

# TRENDS IN DISEASES IN AUSTRALIAN COTTON

S. J. Allen and P. A. Lonergan

NSW Agriculture  
Australian Cotton Research Institute, Narrabri  
(Cooperative Research Centre for Sustainable Cotton Production)

Commercial cotton crops throughout NSW have been surveyed in November and March of each season since 1983 to determine disease distribution, incidence and severity. Cropping history, field preparation, seed rate, plant stand and the amount of crop residue remaining from the previous cotton crop have been recorded for each field inspected. Between 80 and 100 commercial fields have been inspected in each survey. The results of these surveys provide a basis for prioritising research efforts and give an indication of the impact of farm management practices on disease incidence and severity.

## **Farm Management Practices**

The last 15 years have seen significant changes in farm management practices (Table 1). The practice of knocking down the beds and thoroughly incorporating all crop residues has been largely replaced with permanent bed systems and reduced tillage. Consequently the amount of cotton crop residue retained from one season to the next initially increased, and then decreased and increased again as the popularity of raking and burning increased and then decreased. The retention of residues on the surface has resulted in greater movement of residues around the farm in tailwater recirculation systems and increased carryover of several important pathogens of cotton. In recent years more growers have become interested in the introduction of legumes into the rotation. Sustainability issues, the economics of cotton production and the fluctuations between 'normal', drought and flood have all played a part in driving these changes.

All of these changes have had, or will have, an impact on the survival and dispersal of cotton pathogens and hence on the distribution, incidence and importance of cotton diseases.

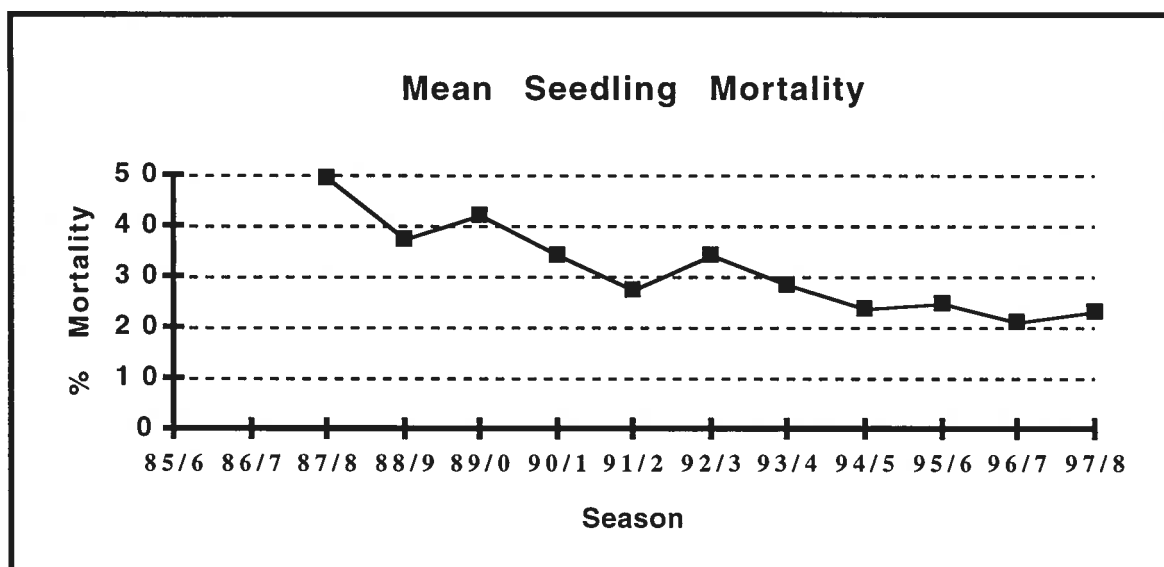
## **Seedling Diseases**

Seedling mortality represents the difference between the number of seeds sown per metre of row and the number of plants established. It includes the effects of seed quality or viability, seedling diseases and the effects of some insect pests that attack seedlings. The results show that there has been a decline in mean seedling mortality over the last 11 seasons (see Figure 1). Factors contributing to this decline have not been determined. They could include better ground preparation and planting practices, better seed quality, better

seed treatment formulations, reduced impact of pre-emergent herbicides, better soil insect control etc. etc..

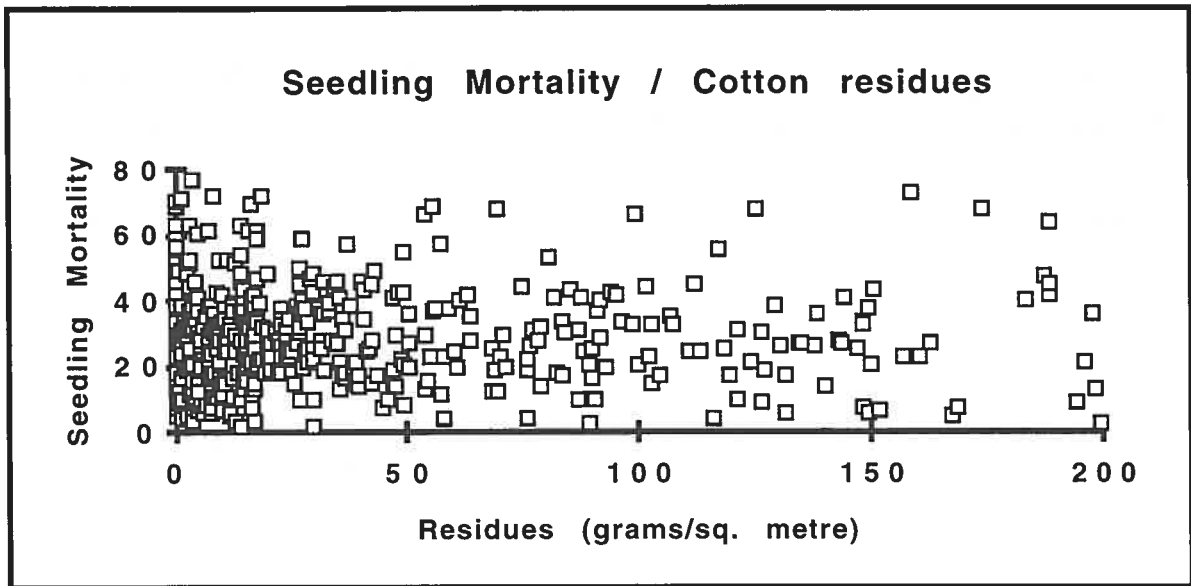
**Table 1.** Observed changes in the amount of cotton residue carried over from the previous season, the use of raking and burning to eliminate residues and the adoption of permanent bed systems in fields inspected during disease surveys in NSW over the last 14 seasons.

Season	Cotton Residues	Raked and Burned	Permanent beds
	(gram/sq.metre)	(% of fields inspected)	(% of fields inspected)
84/85	93.78	2.04	2.00
85/86	97.9	7.7	26.4
86/87	141.4	6.1	31.3
87/88	70.1	5.3	19.8
88/89	151.4	1.1	26.3
89/90	139.8	8.1	36.4
90/91	90.3	37.1	53.3
91/92	71.2	24.2	47.4
92/93	52.3	40.9	66.7
93/94	36.9	41.6	76.9
94/95	42.7	48.3	57.6
95/96	37.7	41.8	75.4
96/97	73.5	21.5	77.2
97/98	96.3	5.0	64.2



**Figure 1.** Mean seedling mortality in commercial cotton crops in NSW production areas.

The survival of the pathogens responsible for seedling disease is supposedly favoured by the retention of crop residues from season to season. However, no trends were apparent when seedling mortality was graphed against the amount of cotton residues carried over from previous seasons (Figure 2). It should be noted that high seedling mortality has been associated with carryover of legume residues on several occasions.



**Figure 2.** The relationship between cotton seedling mortality and amount of cotton residue carried over from the previous season.

### Verticillium Wilt

As a result of the repeated use of susceptible cultivars and the increasing adoption of permanent bed/reduced tillage systems the incidence of Verticillium wilt increased during the 1980's and reached a peak in 1989/90 (Table 2). The introduction and quick adoption of new cotton cultivars with good resistance to Verticillium wilt (Table 2) has since resulted in a steady reduction in disease incidence.

**Table 2.** The mean incidence of Verticillium wilt in commercial cotton crops in NSW and the Namoi Valley and the rate of adoption of Verticillium wilt resistant cultivars.

Season	Mean Incidence of Verticillium wilt (%)		Resistant Cultivars (% adoption-NSW)
	NSW	Namoi only	
84/85	4.1	5.5	0.0
85/86	4.9	11.1	0.0
86/87	4.1	9.1	0.0
87/88	5.3	13.0	0.0
88/89	9.5	23.7	0.0
89/90	16.6	31.2	0.0
90/91	10.2	22.8	1.1
91/92	12.4	23.4	12.4
92/93	6.0	10.5	25.3
93/94	5.8	8.9	41.2
94/95	6.1	11.0	68.4
95/96	5.0	4.7	73.8
96/97	2.5	3.9	84.6
97/98	4.0	7.7	85.4

The reduction in wilt incidence on farms where disease incidence was previously high has been outstanding. This is particularly true for farms in the Namoi Valley where *Verticillium* wilt was particularly common.

The new cultivars are not immune to the *Verticillium* wilt pathogen and their resistance is shown as reduced disease incidence and reduced disease severity. In other words fewer plants are infected and the symptoms aren't as severe. The incidence and severity of *Verticillium* wilt will continue to be monitored so that any shift to increased virulence by the pathogen can be detected.

### Bacterial Blight

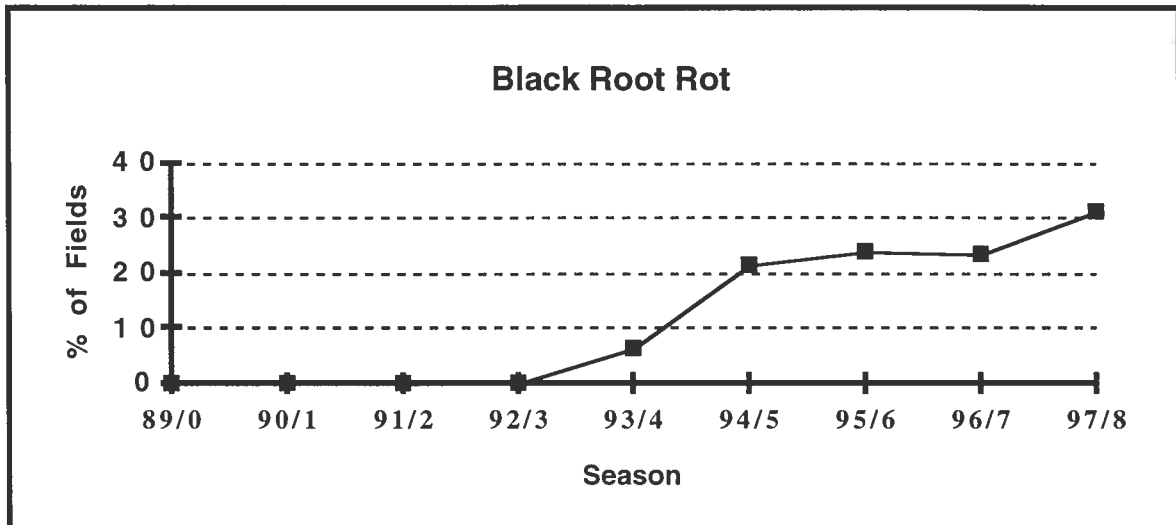
Almost all of the cotton cultivars (*Gossypium hirsutum*) grown in Australia are now immune to bacterial blight. Pima cotton cultivars (*Gossypium barbadense*) are grown in the drier western areas of NSW and are very susceptible to bacterial blight. The disease was first observed on Pima cotton at Bourke in the 1995/96 season and the incidence and severity has quickly increased (Table 3). The pathogen is able to survive on crop residues and within seed. 70% of bolls were blighted in a crop of Pima cotton inspected in February 1998 in the Bourke area. The crop had been planted in a field where Pima had also been grown the previous season. Bacterial blight was found to be present in all of the Pima pure seed crops that were inspected during March 1998.

**Table 3.** The mean incidence of bacterial blight on bolls of Pima cotton in commercial crops in the Bourke and Brewarrina areas of NSW over the last four seasons.

Season	Mean Incidence of Boll Blight in Pima at Bourke (%)
1994/95	0.00 %
1995/96	0.02 %
1996/97	3.52 %
1997/98	39.40 %

### Black Root Rot

Black root rot was first observed in seedling cotton in NSW in 1989. The disease was found in 31% of the fields inspected in November 1997 (Figure 3) and is now present in the Macquarie, Namoi, Gwydir and McIntyre Valleys of NSW. The adoption of permanent bed systems, repeated cropping to cotton and use of legumes in the rotation have all contributed to the increasing incidence. The mean percentage of plants infected within fields where the disease was found has varied between 8 and 17% over the last five seasons.



**Figure 3.** The percentage of commercial cotton fields inspected during annual disease surveys in NSW where black root rot was found to be present.

### Phytophthora Boll Rot

Phytophthora boll rot occurs when infected soil is splashed up onto low maturing bolls or when bolls are inundated with water in the furrow or near the tail drain. The disease is minimised in crops with a well-developed, closed canopy and can be most serious when there are gaps in the stand, incomplete canopy closure or lodging which exposes the soil. The mean incidence of this disease has generally been less than 2.0% although crops with up to 25% of bolls infected have been observed. Phytophthora boll rot has the potential to cause major yield reductions within a short period of time if conditions are favourable.

### Alternaria Leaf Spot

Alternaria leaf spot is a relatively new disease of cotton which is readily carried over from season to season in infected crop residues. It is now found in almost every crop that is inspected. The development of symptoms is favoured by wet weather when crops are suffering physiological stresses such as those associated with premature senescence. Pima cotton is very susceptible to Alternaria leaf spot and may prematurely defoliate when conditions favour the pathogen. Most *G. hirsutum* cultivars have some resistance to the pathogen.

### Fusarium Wilt

Fusarium wilt was first recorded in NSW in a single field on a farm near Boggabilla during the 1993/94 season. The disease has now been recorded on 10 different farms in the McIntyre and Gwydir Valleys. The incidence of Fusarium wilt on these 10 farms varies from a single, small patch a few metres across to large areas extending the length of the field with few surviving, unaffected plants. Even our most resistant cultivars are very

susceptible in the seedling stage. It would appear that all of the new records for the 1997/98 season have resulted from introduction of the pathogen either by the movement of dirty vehicles or machinery or by the movement of floodwater.

## Conclusions

It has long been recognised that plant diseases are a man made problem. We repeatedly grow large areas of genetically similar hosts. We impose farming systems which often encourage survival and dispersal of the pathogens and we move plants and plant products from one corner of the world to the other with considerable ease. The repeated use of susceptible cultivars along with the adoption of permanent bed / reduced tillage systems and the considerable traffic of people and machinery from one farm to another has contributed to the disease problems of Australian cotton growers.

In the past we have tended to turn to breeders for solutions. Breeders are blamed for susceptible cultivars and praised for resistant cultivars. The use of resistant cultivars has largely solved the problems of bacterial blight and *Verticillium* wilt and growers are calling for cultivars with resistance to *Fusarium* wilt and black root rot. The development of a resistant cultivar provides an easy, long term answer to a disease problem - unless there is the development of more virulent strains of the pathogen that can overcome that resistance!

Plant diseases can also be controlled using biological and cultural methods but these methods require greater effort or commitment. Biocontrol has demonstrated real potential for growth promotion and control of soil-borne cotton pathogens. Manipulation of the plants natural defence mechanisms has been shown to have positive effects. Trash management and crop rotation strategies can be used to minimise the impact of disease. Better farm hygiene can reduce the rate at which pathogens are moved from farm to farm and area to area.

There will never be a comprehensive single disease management strategy for cotton. The best disease control strategy will vary from field to field according to which disease(s) is present, the cropping objectives of the grower and what weather conditions predominate.

## **Quarantine - Tropical Rust**

Quarantine will always be important. There are many diseases of cotton that are present overseas that are not present in Australia. We don't want them here!! Tropical rust **was** one of those diseases until it was reported on *Gossypium barbadense* at Cooktown in northern Queensland in June, 1998.

Tropical rust is caused by *Phakospora gossypii* and occurs on cotton throughout the tropics. All cultivated species of *Gossypium* are susceptible. According to Hillocks (1992) (In 'Cotton Diseases' - CAB International) tropical rust "usually appears late in the season, often after the onset of senescence when it causes little damage to the crop." "However, substantial losses due to the disease have occurred in Brazil, India and Jamaica, when the crop has been attacked at an earlier stage of development." Losses estimated to be "as high as 24% were recorded in Brazil and India."

Hillocks also reported that the "severe outbreaks of the disease have occurred during the dry season in irrigated cotton or after rain, following a long dry spell." Disease development "appeared to be favoured by wide fluctuations in diurnal temperature and prolonged dew periods, under dry weather conditions."

## **ACKNOWLEDGEMENT**

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