Jan, 35 days after exposure.

All new leaves were severely distorted by the herbicide. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage. Glyphosate damage was not apparent.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 8 node cotton. Photo taken on 24th Mar, 93 days after exposure.

The plant produced distorted growth on the main stem and most vegetative branches throughout the season, but the growth on the later vegetative branches was largely unaffected by the herbicides.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing an increase in leaf production, mainly through the production of small, distorted leaves. Total leaf area was reduced by 43%.

Normal leaves developed on some of the later vegetative branches.

**Squares**: most of the early squares were shed following the herbicide exposure, but later squares were retained and developed.

**Bolls:** most early bolls were shed. Some later bolls were retained and developed, but these bolls were very small and few reached maturity.

**Plant:** growth responded vegetatively, producing an additional 2.5 nodes, and an additional 4.5 cm in height.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Height (cm)** | 73.9 | 78.4 |
| **Nodes/plant** | 21.5 | 23.9 |
| **Internode length** (post-spray) | 4.2 | 3.8 |
| **Leaves/m** | 502 | 895 |
| **Light interception** | 87% | 73% |
| **Leaf area (cm²/m)** | 22921 | 13132 |
| **Bolls/m** | 114 | 26 |
| **Boll weight (g/boll)** | 4.4 | 0.6 |
| **Days to 50% open** | 154 | - |
| **% Open bolls at picking** | 82% | 10% |
| **Lint yield/ha** | 1649 | 453 |

Heavy glyphosate + 2,4-D exposure at 8 nodes caused extensive leaf deformation on the main stem and most vegetative branches, and a loss of fruit.

The plant compensated for this damage by setting a very late crop. Most of these bolls were very small and green at harvest.

The damage caused a 73% reduction in lint yield, with only 10% of bolls mature at picking.

**Herbicide:** Glyphosate + 2,4-D
**Rate:** 35 + 8 g a.i./ha
**Date of exposure:** 4th Jan (7½ weeks post-emergence)
**Growth stage at exposure:** 12 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide groups:** M + I

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 12 node cotton. Photo taken on 25th Jan, 21 days after exposure.

All new leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

Glyphosate damage was not apparent on these plants.

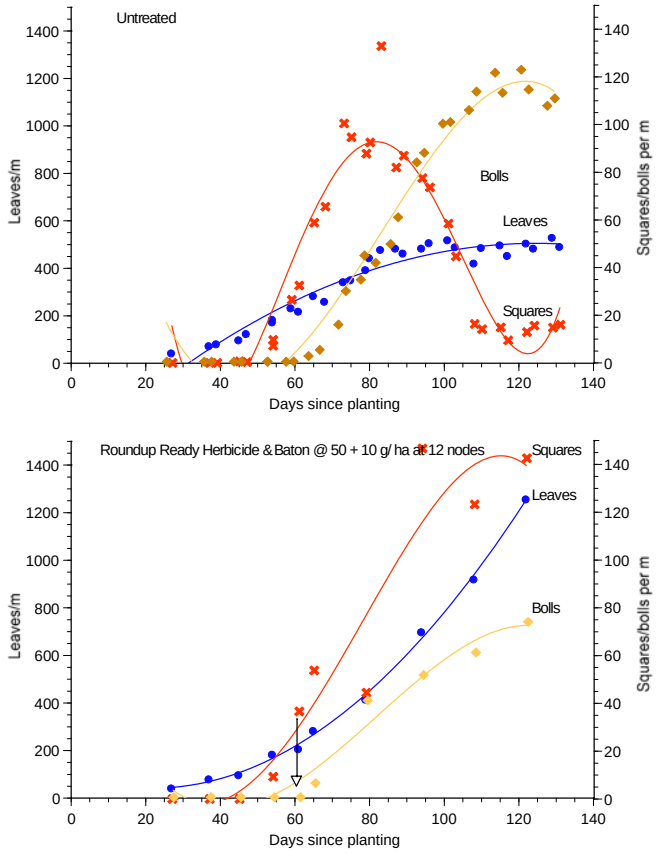
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 12 node cotton. Photo taken on 25th Jan, 21 days after exposure.

A close-up of the plants in the previous photo.

Older leaves showed some damage, with cupping and distorted edges. Newly emerging leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 12 node cotton. Photo taken on 8th Mar, 63 days after exposure.

The plant continued to produce distorted growth throughout the remainder of the season. This growth was still obvious at picking.




## Impact on plant growth

**Leaves:** the primary effect of the herbicide was on the leaves that developed following the exposure, causing a 150% increase in leaf production, mainly through the production of small, distorted leaves. The increase in leaf number compensated for the reduction in leaf size.

**Squares**: many early squares were shed following the herbicide exposure. The plant produced masses of later squares, but many of these were distorted and failed to develop normally.

**Bolls:** many of the early bolls were shed following the herbicide exposure. A large number of later bolls were retained, but these were small and few reached maturity.

**Plant:** growth responded vegetatively to the herbicide exposure, producing an additional 4.5 nodes and 20 cm in height.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Height (cm)** | 73.9 | 93.4 |
| **Nodes/plant** | 21.5 | 25.9 |
| **Internode length** (post-spray) | 4.5 | 4.5 |
| **Leaves/m** | 502 | 1252 |
| **Light interception** | 87% | 85% |
| **Leaf area (cm²/m)** | 22921 | 24422 |
| **Bolls/m** | 114 | 73 |
| **Boll weight (g/boll)** | 4.4 | 1.6 |
| **Days to 50% open** | 154 | 174 |
| **% Open bolls at picking** | 82% | 64% |
| **Lint yield/ha** | 1649 | 708 |

Glyphosate + 2,4-D exposure at 12 nodes caused extensive deformation of new growth and a loss of early fruit.

The plant compensated for the damage by producing a mass of late square, but few of these developed. Many of the bolls which were retained were small and green at harvest.

The damage caused an 57% reduction in lint yield and 20 day delay in crop maturity.

**Herbicide:** Glyphosate + 2,4-D
**Rate:** 173 + 80 g a.i./ha
**Date of exposure:** 4th Jan (7½ weeks post-emergence)
**Growth stage at exposure:** 12 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide groups:** M + I

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 12 node cotton. Photo taken on 25th Jan, 21 days after exposure.

All new leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage. Glyphosate damage was not apparent on these plants.

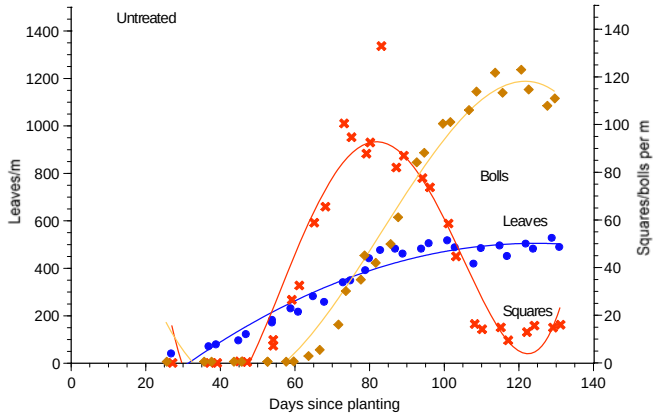
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 12 node cotton. Photo taken on 25th Jan, 21 days after exposure.

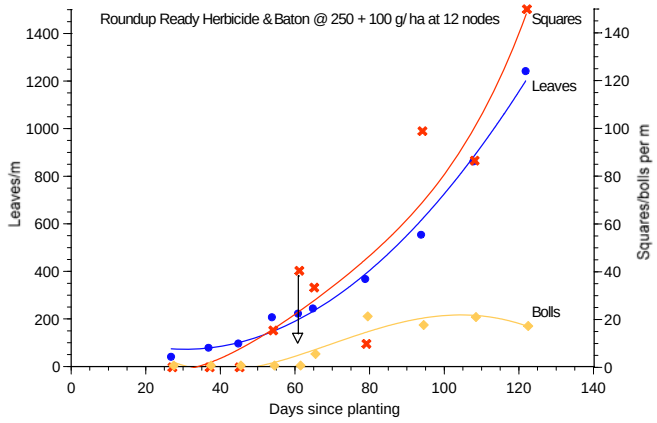
A close-up of the plants in the previous photo.

Older leaves showed some damage, with cupping and distorted edges. Newly emerging leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 12 node cotton. Photo taken on 8th Mar, 63 days after exposure.

The plant continued to produce distorted growth throughout the remainder of the season. This growth was still obvious at picking.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing an increase in leaf production, mainly through the production of small, distorted leaves. Total leaf area was reduced by 41%.

**Squares**: most early squares were shed following the herbicide exposure. The plant produced masses of later squares, but many of these were distorted and failed to develop normally.

**Bolls:** most bolls were shed thoughout the season. Bolls which were retained were very small and few reached maturity.

**Plant:** growth responded vegetatively, producing an additional 3.5 nodes, but these nodes were very short, giving a 8 cm reduction in final plant height.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Height (cm)** | 73.9 | 66.0 |
| **Nodes/plant** | 21.5 | 25.0 |
| **Internode length** (post-spray) | 4.5 | 2.5 |
| **Leaves/m** | 502 | 1239 |
| **Light interception** | 87% | 67% |
| **Leaf area (cm²/m)** | 22921 | 13609 |
| **Bolls/m** | 114 | 17 |
| **Boll weight (g/boll)** | 4.4 | 0.9 |
| **Days to 50% open** | 154 | - |
| **% Open bolls at picking** | 82% | 31% |
| **Lint yield/ha** | 1649 | 190 |

Heavy glyphosate + 2,4-D exposure at 12 nodes caused extensive deformation of all new growth and a loss of fruit.

The plant compensated for the damage by producing a mass of late square, but almost none of these developed. Most of the bolls which were retained were very small and green at harvest.

The damage caused an 88% reduction in lint yield, with only 5 bolls/m mature at picking.

**Herbicide:** Glyphosate + 2,4-D
**Rate:** 35 + 8 g a.i./ha
**Date of exposure:** 24th Jan
(10½ weeks post-emergence)
**Growth stage at exposure:** 16 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide groups:** M + I

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 16 node cotton. Photo taken on 24th March, 59 days after the exposure.

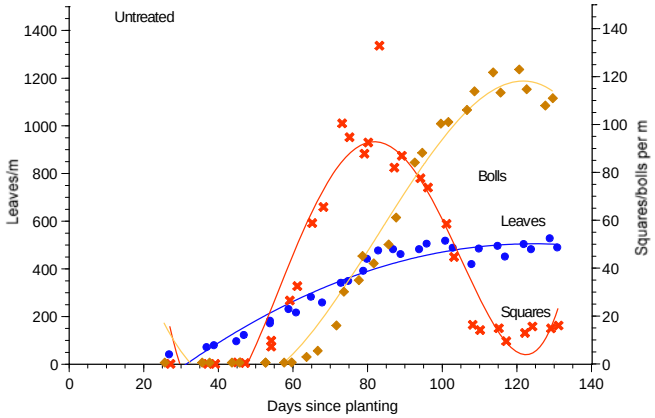
All new leaves which emerged after the herbicide exposure were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage.

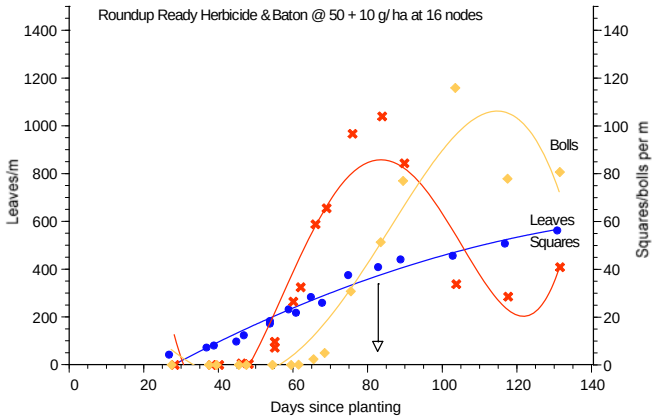
No glyphosate damage was apparent on these plants.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 50 + 10 g/ha to 16 node cotton. Photo taken on 24th March, 59 days after the exposure.

A close-up of the plants in the previous photo.

The plant continued to produce distorted growth throughout the remainder of the season. This growth was still obvious at picking.




## Impact on plant growth

**Leaves:** the primary effect of the herbicide was on the leaves that developed following the exposure, causing an increase in leaf production, mainly through the production of small, distorted leaves. Total leaf area and light interception were not seriously affected.

**Squares**: most squares initiated before the herbicide exposure were retained and developed normally. The plant produced a few additional late squares.

**Bolls:** most bolls were retained, although there was some loss of later bolls, resulting in an increase in average boll size.

**Plant:** the plant responded to the herbicide exposure with some additional vegetative growth, producing an additional 1.5 nodes and 1.5 cm in height. Internode length was reduced slightly following the exposure.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Height (cm)** | 73.9 | 75.2 |
| **Nodes/plant** | 21.5 | 23.9 |
| **Internode length** (post-spray) | 2.5 | 2.1 |
| **Leaves/m** | 502 | 559 |
| **Light interception** | 87% | 83% |
| **Leaf area ($cm^2/m$)** | 22921 | 18760 |
| **Bolls/m** | 114 | 80 |
| **Boll weight (g/boll)** | 4.4 | 5.5 |
| **Days to 50% open** | 154 | 179 |
| **% Open bolls at picking** | 82% | 62% |
| **Lint yield/ha** | 1649 | 1377 |

Glyphosate + 2,4-D exposure at 16 nodes caused deformation of all new growth and a loss of some fruit.

The plant compensated for the damage by producing some late square, but none of these developed to produce harvestable bolls.

Most early bolls were retained.

The damage caused a 16% lint yield loss and a 25 day delay in crop maturity.

**Herbicide:** Glyphosate + 2,4-D
**Rate:** 173 + 80 g a.i./ha
**Date of exposure:** 24th Jan (10½ weeks post-emergence)
**Growth stage at exposure:** 16 nodes

| Damage key: | |
|---|---|
| Leaf loss | |
| Leaf distortion | x |
| Petiole distortion | x |
| Plant stunting | |
| Square shedding | x |
| Boll shedding | x |

## Herbicidal action

**Herbicide groups:** M + I

### Glyphosate

**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

### 2,4-D

**Translocation:** readily moves to the plant growth points
**Mode of action:** An auxin-type (phenoxy) herbicide. 2,4-D affects cell wall plasticity & nucleic acid metabolism. Low concentrations cause abnormal increases in RNA, DNA & protein biosynthesis, resulting in uncontrolled cell division & growth, leading to plant death.
**Residual activity:** limited
**Soil half-life:** 10 days in moist soil

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 16 node cotton. Photo taken on 10th Feb, 17 days after exposure.

All new leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins. These symptoms are typical of 2,4-D damage. Glyphosate damage was not apparent on these plants.

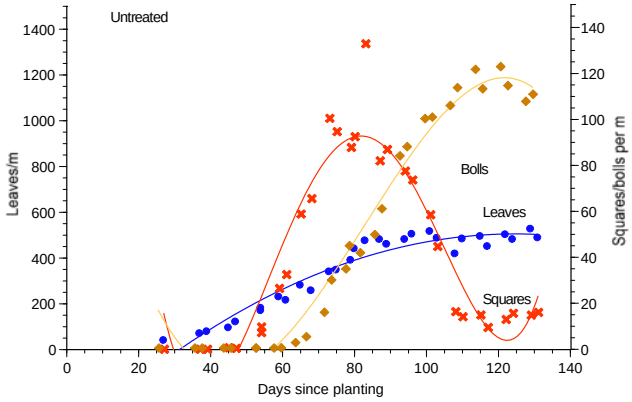
Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 16 node cotton. Photo taken on 10th Feb, 17 days after exposure.

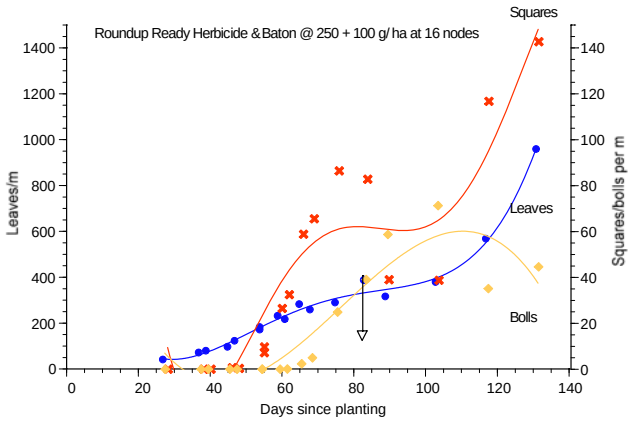
A close-up of the plants in the previous photo.

Some older leaves showed damage, with cupping and distorted edges. Newly emerging leaves were severely distorted. Leaves were narrow, cupped, twisted and leathery, with prominent veins. Petioles and stems at the top of the plant were twisted.

Roundup Ready Herbicide (glyphosate) and Baton (2,4-D amine) applied in combination broadcast at 250 + 100 g/ha to 16 node cotton. Photo taken on 24th Mar, 59 days after exposure.

The plant continued to produce distorted growth throughout the remainder of the season. This growth was still obvious at picking.




## Impact on plant growth

**Leaves:** the 2,4-D exposure initially caused bending and twisting of the petioles (leaf stems), giving a wilted appearance. This effect was transitory.

The primary effect was on leaves that developed following the exposure, causing an increase in leaf production, mainly through the production of small, distorted leaves. Total leaf area was not affected, but light interception was reduced.

**Squares**: most squares were shed following the herbicide exposure. The plant produced masses of later squares, but many of these were distorted and failed to develop normally.

**Bolls:** most bolls set before the herbicide exposure were retained. The plant retained few later bolls. The bolls which were retained were small and few reached maturity.

**Plant:** growth responded vegetatively to the herbicide exposure, producing an additional 4 nodes and 8 cm in height.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **2,4-D** |
| **Height (cm)** | 73.9 | 82.2 |
| **Nodes/plant** | 21.5 | 25.3 |
| **Internode length** (post-spray) | 2.5 | 2.8 |
| **Leaves/m** | 502 | 956 |
| **Light interception** | 87% | 74% |
| **Leaf area ($cm^2$/m)** | 22921 | 20155 |
| **Bolls/m** | 114 | 45 |
| **Boll weight (g/boll)** | 4.4 | 2.3 |
| **Days to 50% open** | 154 | 164 |
| **% Open bolls at picking** | 82% | 70% |
| **Lint yield/ha** | 1649 | 780 |

Heavy glyphosate + 2,4-D exposure at 16 nodes caused extensive deformation of all new growth and a loss of fruit.

The plant compensated for the damage by producing a mass of late square, but none of these developed to produce harvestable bolls. The bolls which were retained were small and green at harvest.

The damage caused a 10 days delay in crop maturity and a 53% reduction in lint yield.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate** |
| **Rate:** | **35 g a.i./ha** |
| **% of typical field rate** | **3%** |
| **Date of exposure:** | **12 Dec** **(4 weeks post-emergence)** |
| **Growth stage at exposure:** | **6 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **M**
**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

Roundup Ready Herbicide applied broadcast at 50 g/ha to 6 node cotton. Photo taken on 5 Jan, 24 days after exposure.

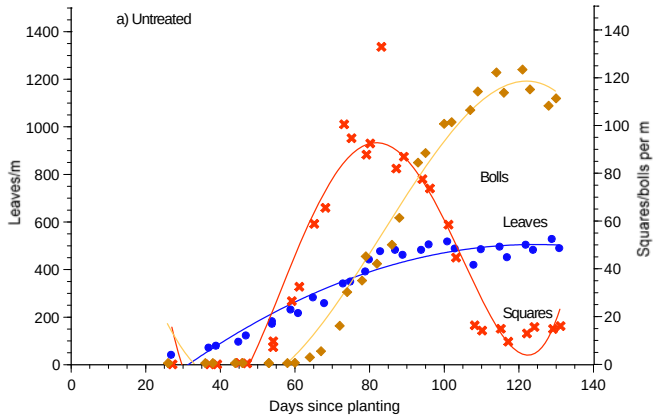
There were no visual symptoms of herbicide damage at this time.

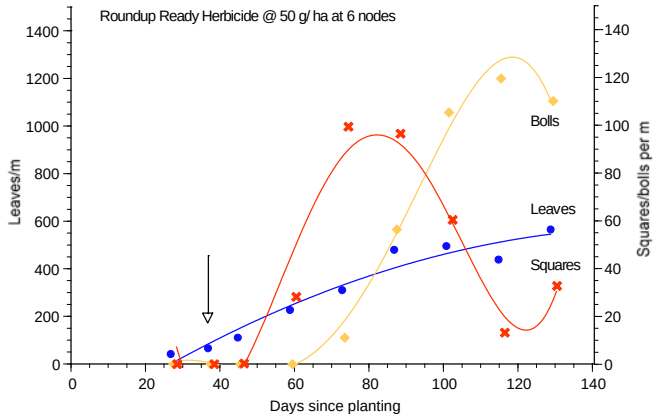
Roundup Ready Herbicide applied broadcast at 50 g/ha to 6 node cotton. Photo taken on 5 Jan, 24 days after exposure.

Roundup Ready Herbicide applied broadcast at 50 g/ha to 6 node cotton. Photo taken on 24 Mar, 102 days after exposure.

There were no visible symptoms of herbicide damage on these plants, which looked identical to the untreated plants.

Roundup Ready Herbicide applied broadcast at 50 g/ha to 6 node cotton. Photo taken on 24 Mar, 102 days after exposure.




## Impact on plant growth

**Leaves:** the herbicide exposure had no effect on leaf shape or orientation, but did result in a 12% increase in leaf number. However, the increased leaf number did not compensate for a decrease in leaf size, resulting in a 15% reduction in total leaf area.

**Squares**: the herbicide had no measurable effect on square production.

**Bolls:** the herbicide had no negative effect on boll production.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **glyphosate** |
| **Nodes/plant** | 21.5 | 22.1 |
| **Leaves/m** | 502 | 562 |
| **Light interception** | 87% | 89% |
| **Leaf area ($cm^2$/m)** | 22921 | 19379 |
| **Bolls/m** | 114 | 110 |
| **Boll weight (g/boll)** | 4.4 | 4.7 |
| **Days to 50% open** | 154 | 154 |
| **% Open bolls at picking** | 82% | 91% |
| **Lint yield/ha** | 1649 | 1684 |

Exposure of a 6 node cotton plant to Roundup Ready Herbicide at 50 g/ha caused no measurable negative effects. The plant was able to compensate for any negative effects caused by the herbicide, resulting in no delay in maturity or reduction in yield.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate** |
| **Rate:** | **173 g a.i./ha** |
| **% of typical field rate** | **17%** |
| **Date of exposure:** | **12th Dec** **(4 weeks post-emergence)** |
| **Growth stage at exposure:** | **6 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **M**
**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

Roundup Ready Herbicide applied broadcast at 250 g/ha to 6 node cotton. Photo taken on 5th Jan, 24 days after exposure.

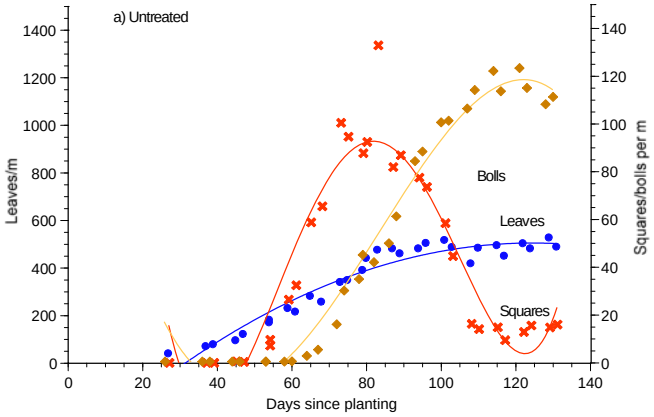
There were no visual symptoms of herbicide damage at this time.

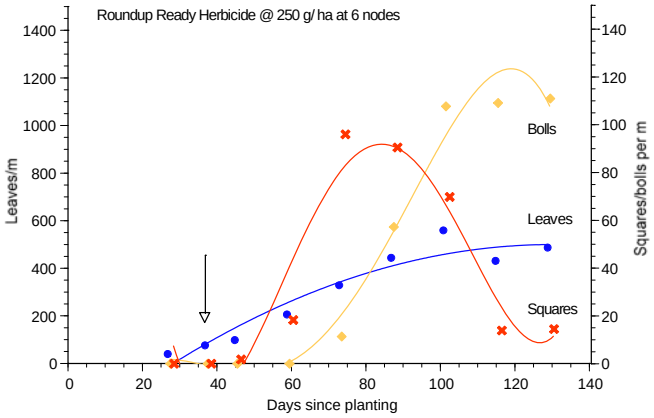
Roundup Ready Herbicide applied broadcast at 250 g/ha to 6 node cotton. Photo taken on 5th Jan, 24 days after exposure.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 6 node cotton. Photo taken on 8th Mar, 86 days after exposure.

There were no visible symptoms of herbicide damage on these plants, which looked identical to the untreated plants.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 6 node cotton. Photo taken on 8th Mar, 86 days after exposure.




## Impact on plant growth

**Leaves:** the herbicide had no effect on leaf number, shape or orientation, but did cause a reduction in leaf size, resulting in a 15% reduction in total leaf area.

**Squares**: the herbicide had no measurable effect on square production.

**Bolls:** the herbicide had no measurable effect on boll production.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **glyphosate** |
| **Nodes/plant** | 21.5 | 21.8 |
| **Leaves/m** | 502 | 484 |
| **Light interception** | 87% | 85% |
| **Leaf area (cm²/m)** | 22921 | 19179 |
| **Bolls/m** | 114 | 111 |
| **Boll weight (g/boll)** | 4.4 | 4.4 |
| **Days to 50% open** | 154 | 157 |
| **% Open bolls at picking** | 82% | 82% |
| **Lint yield/ha** | 1649 | 1684 |

Exposure of a 6 node cotton plant to Roundup Ready Herbicide at 250 g/ha caused no measurable negative impact.

The plant was able to compensate for any negative effects caused by the herbicide at this early crop stage, resulting in no delay in crop maturity or reduction in yield.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate** |
| **Rate:** | **35 g a.i./ha** |
| **% of typical field rate** | **3%** |
| **Date of exposure:** | **21st Dec** |
| | **(5½ weeks post-emergence)** |
| **Growth stage at exposure:** | **8 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **M**
**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

Roundup Ready Herbicide applied broadcast at 50 g/ha to 8 node cotton. Photo taken on 5th Jan, 15 days after exposure.

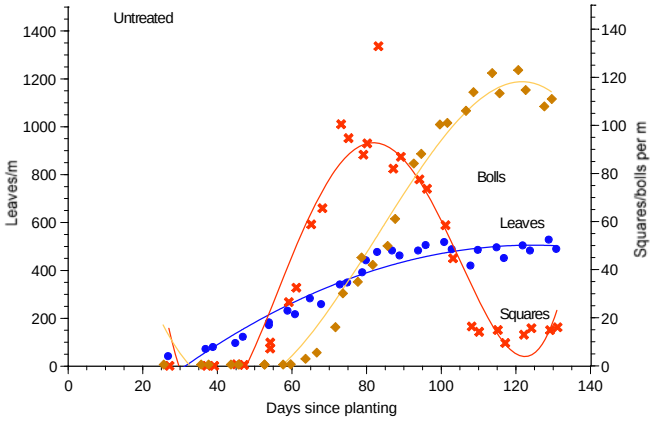
There were no visual symptoms of herbicide damage at this time.

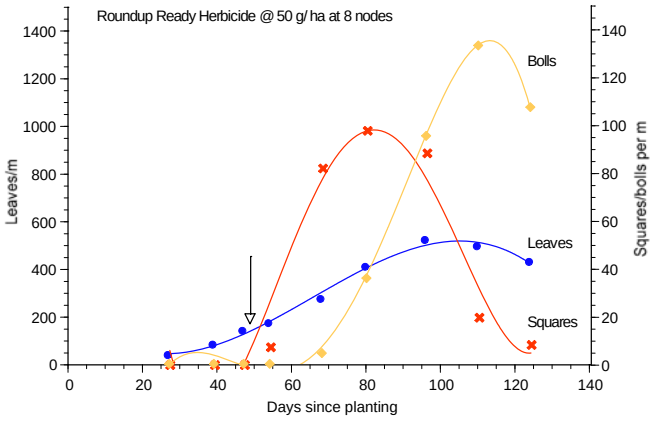
Roundup Ready Herbicide applied broadcast at 50 g/ha to 8 node cotton. Photo taken on 5th Jan, 15 days after exposure.

Roundup Ready Herbicide applied broadcast at 50 g/ha to 8 node cotton. Photo taken on 24th Mar, 93 days after exposure.

There were no visible symptoms of herbicide damage on these plants, which looked identical to the untreated plants.

Roundup Ready Herbicide applied broadcast at 50 g/ha to 8 node cotton. Photo taken on 24th Mar, 93 days after exposure.




## Impact on plant growth

**Leaves:** the herbicide had no effect on leaf shape or orientation, but did reduce leaf number by 17% and leaf area by 12%,.

**Squares**: the herbicide exposure had no observable impact on squaring.

**Bolls:** the herbicide exposure had no observable impact on crop yield, although average boll size was reduced by 18%.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **glyphosate** |
| **Nodes/plant** | 21.5 | 21.3 |
| **Leaves/m** | 502 | 429 |
| **Light interception** | 87% | 86% |
| **Leaf area (cm²/m)** | 22921 | 20207 |
| **Bolls/m** | 114 | 107 |
| **Boll weight (g/boll)** | 4.4 | 3.6 |
| **Days to 50% open** | 154 | 156 |
| **% Open bolls at picking** | 82% | 83% |
| **Lint yield/ha** | 1649 | 1592 |

Exposure of an 8 node cotton plant to Roundup Ready Herbicide at 50 g/ha caused a small decrease in leaf number and boll size, but didn't delay crop maturity or reduce lint yield.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate** |
| **Rate:** | **173 g a.i./ha** |
| **% of typical field rate** | **17%** |
| **Date of exposure:** | **21 Dec** |
| | **(5½ weeks post-emergence)** |
| **Growth stage at exposure:** | **8 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **M**
**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

Roundup Ready Herbicide applied broadcast at 250 g/ha to 8 node cotton. Photo taken on 5 Jan, 15 days after exposure.

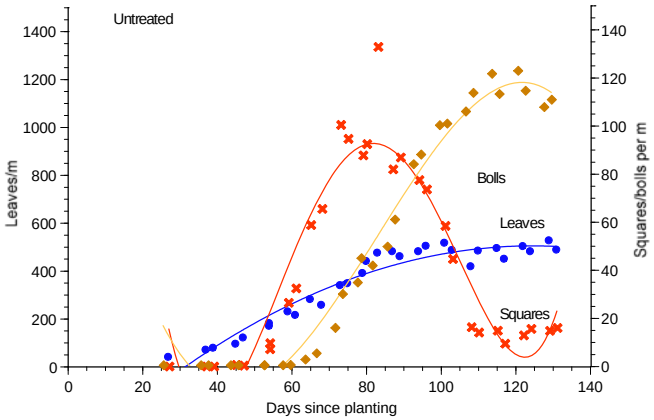
There were no visual symptoms of herbicide damage at this time.

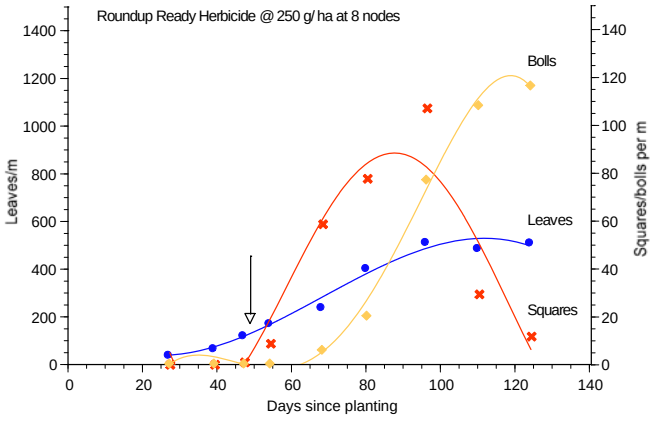
Roundup Ready Herbicide applied broadcast at 250 g/ha to 8 node cotton. Photo taken on 5 Jan, 15 days after exposure.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 8 node cotton. Photo taken on 8 Mar, 77 days after exposure.

There were no visible symptoms of herbicide damage on these plants, which looked identical to the untreated plants.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 8 node cotton. Photo taken on 8 Mar, 77 days after exposure.




## Impact on plant growth

**Leaves:** the herbicide had no effect on leaf number, shape or orientation.

**Squares**: the plant shed some early squares following the glyphosate exposure. Peak squaring was delayed by 5 days.

**Bolls:** the plant shed some early bolls following the glyphosate exposure. Crop maturity was delayed by 8 days.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **glyphosate** |
| **Nodes/plant** | 21.5 | 20.7 |
| **Leaves/m** | 502 | 509 |
| **Light interception** | 87% | 86% |
| **Leaf area (cm²/m)** | 22921 | 21731 |
| **Bolls/m** | 114 | 116 |
| **Boll weight (g/boll)** | 4.4 | 3.0 |
| **Days to 50% open** | 154 | 162 |
| **% Open bolls at picking** | 82% | 80% |
| **Lint yield/ha** | 1649 | 1393 |

Exposure of an 8 node cotton plant to Roundup Ready Herbicide at 250 g/ha caused no measurable negative effects of leaf production, but did delay peak flowering and crop maturity.

Final boll count was not reduced, but a percentage of bolls were malformed and average boll size was reduced by 32%, resulting in a 16% yield reduction.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate** |
| **Rate:** | **35 g a.i./ha** |
| **% of typical field rate** | **3%** |
| **Date of exposure:** | **4th Jan** |
| | **(7½ weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **M**
**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

Roundup Ready Herbicide applied broadcast at 50 g/ha to 12 node cotton. Photo taken on 25th Jan, 21 days after exposure.

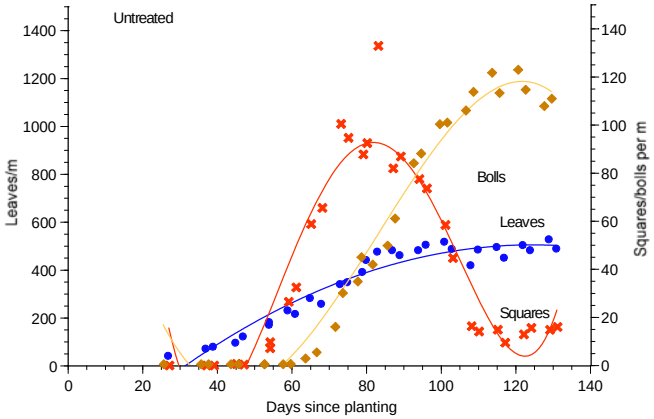
There were no visual symptoms of herbicide damage at this time.

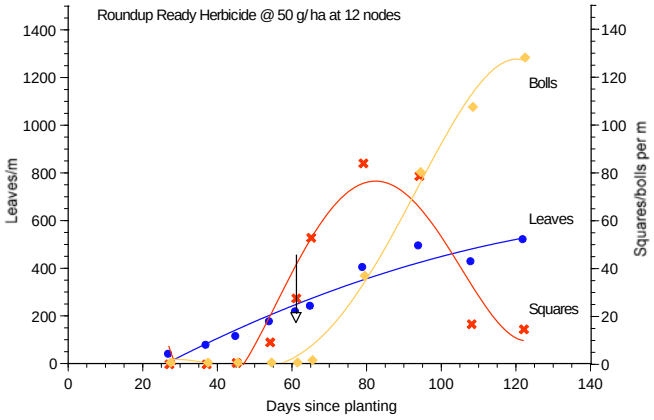
Roundup Ready Herbicide applied broadcast at 50 g/ha to 12 node cotton. Photo taken on 25th Jan, 21 days after exposure.

Roundup Ready Herbicide applied broadcast at 50 g/ha to 12 node cotton. Photo taken on 24th Mar, 79 days after exposure.

There were no visible symptoms of herbicide damage on these plants, which looked identical to the untreated plants.

Roundup Ready Herbicide applied broadcast at 50 g/ha to 12 node cotton. Photo taken on 24th Mar, 79 days after exposure.




## Impact on plant growth

**Leaves:** the glyphosate exposure at 12 nodes had no effect of leaf number, shape, size or orientation.

**Squares**: the plant shed some squares following the glyphosate exposure, but peak squaring was not delayed.

**Bolls:** the glyphosate exposure had no effect on boll retention, but did reduce average boll size and delayed crop maturity by 15 days.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **glyphosate** |
| **Nodes/plant** | 21.5 | 20.9 |
| **Leaves/m** | 502 | 519 |
| **Light interception** | 87% | 89% |
| **Leaf area (cm²/m)** | 22921 | 22519 |
| **Bolls/m** | 114 | 128 |
| **Boll weight (g/boll)** | 4.4 | 3.7 |
| **Days to 50% open** | 154 | 169 |
| **% Open bolls at picking** | 82% | 67% |
| **Lint yield/ha** | 1649 | 1655 |

Exposure of a 12 node cotton plant to Roundup Ready Herbicide at 50 g/ha had little impact on the plant.

The herbicide exposure reduced average boll size and delaying crop maturity, but did not reduce lint yield.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

| | |
|---|---|
| **Herbicide:** | **glyphosate** |
| **Rate:** | **173 g a.i./ha** |
| **% of typical field rate** | **17%** |
| **Date of exposure:** | **4th Jan** |
| | **(7½ weeks post-emergence)** |
| **Growth stage at exposure:** | **12 nodes** |

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** **M**
**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

Roundup Ready Herbicide applied broadcast at 250 g/ha to 12 node cotton. Photo taken on 25th Jan, 21 days after exposure.

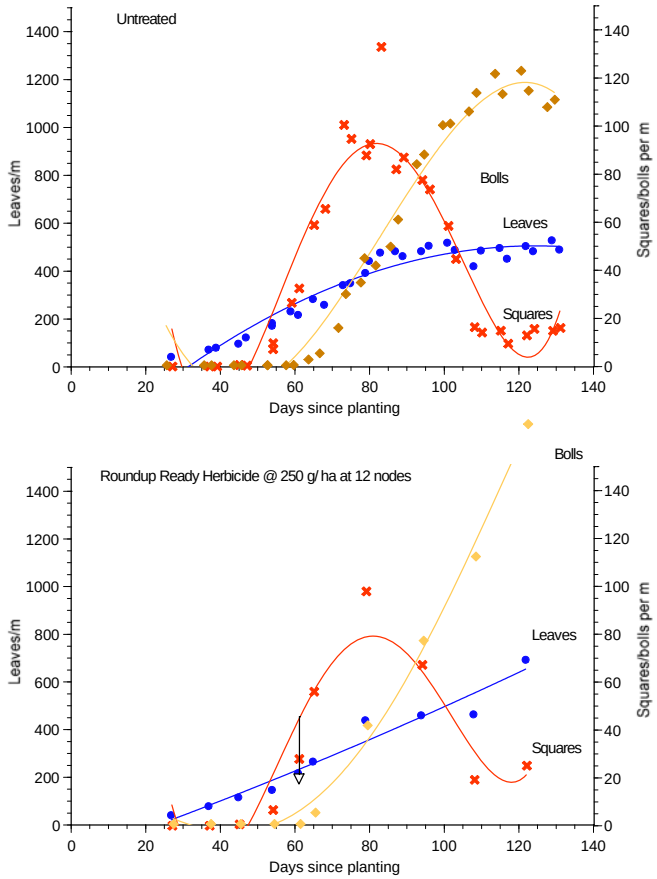
There were no visual symptoms of herbicide damage at this time.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 12 node cotton. Photo taken on 25th Jan, 21 days after exposure.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 12 node cotton. Photo taken on 24th Mar, 79 days after exposure.

There were no visible symptoms of herbicide damage on these plants, which looked identical to the untreated plants.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 12 node cotton. Photo taken on 24th Mar, 79 days after exposure.




## Impact on plant growth

**Leaves:** the glyphosate exposure at 12 nodes caused an increase in leaf production, with 37% more leaves, and a 26% increase in leaf area.

**Squares**: the plant shed some early squares following the glyphosate exposure. Peak squaring was not delayed.

**Bolls:** the plant shed some early bolls following the glyphosate exposure and set a large crop of late bolls. Crop maturity was delayed by 25 days, with a large percentage of bolls not reaching maturity before picking.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **glyphosate** |
| **Nodes/plant** | 21.5 | 22.6 |
| **Leaves/m** | 502 | 690 |
| **Light interception** | 87% | 80% |
| **Leaf area (cm²/m)** | 22921 | 28893 |
| **Bolls/m** | 114 | 167 |
| **Boll weight (g/boll)** | 4.4 | 3.4 |
| **Days to 50% open** | 154 | 179 |
| **% Open bolls at picking** | 82% | 54% |
| **Lint yield/ha** | 1649 | 1427 |

Exposure of a 12 node cotton plant to Roundup Ready Herbicide at 250 g/ha caused an increase in leaf production and production of a large number of late bolls, delaying crop maturity.

Final boll number was increased by 46%, but many of these bolls were small and didn't reach maturity.

Average boll size was reduced by 23%, and lint yield by 13%.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

**Herbicide:** glyphosate
**Rate:** 35 g a.i./ha
**% of typical field rate** 3%
**Date of exposure:** 24th Jan (10½ weeks post-emergence)
**Growth stage at exposure:** 16 nodes

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** M
**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

Roundup Ready Herbicide applied broadcast at 50 g/ha to 16 node cotton. Photo taken on 10th Feb, 17 days after exposure.

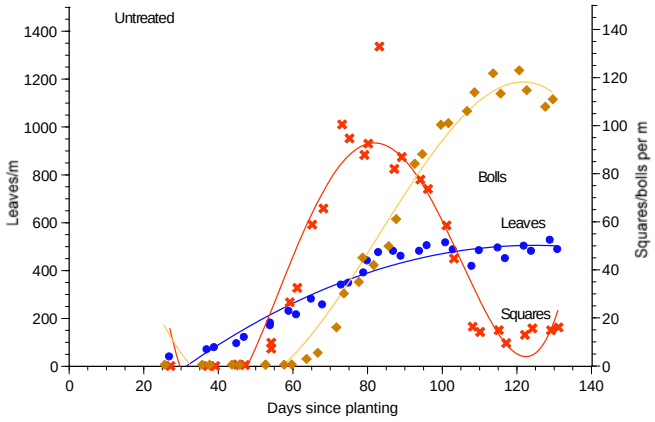
There were no visual symptoms of herbicide damage at this time.

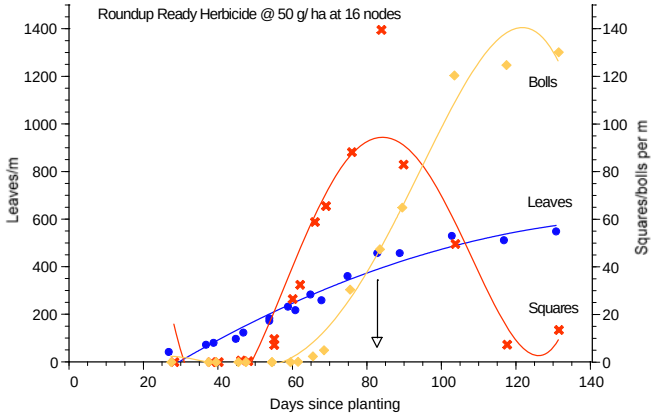
Roundup Ready Herbicide applied broadcast at 250 g/ha to 16 node cotton. Photo taken on 10th Feb, 17 days after exposure.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 16 node cotton. Photo taken on 24th Mar, 59 days after exposure.

There were no visible symptoms of herbicide damage on these plants, which looked identical to the untreated plants.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 16 node cotton. Photo taken on 24th Mar, 59 days after exposure.




## Impact on plant growth

**Leaves:** the glyphosate exposure at 16 nodes had no impact on leaf number, shape or orientation, but did reduce leaf area, resulting in a 13% reduction in leaf area.

**Squares**: the herbicide had no measurable effect on square production.

**Bolls:** the herbicide had little impact on boll production, but had a large impact on crop maturity. Crop maturity was delayed by 26 days, with many of the later bolls not reaching maturity before picking.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **glyphosate** |
| **Nodes/plant** | 21.5 | 21.6 |
| **Leaves/m** | 502 | 545 |
| **Light interception** | 87% | 83% |
| **Leaf area (cm²/m)** | 22921 | 19966 |
| **Bolls/m** | 114 | 130 |
| **Boll weight (g/boll)** | 4.4 | 4.0 |
| **Days to 50% open** | 154 | 170 |
| **% Open bolls at picking** | 82% | 65% |
| **Lint yield/ha** | 1649 | 1649 |

Exposure of a 16 node cotton plant to Roundup Ready Herbicide at 50 g/ha had little impact on the plant, except for a decrease in leaf area and a delay in crop maturity.

Average boll size and lint yield were not affected by the herbicide.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept of Primary Industries

**Herbicide:** glyphosate
**Rate:** 173 g a.i./ha
**% of typical field rate** 17%
**Date of exposure:** 24th Jan (10½ weeks post-emergence)
**Growth stage at exposure:** 16 nodes

**Damage key:**
**Leaf loss**
**Leaf distortion**
**Petiole distortion**
**Plant stunting**
**Square shedding**
**Boll shedding**

## Herbicidal action

**Herbicide group:** M
**Translocation:** moves throughout the plant to growth points
**Mode of action:** Inhibits EPSP synthase, leading to the depletion of some amino acids, preventing protein synthesis.
**Residual activity:** none
**Soil half-life:** 47 days in moist soil

Roundup Ready Herbicide applied broadcast at 250 g/ha to 16 node cotton. Photo taken on 10th Feb, 17 days after exposure.

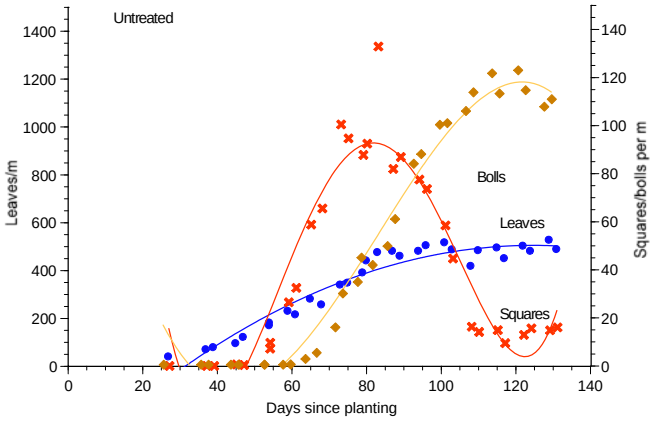
There were no visual symptoms of herbicide damage at this time.

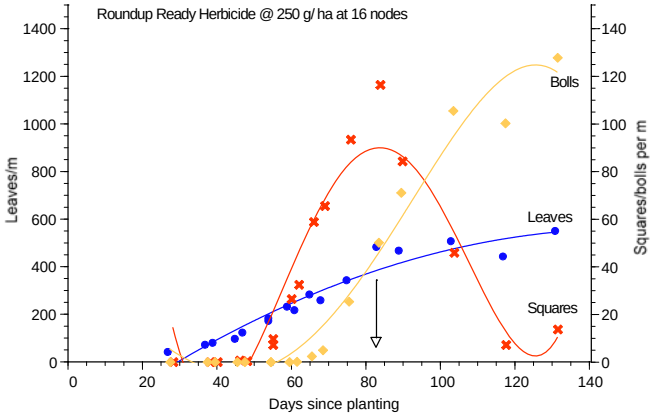
Roundup Ready Herbicide applied broadcast at 250 g/ha to 16 node cotton. Photo taken on 10th Feb, 17 days after exposure.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 16 node cotton. Photo taken on 24th Mar, 59 days after exposure.

There were no visible symptoms of herbicide damage on these plants, which looked identical to the untreated plants.

Roundup Ready Herbicide applied broadcast at 250 g/ha to 16 node cotton. Photo taken on 24th Mar, 59 days after exposure.




## Impact on plant growth

**Leaves:** the glyphosate exposure at 16 nodes had no impact on leaf number, shape or orientation, but did reduce leaf area, resulting in a 23% reduction in leaf area.

**Squares**: the herbicide had no measurable effect on square production.

**Bolls:** the herbicide had little impact on boll production, but had a large impact on crop maturity. Crop maturity was delayed by 26 days, with many of the later bolls not reaching maturity before picking.

| Final plant count data | | |
|---|---|---|
| | **Untreated** | **glyphosate** |
| **Nodes/plant** | 21.5 | 22.4 |
| **Leaves/m** | 502 | 547 |
| **Light interception** | 87% | 84% |
| **Leaf area (cm²/m)** | 22921 | 17681 |
| **Bolls/m** | 114 | 127 |
| **Boll weight (g/boll)** | 4.4 | 4.4 |
| **Days to 50% open** | 154 | 180 |
| **% Open bolls at picking** | 82% | 68% |
| **Lint yield/ha** | 1649 | 1606 |

Exposure of a 16 node cotton plant to Roundup Ready Herbicide at 250 g/ha had little impact on the plant, except for a decrease in leaf area and a delay in crop maturity.

Average boll size and lint yield were not affected.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

**Herbicide:** glufosinate
**Rate:** 75 g a.i./ha
**% of typical field rate** 10%
**Date of exposure:** 12th Nov
(6 weeks post-emergence)
**Growth stage at exposure:** 6 nodes

| Damage key: | |
|---|---|
| Leaf loss | x |
| Leaf distortion | |
| Petiole distortion | |
| Plant stunting | x |
| Square shedding | |
| Boll shedding | |

## Herbicidal action

**Herbicide group:** N
**Translocation:** poorly translocated within the plant
**Mode of action:** inhibits glutamine production, resulting in an accumulation of ammonia which inhibits photosynthesis and destroys cells
**Residual activity:** almost none due to rapid microbial breakdown in the soil
**Soil half-life:** 7 days

Liberty 200 applied broadcast at 375 ml/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

A few burn marks with necrotic spots on some leaves were the only symptoms of glufosinate damage from the 10% rate 3 days after exposure.

Liberty 200 applied broadcast at 375 ml/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

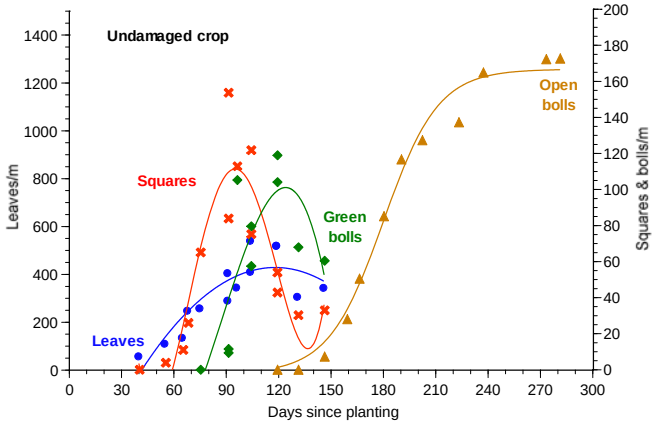
By 10 days, new undamaged leaves had emerged and glufosinate damage was only visible on the older leaves.

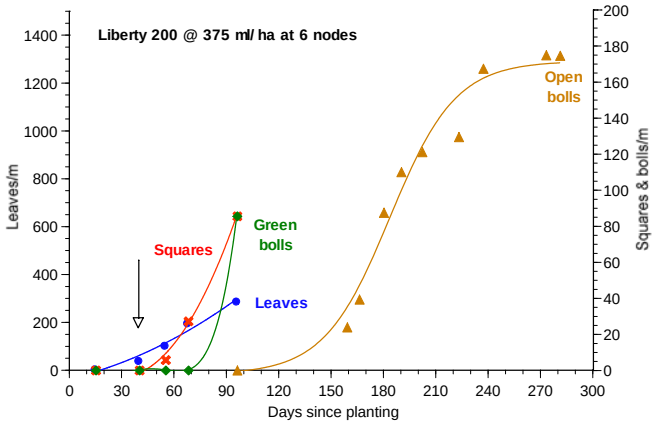
Liberty 200 applied broadcast at 375 ml/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

Plants had resumed normal growth by 29 days after exposure and there were no signs of the herbicide damage.

Liberty 200 applied broadcast at 375 ml/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Plants were growing normally 51 days after exposure.




## Impact on plant growth

**Plants:** exposure to a 10% rate of glufosinate caused little obvious damage, although plants were 20% smaller by weight at the last observation.

**Leaves:** the herbicide exposure caused mild leaf damage, with a few necrotic spots on the leaves. Plants had 17% fewer leaves and 26% less leaf area mid-season.

**Squares**: there was no apparent affect on the production of squares.

**Bolls:** boll production and retention were largely unaffected by the herbicide, with mature bolls retained to node 30, five nodes above the untreated plants. There was no delay in the average boll maturity.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide damage. Lint yield was reduced by 8%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **glufosinate** |
| **Nodes/plant** | 27.8 | 29.8 |
| **Leaves/m*** | 342 | 284 |
| **Leaf area (cm²/m)*** | 17713 | 13034 |
| **Reduction in leaf area*** | | 26% |
| **Bolls/m** | 200 | 199 |
| **Boll weight (g/open boll)** | 4.2 | 4.3 |
| **Retention in posit's 1-3^** | 88% | 85% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 6 - 23 |
| **Days to 50% open** | 187 | 187 |
| **Maturity delay (days)** | | - |
| **% Open bolls at picking** | 86% | 88% |
| **Lint yield/ha** | 2246 | 2059 |

Exposure to 10% of a typical field rate of glufosinate at 6 nodes resulted in a few necrotic spots on the leaves, but plants quickly recovered from this damage.

There was a reduction in leaf number and leaf area mid-season, but no apparent affect on square production, boll number, boll size, boll maturity or crop maturity. There was no appreciable delay in crop maturity or loss of lint yield.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **glufosinate** |
| **Rate:** | **375 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **12th Nov** (6 weeks post-emergence) |
| **Growth stage at exposure:** | **6 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **N**
**Translocation:** poorly translocated within the plant
**Mode of action:** inhibits glutamine production, resulting in an accumulation of ammonia which inhibits photosynthesis and destroys cells
**Residual activity:** almost none due to rapid microbial breakdown in the soil
**Soil half-life:** 7 days

Liberty 200 applied broadcast at 1.875 L/ha to 6 node cotton. Photo taken on 15th Nov, 3 days after exposure.

Symptoms of glufosinate damage were readily apparent 3 days after exposure, with necrotic areas on most leaves. Some leaves are completely desiccated.

Liberty 200 applied broadcast at 1.875 L/ha to 6 node cotton. Photo taken on 22nd Nov, 10 days after exposure.

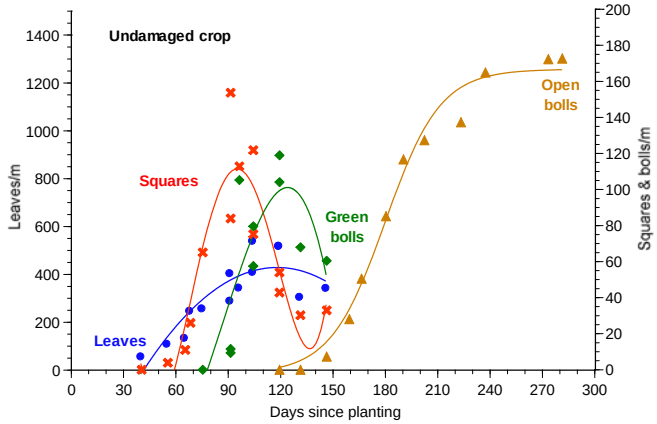
By 10 days, most damaged leaves had died, but a few new undamaged leaves had emerged.

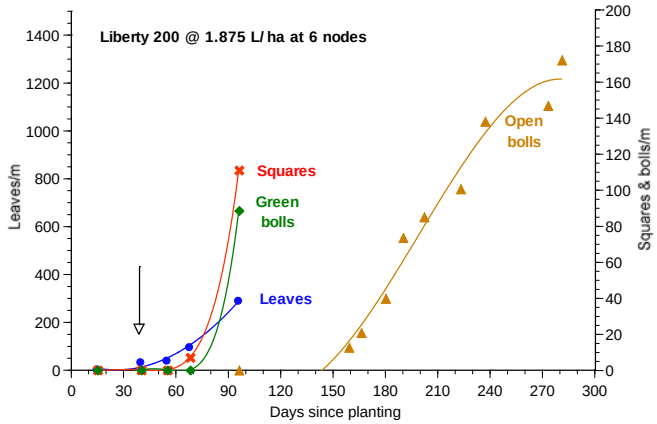
Liberty 200 applied broadcast at 1.875 L/ha to 6 node cotton. Photo taken on 11th Dec, 29 days after exposure.

Plants had resumed normal growth 29 days after exposure.

Liberty 200 applied broadcast at 1.875 L/ha to 6 node cotton. Photo taken on 2nd Jan, 51 days after exposure.

Plants were growing normally 51 days after exposure.




## Impact on plant growth

**Plants:** exposure to a 50% rate of glufosinate caused extensive leaf damage, killing a large proportion on exposed leaves. Plants were stunted, 29% smaller by weight, mid-season, and 43% more plants were tipped-out.

**Leaves:** plants recovered rapidly from the damage but had 16% fewer leaves and 23% less leaf area mid-season.

**Squares**: the herbicide damage delayed early square production by around 15 days, but peak squaring was little affected.

**Bolls:** boll production and boll retention was largely unaffected by the herbicide, although some early bolls were shed. Plants retained 15% fewer bolls in positions 1 – 3, with more bolls retained on the lateral branches. Plants retained 15% more bolls at picking, but 14% fewer bolls were open at picking. There was a 38 day delay in the average boll maturity.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide damage. Lint yield was reduced by 59%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **glufosinate** |
| **Nodes/plant** | 27.8 | 27.5 |
| **Leaves/m*** | 342 | 287 |
| **Leaf area (cm²/m)*** | 17713 | 13669 |
| **Reduction in leaf area*** | | 23% |
| **Bolls/m** | 200 | 231 |
| **Boll weight (g/open boll)** | 4.2 | 4.0 |
| **Retention in posit's 1-3^** | 88% | 0.94 |
| **Nodes carrying >80% bolls#** | 6 - 22 | 1 - 19 |
| **Days to 50% open** | 187 | 225 |
| **Maturity delay (days)** | | 38 |
| **% Open bolls at picking** | 86% | 74% |
| **Lint yield/ha** | 2246 | 923 |

Exposure to 50% of a typical field rate of glufosinate at 6 nodes defoliated most plants, but they quickly recovered. Nevertheless, plants were stunted, with fewer leaves and less leaf area mid-season.

The herbicide delayed square and boll production, with more bolls retained on the lateral branches. There was no affect on boll size or fibre quality, but crop maturity was delayed and lint yield was reduced by 59%.

Note* These parameters were last recorded 96 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **glufosinate** |
| **Rate:** | **75 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **5th Dec** |
| | **(9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **N**
**Translocation:** poorly translocated within the plant
**Mode of action:** inhibits glutamine production, resulting in an accumulation of ammonia which inhibits photosynthesis and destroys cells
**Residual activity:** almost none due to rapid microbial breakdown in the soil
**Soil half-life:** 7 days

Liberty 200 applied broadcast at 375 ml/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Symptoms of glufosinate damage were readily apparent 6 days after exposure, with necrotic spots and dead areas on the leaves.

Liberty 200 applied broadcast at 375 ml/ha to 11 node cotton. Photo taken on 14th Dec, 9 days after exposure.

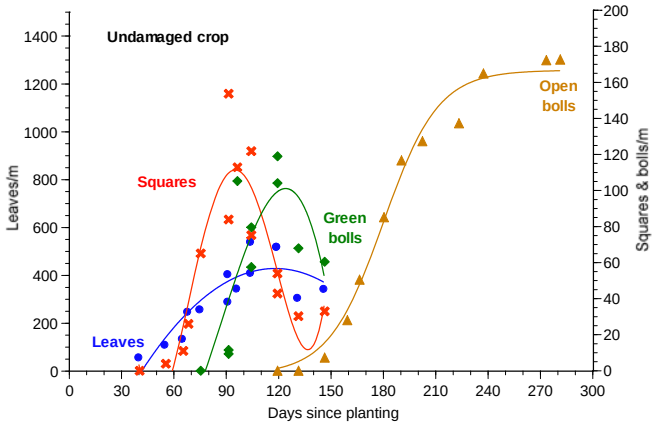
By 9 days, most damaged leaves had died, but new, undamaged leaves were emerging.

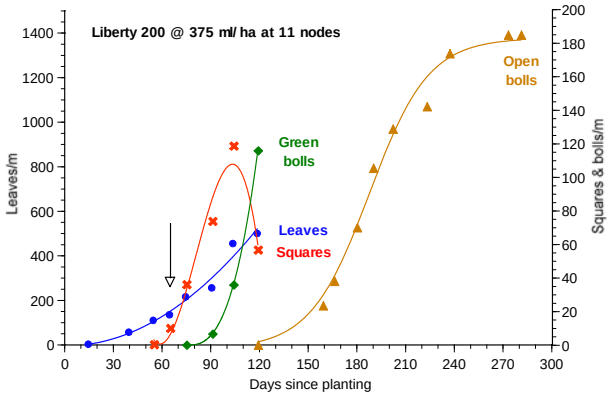
Liberty 200 applied broadcast at 375 ml/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

Plants had resumed normal growth 16 days after exposure.

Liberty 200 applied broadcast at 375 ml/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

Plants were growing normally 28 days after exposure.




## Impact on plant growth

**Plants:** exposure to a 10% rate of glufosinate caused moderate leaf damage, killing a small number on exposed leaves, but had no other apparent effect on plant growth and development.

**Leaves:** plants rapidly recovered from the damage, producing a flush of new growth mid-season. Plants had 21% more leaf area mid-season than the undamaged plants.

**Squares**: the herbicide damage had no appreciable impact on squaring.

**Bolls:** boll production and retention were largely unaffected by the herbicide, with mature bolls retained to node 25. Some early bolls were shed, reducing retention in the first 3 positions by 10%, but plants retained 10% more bolls at picking, with no reduction in boll size. There was an 8 day delay in the average boll maturity.

**Lint:** ginning turnout and fibre quality were unaffected by the herbicide damage. Lint yield was reduced by 16%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **glufosinate** |
| **Nodes/plant** | 27.8 | 28.5 |
| **Leaves/m*** | 342 | 497 |
| **Leaf area (cm²/m)*** | 13541 | 16363 |
| **Reduction in leaf area*** | | - |
| **Bolls/m** | 200 | 220 |
| **Boll weight (g/open boll)** | 4.2 | 4.1 |
| **Retention in posit's 1-3^** | 88% | 79% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 5 - 22 |
| **Days to 50% open** | 187 | 195 |
| **Maturity delay (days)** | | 8 |
| **% Open bolls at picking** | 86% | 84% |
| **Lint yield/ha** | 2246 | 1881 |

Exposure to 10% of a typical field rate of glufosinate at 11 nodes caused some leaf damage and partially defoliated the plants, but they quickly recovered from this damage.

The herbicide had minimal impact on boll retention and development, although some early bolls were shed. There was a delay in crop maturity and lint yield was reduced by 16%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **glufosinate** |
| **Rate:** | **375 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **5th Dec** |
| | **(9 weeks post-emergence)** |
| **Growth stage at exposure:** | **11 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **N**
**Translocation:** poorly translocated within the plant
**Mode of action:** inhibits glutamine production, resulting in an accumulation of ammonia which inhibits photosynthesis and destroys cells
**Residual activity:** almost none due to rapid microbial breakdown in the soil
**Soil half-life:** 7 days

Liberty 200 applied broadcast at 1.875 L/ha to 11 node cotton. Photo taken on 11th Dec, 6 days after exposure.

Symptoms of glufosinate damage were readily apparent days after exposure, with dead areas on many of the leaves.

Liberty 200 applied broadcast at 1.875 L/ha to 11 node cotton. Photo taken on 14th Dec, 9 days after exposure.

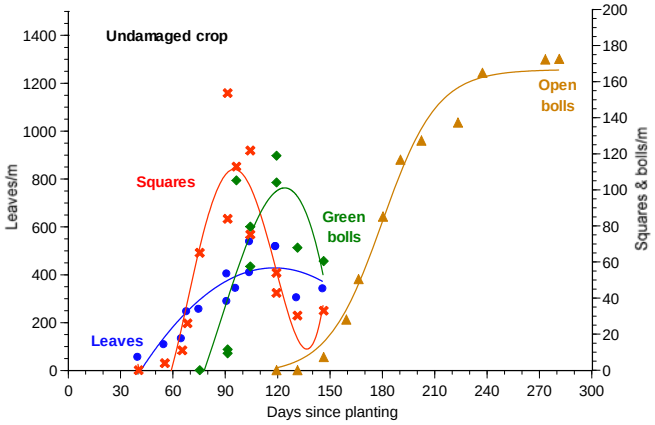
By 9 days, most damaged leaves had died, but new, undamaged leaves were emerging.

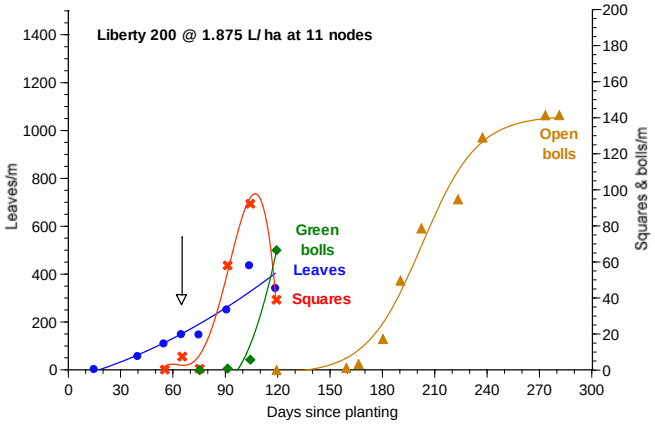
Liberty 200 applied broadcast at 1.875 L/ha to 11 node cotton. Photo taken on 21st Dec, 16 days after exposure.

Plants had resumed normal growth 16 days after exposure.

Liberty 200 applied broadcast at 1.875 L/ha to 11 node cotton. Photo taken on 2nd Jan, 28 days after exposure.

Plants were stunted, compared to undamaged plants 28 days after exposure, but were growing normally.




## Impact on plant growth

**Plants:** exposure to a 50% rate of glufosinate caused extensive leaf damage, killing a proportion on leaves. Plants recovered from this damage, but were 47% smaller by weight at the last observation.

**Leaves:** plants rapidly recovered from the damage, but had 34% fewer leaves and 18% less leaf area mid-season.

**Squares**: the herbicide damage caused little delay to early square production, but caused a reduction in peak squaring.

**Bolls:** boll production and retention were delayed by around 30 days by the herbicide, with many early bolls shed. Plants retained 17% fewer bolls in positions 1 – 3, retaining more late bolls towards the top of the plant. Final boll retention was down by 20% and boll weight by 15%. There was a 20 day delay in average boll maturity.

**Lint:** ginning turnout was unaffected but the cotton was immature, with low micronare (3.0) and 1.2% more short fibres. Lint yield was reduced by 48%.

**Final plant count data**

| | undamaged | glufosinate |
|---|---|---|
| **Nodes/plant** | 27.8 | 29.6 |
| **Leaves/m*** | 342 | 339 |
| **Leaf area (cm²/m)*** | 13541 | 11077 |
| **Reduction in leaf area*** | | 18% |
| **Bolls/m** | 200 | 160 |
| **Boll weight (g/open boll)** | 4.2 | 3.6 |
| **Retention in posit's 1-3^** | 88% | 73% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 6 - 27 |
| **Days to 50% open** | 187 | 207 |
| **Maturity delay (days)** | | 20 |
| **% Open bolls at picking** | 86% | 88% |
| **Lint yield/ha** | 2246 | 1157 |

Exposure to 50% of a typical field rate of glufosinate at 11 nodes defoliated many plants, but they quickly recovered, although they remained smaller, with fewer leaves and less leaf area mid-season.

Some early bolls were shed, with an increased retention of late bolls higher up the plant. There was a reduction in final boll retention, a reduction in boll size, a reduction in lint quality and a delay in crop maturity. Lint yield was reduced by 48%.

Note* These parameters were last recorded 119 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **glufosinate** |
| **Rate:** | **75 g a.i./ha** |
| **% of typical field rate** | **10%** |
| **Date of exposure:** | **2nd Jan** |
| | **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **N**
**Translocation:** poorly translocated within the plant
**Mode of action:** inhibits glutamine production, resulting in an accumulation of ammonia which inhibits photosynthesis and destroys cells
**Residual activity:** almost none due to rapid microbial breakdown in the soil
**Soil half-life:** 7 days

Liberty 200 applied broadcast at 375 ml/ha to 15 node cotton. Photo taken on 4th Jan, 2 days after exposure.

Minor symptoms of glufosinate damage were apparent 2 days after exposure, with some bleached areas visible on the leaves.

Liberty 200 applied broadcast at 375 ml/ha to 15 node cotton. Photo taken on 7th Jan, 5 days after exposure.

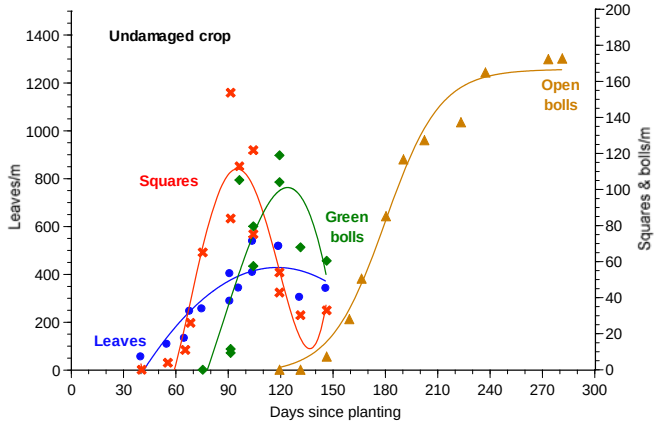
By 5 days, necrotic spots and patches were obvious on some leaves. A few leaves were completely dead.

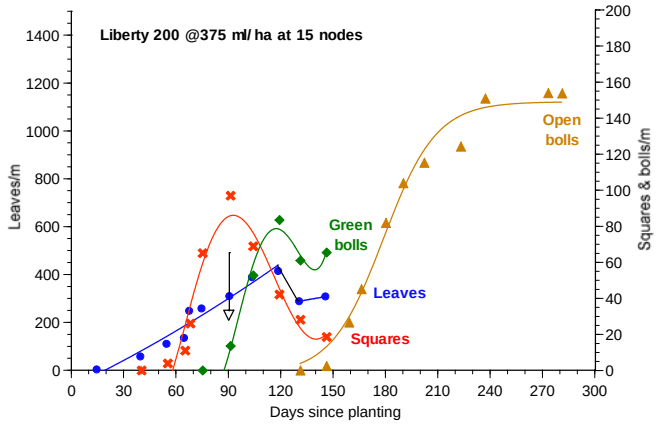
Liberty 200 applied broadcast at 375 ml/ha to 15 node cotton. Photo taken on 14th Jan, 12 days after exposure.

Necrotic spots were still visible on many leaves 12 days after exposure, but new leaves were emerging and plants were resuming normal growth.

Liberty 200 applied broadcast at 375 ml/ha to 15 node cotton. Photo taken on 31st Jan, 29 days after exposure.

Plants were growing normally 29 days after exposure, although necrotic spots were present on most lower leaves.




## Impact on plant growth

**Plants:** exposure to a 10% rate of glufosinate caused some leaf damage, killing some exposed leaves. There was no apparent impact on plant growth and development.

**Leaves:** many of the exposed leaves were killed by the herbicide and plants had 31% fewer leaves 40 days after exposure. Plants were recovering by 55 days, but still had 9% less leaf area at this stage.

**Squares**: the herbicide damage caused shedding of some early squares, reducing peak square production by 37%.

**Bolls:** the herbicide caused the crop to shed some small green bolls, but had little impact on more mature bolls. There was no reduction in boll size or the number of bolls, with mature bolls retained to node 25, although 11% fewer bolls were open at picking. There was a 5 day delay in the average boll maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton had 1.2% more short fibres and lint yield was reduced by 13%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **glufosinate** |
| **Nodes/plant** | 27.8 | 27.7 |
| **Leaves/m*** | 342 | 332 |
| **Leaf area (cm²/m)*** | 22084 | 20145 |
| **Reduction in leaf area*** | | 9% |
| **Bolls/m** | 200 | 201 |
| **Boll weight (g/open boll)** | 4.2 | 4.0 |
| **Retention in posit's 1-3^** | 88% | 91% |
| **Nodes carrying >80% bolls#** | 6 - 22 | 5 - 21 |
| **Days to 50% open** | 187 | 192 |
| **Maturity delay (days)** | | 5 |
| **% Open bolls at picking** | 86% | 76% |
| **Lint yield/ha** | 2246 | 1956 |

Exposure to 10% of a typical field rate of glufosinate caused leaf damage, partially defoliating the plants, but they quickly recovered.

The herbicide damage resulted in the loss of early squares and small green bolls, but additional bolls were retained higher up the plant. There was no reduction in the final boll retention or boll size and only a short delay in crop maturity. Fibre quality was reduced, although it remained above base grade, while lint yield was reduced by 13%.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.

# Herbicide damage guide for cotton

**Photographs & material by:** Graham Charles
NSW Dept. Primary Industries

| | |
|---|---|
| **Herbicide:** | **glufosinate** |
| **Rate:** | **375 g a.i./ha** |
| **% of typical field rate** | **50%** |
| **Date of exposure:** | **2nd Jan** |
| | **(13 weeks post-emergence)** |
| **Growth stage at exposure:** | **15 nodes** |

| **Damage key:** | |
|---|---|
| **Leaf loss** | **x** |
| **Leaf distortion** | |
| **Petiole distortion** | |
| **Plant stunting** | **x** |
| **Square shedding** | **x** |
| **Boll shedding** | **x** |

## Herbicidal action

**Herbicide group:** **N**
**Translocation:** poorly translocated within the plant
**Mode of action:** inhibits glutamine production, resulting in an accumulation of ammonia which inhibits photosynthesis and destroys cells
**Residual activity:** almost none due to rapid microbial breakdown in the soil
**Soil half-life:** 7 days

Liberty 200 applied broadcast at 1.875 L/ha to 15 node cotton. Photo taken on 4th Jan, 2 days after exposure.

Symptoms of glufosinate damage appeared as bleached patches on the leaves 2 days after exposure.

Liberty 200 applied broadcast at 1.875 L/ha to 15 node cotton. Photo taken on 7th Jan, 5 days after exposure.

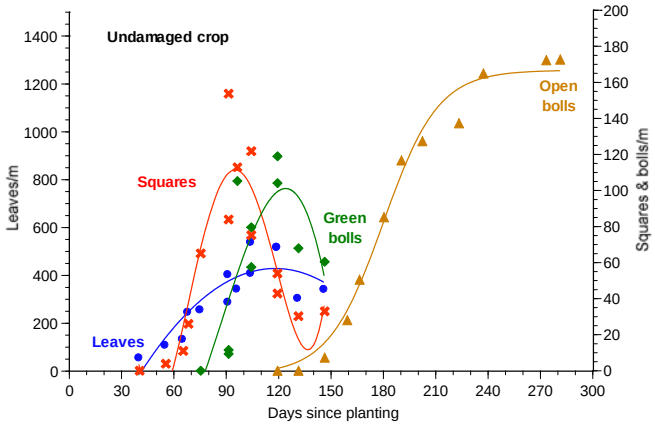
By 5 days, necrotic patches were obvious on most leaves, although few leaves were completely dead.

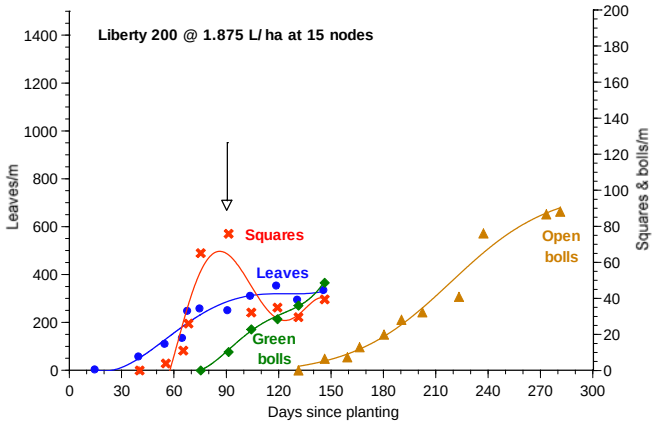
Liberty 200 applied broadcast at 1.875 L/ha to 15 node cotton. Photo taken on 14th Jan, 12 days after exposure.

Most damaged leaves had died 12 days after exposure, but new leaves were emerging and plants were resuming normal growth.

Liberty 200 applied broadcast at 1.875 L/ha to 15 node cotton. Photo taken on 31st Jan, 29 days after exposure.

Plants were growing normally 29 days after exposure, although dead leaves could still be found under the surface layer of leaves.




## Impact on plant growth

**Plants:** exposure to a 50% rate of glufosinate caused some leaf damage, killing a proportion on exposed leaves and stunting the plants. Plants were 26% smaller by weight mid-season.

**Leaves:** many of the exposed leaves were killed and plants had 10% fewer and 14% less leaf area at the final observation.

**Squares**: the herbicide caused the loss of many early squares and peak squaring was reduced by 51%.

**Bolls:** many early bolls were lost, reducing retention in positions 1 – 3 by 16%. Plants compensated, retaining bolls to node 25, with a uniform reduction in the number of bolls at each node compared to the undamaged crop. There were 52% fewer bolls at picking, a 20% reduction in boll weight and 33 day delay in boll maturity.

**Lint:** ginning turnout was unaffected by the herbicide damage, but the cotton was immature, with low micronare (2.6), reduced fibre length and 1.2% more short fibres. Lint yield was reduced by 54%.

| Final plant count data | | |
|---|---|---|
| | **undamaged** | **glufosinate** |
| **Nodes/plant** | 27.8 | 28.7 |
| **Leaves/m*** | 342 | 332 |
| **Leaf area (cm²/m)*** | 22084 | 20145 |
| **Reduction in leaf area*** | | 9% |
| **Bolls/m** | 200 | 97 |
| **Boll weight (g/open boll)** | 4.2 | 3.4 |
| **Retention in posit's 1-3^** | 88% | 0.43 |
| **Nodes carrying >80% bolls#** | 6 - 22 | 211 |
| **Days to 50% open** | 187 | 211 |
| **Maturity delay (days)** | | 28 |
| **% Open bolls at picking** | 86% | 91% |
| **Lint yield/ha** | 2246 | 1034 |

Exposure to 50% of a typical field rate of glufosinate caused some defoliation and stunted the plants.

The herbicide damage resulted in the loss of many early squares and bolls, reducing retention in the first 3 fruiting positions. Later bolls were retained higher up the plants, but there was a reduction in the final boll load, a reduction in boll size, a long delay in crop maturity and a reduction in fibre quality and maturity. Lint yield was reduced by 54%.

Note* These parameters were last recorded 146 days after planting.

Note^ Percentage of bolls retained on positions 1 – 3.

Note# The spread of nodes carrying more than 80% of open bolls.