FINREP95 DAN102C

Cotton *Research and Development Corporation*

FINAL REPORT

"Dr Ian Denholm - Travel"

DAN 102C

September 1995 to October 1995

Dr Robin Gunning, The Tamworth Centre for Crop Improvement (067-63 1128)

NSW Agriculture

Cotton ***Research and Development Corporation***

Project Title : **Dr Ian Denholm - Travel**

Project Number: DAN 102C

Research Organisation: NSW Agriculture

Principal Researchers: Dr Robin Gunning
Senior Research Scientist
NSW Agriculture
The Tamworth Centre for Crop Improvement
RMB 944 Calala lane, Tamworth, NSW 2340
Phone (067) 63 1128
Fax (067) 63 1222

Dr Ian Denholm
Department of Biological and Ecological Chemistry
Rothamsted Experimental Station
Harpenden, Herts., AL5 2JQ
United Kingdom

Project Supervisor: Mr A. J. Shaw
Program Leader (Cotton)
NSW Agriculture
Narrabri Agricultural Research Station
PMB Narrabri, NSW 2390
Phone (067) 99 1500

A final report prepared for the Cotton Research and Development Corporation

SUMMARY

1. INTRODUCTION

Bemisia tabaci is a serious pest of fibre, horticultural and ornamental crops world wide. When present in sufficient numbers, it can cause extensive damage through direct feeding, the production of large quantities of honeydew and as a vector of many viruses. In recent years, a novel biotype was identified in the USA known as the B-biotype or poinsettia strain. Now known to have spread round the world, the B-Type occurs widely in the Middle East, Europe, North and Central America. This biotype is distinguished by a characteristic esterase banding pattern, its ability to inflict physiological disorders on vegetables, adaptability to temperate climates and insecticide resistance. Overseas, the B-biotype has achieved primary pest status on cotton, other vegetable crops (curcubits, tomatoes, rock melons) and ornamentals. The B-Type is more virulent than other *B. tabaci* and has a much wider host range. Poinsettias have become the major host for B-types, and the immature stages of this insect have been transported between countries and continents on poinsettias.

B-Type *Bemisia tabaci* was detected in Australia by Robin Gunning in October 1994. Initially found in Darwin, NT and in Tamworth, NSW, the whitefly is now known to be widely distributed. NSW (Alstonville, Wollongbah, Moree, Tamworth, Coffs Harbour, Dubbo, Richmond, Blue Mountains, Sydney, Warren, Narromine, Coonabarabran), Queensland (Cairns, Ayr, Emerald Kingaroy Dalby, Toowoomba, Bileola, Brisbane), the Darwin and Katherine areas of NT. The whitefly was also found in the ACT and Devonport in Tasmania. At this stage, while infestations are largely confined to plant nurseries, B-biotype *B. tabaci* were found in May 1995 on a field pumpkin crop near Tamworth and a sunflower crop at Moree. More recently (November 1995) the whitefly was found on cotton at Emerald (at very low densities) and in the Macquarie Valley on cotton and weeds (December 1995).

2. OBJECTIVES

Reason for Travel :

Dr Denholm is an international authority on the management of resistant *Bemisia tabaci* on cotton.

1. Funds were requested to bring Dr Denholm to Australia to present a keynote address on whitefly management at a special cotton entomology symposium at the Australian Entomological Society's Scientific Conference, Tamworth 23 -28 th September 1995.

2. Dr Denholm was also requested to address a CRDC/HRDC Workshop on Biotype B *Bemisia tabaci* in Australia, discussing the options for the management of resistant *B. tabaci* on cotton in Australia, held at the Airport Hilton, Sydney 10 October 1995.

3. To discuss progress in collaborative research on B-type *B. tabaci* and *Helicoverpa* resistance biochemistry between Dr Gunning and the Rothamsted Insecticide Resistance Group.

3. RESULTS AND DISCUSSION

B-type *B. tabaci* is a new insect pest in Australia and is one with which Australian researchers have little experience. Dr Denholm's very timely presentations, and his experience and advice have been very valuable to the Australian cotton industry.

4. DISCUSSION AND RECOMMENDATIONS

Dr Denholm's visit and invited talks have greatly assisted Australians to formulate research priorities to tackle B-type *B. tabaci* in Australia. (His suggestions are attached in an appendix to this report). He has urged us be pro-active in response to this whitefly. Dr Denholm's presence in Australia has also enabled us to raise the profile of this potentially, very damaging insect. As a result, the horticultural industry seems willing to share some of the costs of research that will be required to contain this insect.

A result of Dr Denholm's visit has been the commencement of a formal collaborative research project between Dr Robin Gunning and the Rothamsted group. This work will involve resistance studies and resistance management in Australian *B. tabaci* and has been submitted to CRDC for funding.

5. COMMUNICATION OF RESULTS

The results of Dr Denholm's visit have been communicated by conference proceedings of and by the CRDC published *Bemisia tabaci* workshop report. *The Australian Cotton Grower* has also published updates on the whitefly situation.

6. APPENDIX 1

Budget

Total funds contributed by the Cotton Research and Development Corporation were $4,958.

7. APPENDIX 2

Dr Denholm's suggestions for research priorities on *Bemisia tabaci* in Australian are attached.

8. SPECIAL CONSIDERATIONS

NSW Agriculture and the Australian Entomological Society thank Dr Denholm for making himself available to come to Australia, and working so hard whilst he was here. We also thank Ciba Geigy, ICI Crop Care, Hoechst-Schering AgrEvo, Rhône-Poulenc Rural and *The Australian Cotton Grower* for sponsorship of the cotton entomology symposium.

Cotton *Research and Development Corporation*

Project Title : **Dr Ian Denholm - Travel**

Project Number: DAN 102C

Research Organisation: NSW Agriculture

Principal Researchers: Dr Robin Gunning
Senior Research Scientist
NSW Agriculture
The Tamworth Centre for Crop Improvement
RMB 944 Calala lane, Tamworth, NSW 2340
Phone (067) 63 1128
Fax (067) 63 1222

Dr Ian Denholm
Department of Biological and Ecological Chemistry
Rothamsted Experimental Station
Harpenden, Herts., AL5 2JQ
United Kingdom

Project Supervisor: Mr A. J. Shaw
Program Leader (Cotton)
NSW Agriculture
Narrabri Agricultural Research Station
PMB Narrabri, NSW 2390
Phone (067) 99 1500

A final report prepared for the Cotton Research and Development Corporation

1. INTRODUCTION

Bemisia tabaci is a serious pest of fibre, horticultural and ornamental crops world wide. When present in sufficient numbers, it can cause extensive damage through direct feeding, the production of large quantities of honeydew and as a vector of many viruses. In recent years, a novel biotype was identified in the USA known as the B-biotype or poinsettia strain. Now known to have spread round the world, the B-Type occurs widely in the Middle East, Europe, North and Central America. This biotype is distinguished by a characteristic esterase banding pattern, its ability to inflict physiological disorders on vegetables, adaptability to temperate climates and insecticide resistance. Overseas, the B-biotype has achieved primary pest status on cotton, other vegetable crops (curcubits, tomatoes, rock melons) and ornamentals. The B-Type is more virulent than other *B. tabaci* and has a much wider host range. Poinsettias have become the major host for B-types, and the immature stages of this insect have been transported between countries and continents on poinsettias.

A native, non-pest strain of *Bemisia tabaci*, has been known in tropical and temperate Australia for many years. B-Type *Bemisia tabaci* was detected in Australia by Robin Gunning in October 1994. Initially found in Darwin, NT and in Tamworth, NSW, the whitefly is now known to be widely distributed. NSW (Alstonville, Wollongbah, Moree, Tamworth, Coffs Harbour, Dubbo, Richmond, Blue Mountains, Sydney, Warren, Narromine, Coonabarabran), Queensland (Cairns, Ayr, Emerald Kingaroy Dalby, Toowoomba, Bileola, Brisbane), the Darwin and Katherine areas of NT. The whitefly was also found in the ACT and Devonport in Tasmania. At this stage, infestations are largely confined to plant nurseries, although B-biotype *B. tabaci* were found in May 1995 on a field pumpkin crop near Tamworth and a sunflower crop at Moree. More recently (November 1995) the whitefly was found on cotton at Emerald (at very low densities) and in the Macquarie Valley on cotton and weeds (December 1995).

The spread of this whitefly is expected to result in it becoming a major pest in cotton and other crops in Australia. Its host range suggests that B-biotype *B. tabaci* may effect field crops (such as cotton, maize, lucerne and sunflowers); field grown vegetables (curcubits, cole crops, melons, tomatoes); glasshouse vegetables; fruit crops (grapes) and glasshouse ornamentals (poinsettias, hibiscus, geberas and gloxinia).

The Insecticide Resistance Group of the Department of Biological and Ecological Chemistry at Rothamsted Experimental Station, UK. is the leading centre for the study of insecticide resistance in the world. The Rothamsted group, has considerable expertise in the management of resistant B-type B. tabaci on cotton (USA, Europe, Israel and Pakistan). Dr Gunning has already established a very successful collaboration with Rothamsted Resistance Group. Dr Ian Denholm is an international authority on the management of resistant *B. tabaci* on cotton and he was an obvious of choice as guest speaker for the Australian Entomological Society's cotton entomology symposium.

2. OBJECTIVES

Reason for Travel:

1. Funds were requested to bring Dr Denholm to Australia to present a keynote address on whitefly management at a special cotton entomology symposium at the Australian Entomological Society's Scientific Conference, Tamworth 23 -28 th September 1995.

2. Dr Denholm was also requested to address a CRDC/HRDC Workshop on Biotype B *Bemisia tabaci* in Australia, discussing the options for the management of resistant *B. tabaci* on cotton in Australia. The Airport Hilton, Sydney 10 October 1995.

3. To discuss progress in collaborative research on B-type *B. tabaci* and *Helicoverpa* resistance biochemistry between Dr Gunning and the Rothamsted Insecticide Resistance Group.

3. RESULTS AND DISCUSSION

B-type *B. tabaci* is a new insect pest in Australia and is one with which Australian resistance researchers have little experience. Dr Denholm's very timely presentations, experience and advice has been very valuable to Australian researchers.

Australian Entomological Society's Annual Scientific Conference, 23 - 28 September
The Australian Entomological Society is the professional society of Australia's entomologists. The society held its 26 th AGM and Scientific Conference in Tamworth 23 - 28 September 1995. The conference was convened Robin Gunning (NSW Agriculture). A particular feature of the conference was a special symposium on cotton entomology and insecticide resistance. This symposium comprised sessions on *Whiteflies on Cotton, Mangement of Transgenic Cotton* and *Industry Perspectives* Dr Denholm was the keynote speaker, discussing the management of resistant whitefly *B. tabaci* on cotton. The symposium attracted a large attendance from the cotton industry.

CRDC/HRDC Workshop on Biotype B *Bemisia tabaci* (10 October 1995.)
To take advantage of Dr Denholm's presence in Australia, and responding to the spread of B-type *B. tabaci* in Australia, the CRDC and HRDC, organised a workshop to discuss the potential impact of this insect in Australia. Dr Denholm gave a comprehensive presentation on "Managing *Bemisia tabaci* with particular emphasis on insecticide resistance. He discussed the extensive whitefly experience at Rothamsted and that of other overseas researchers and emphasised that Australian should take advantage of this. He supported the *B. tabaci* resistance work which was begun by Dr Gunning on finding the insect in Australia. In view of the already successful collaboration between Dr Gunning and the Rothamsted Resistance Group, he suggested that Australian *B. tabaci* resistance work should continue as a collaborative project. (A full report of the workshop has been published by CRDC).

Microbiology Society Symposium on BT toxins, Canberra ACT, 28 September
Dr Denholm attended this symposium in Canberra to update his knowledge of transgenic cottons, to meet with and have discussions with Australian *Helicoverpa* researchers. Whilst in Canberra, Dr Denholm also had discussions with Dr Paul De Barro (CSIRO Entomology) concerning *B. tabaci*.

Discussions with the NT Department of Primary Industries , Darwin (2- 5 October)
Dr Denholm travelled to Darwin for discussions with Mr Barry Condé (Plant Pathologist) and Dr Stuart Smith (Chief Entomologist) about B-type *B. tabaci,* (Mr Condé has been involved in collaborative work with Dr Gunning). Dr Denholm and Mr Condé spent some time in the field examineing both B-type and native *B. tabaci.*

Discussions with Dr Rick Roush, Adelaide 6 - 7 October
Dr Denholm discussed *B. tabaci* and other *Helicoverpa* resistance issues with Dr Rick Roush (University of Adelaide).

Discussions with Dr Robin Gunning and other NSW Agriculture personnel
Dr Denholm and Dr Gunning had several useful discussions with concerning the progress of collaborative whitefly and *Helicoverpa* resistance research between Dr Gunning' and the Rothamsted resistance group. Further joint plans for the study of resistance in Australian *B.tabaci* were formulated. Dr Denholm also held informal resistance discussions on October 9, with other NSW Agriculture personnel (Drs Garry Levot and Grant Herron) at The Biological and Chemical Research Insitute, Rydalmere.

4. DISCUSSION AND RECOMMENDATIONS

Dr Denholm's visit and invited talks have greatly assisted Australians to formulate research priorities to tackle B-type *B. tabaci* in Australia. (His suggestions are attached in an appendix to this report). He has urged us be pro-active in response to this whitefly. Dr Denholm's presence in Australia has also enabled us to raise the profile of this potentially, very damaging insect. As a result, the horticultural industry seems willing to share some of the costs of research that will be required to contain this insect.

A result of Dr Denholm's visit has been the commencement of a formal collaborative research project between Dr Robin Gunning and the Rothamsted group. This work will involve resistance studies and resistance management in Australian *B. tabaci* and has been submitted to CRDC for funding.

5. COMMUNICATION OF RESULTS

The results of Dr Denholm's visit have been communicated in conference proceedings of the Australian Entomological Society and in the CRDC published *Bemisia tabaci* workshop report. *The Australian Cotton Grower* has also published updates on the whitefly situation.

6. APPENDIX 1

Budget
Total funds contributed by the Cotton Research and Development Corporation were $4,958.

7. APPENDIX 2

Dr Denholm's suggestions for research priorities on *Bemisia tabaci* in Australian are attached.

8. SPECIAL CONSIDERATIONS

NSW Agriculture and the Australian Entomological Society thank Dr Denholm for making himself available to come to Australia, he worked very hard whilst he was here. We also thank Ciba Geigy, ICI Crop Care, Hoechsqt-Schering AgrEvo, Rhône-Poulenc Rural and *The Australian Cotton Grower* for sponsorship of the cotton entomology symposium.

DR DENHOLM'S ITINERARY

September 19	Depart London, arrive USA
September 19 - 21	Tucson, Arizona Whitefly discussions with Dr T. Dennahey.
September 23	Arrive Sydney
September 23 - 27	Australian Entomological Society Scientific Conference Tamworth, NSW.
September 27 - 1 October	Microbiology Society Conference, Canberra Discussions at CSIRO Division of Entomology
October 2 - 6	Darwin, discussions with Department of Primary Industries and Fisheries
October 6 -7	Adelaide, discussions with Dr Roush.
October 8 - 10	Sydney, BCRI, Rydalmere and Whitefly Workshop at Sydney Hilton.
October 11	Depart Sydney, arrive London.
October 8	Depart Sydney
October 9	Arrive London

21st November 1995

Bruce Pyke
Technology Transfer Coordinator
Cotton Research and Development Corporation
P.O. Box 282
Narrabri
New South Wales 2390
AUSTRALIA

Dear Bruce

Many thanks for sending a copy of the Whitefly Workshop Report, which I've read through in detail and circulated to senior colleagues here for information and comments. The report is an accurate summary of the contents and outcome of the meeting, and conveys the great concern expressed by several delegates over the threat posed by Bemisia to different cropping systems in Australia. I heard recently from both Robin Gunning and Paul De Barro that B-types have just been found on cotton at Emerald, and will be following these developments as the season progresses.

Within only 18 months or so, this insect has undergone an alarming spread in northern and eastern Australia. I fully endorse the commitment expressed by CRDC and HRDC to funding exploratory work on whitefly distribution and management, and to supporting extension activities for alerting growers and the general public to the gravity of the threat. Having said this, I do feel that the second half of the meeting, relating to the identification of research priorities, was rather disjointed and inconclusive. This was perhaps inevitable, due to the differing perspectives of delegates, the magnitude of the problem in hand, the need for several people to rush off for internal flights etc. As a consequence, considerably more thought should be given to setting priorities for support from commodity-based committees and other funding sources. One criterion for achieving this is to consider what aspects of whitefly biology and management are specific to and can only be addressed within Australia, and what aspects can be tackled, to some extent at least, by importing research findings and/or expertise from overseas. Due to the global importance of Bemisia, a great deal of relevant work is already underway in other countries. This should be exploited as fully as possible to avoid unnecessary duplication of effort. As a contribution to such discussions I would highlight the following areas as ones deserving rapid immediate action within Australia:

WHITEFLY ECOLOGY/BIONOMICS

Available information on whitefly distribution, dynamics and damage potential in Australia is necessarily very sketchy and anecdotal. Detailed and structured surveys are needed to address the following:

1) Temporal dynamics of B-type whiteflies in relation to climate (including overwintering capacity) and agronomy (especially irrigation regimes and crop succession in different parts of the country)

2) Spatial dynamics in relation to realised or suspected host range, including the influence of cropping patterns and availablility of non-crop hosts

3) Damage potential, ie. careful surveillance for viruses and other phytotoxic effects known to be associated with B-types in other countries. I'm particularly intrigued (and concerned) by the implications of contact between B-types and the 'indigenous' strain of Bemisia, which could result in the exchange of genetic traits (eg. insecticide resistance, capacity to induce phytotoxic disorders) through interbreeding, or an increase in the importance of diseases such as Tomato Leaf Roll (so far associated only with the latter)

4) Interactions with other species, both pests and beneficial organisms, especially the propensity for known parasitoids of native whiteflies, Trialeurodes or the indigenous strain of Bemisia to track the spread of B-types and influence their abundance in years to come

5) Identification/origin of biotypes. With two biotypes present in Australia, the identification of B-types on a routine basis is going to prove quite a headache. Robin appears to have made good headway with developing a rapid and user-friendly diagnostic based on total esterase activity, and should be encouraged to validate this test for potential implementation in regional laboratories. Incidentally, the name 'Biotype A' for indigenous Bemisia should be avoided since it implies identity with the 'A' strain described and well-publicised in the USA. As a consequence of Paul De Barro's ongoing work exploiting DNA markers we already know that this isn't the case.

The importance of strengthened quarantine procedures to preclude further importation of B-types (and hence novel diseases and/or resistance genes) was discussed at some length and agreed at the meeting. It won't, of course, prevent novel genes arising through mutation in B-types already present in the country.

Two people with excellent credentials in this area, and who could help considerably with formulating and evaluating work programmes are:

1) Prof. David Byrne, Department of Entomology, University of Arizona (Tucson) - specialist in whitefly ecology and dispersal.

2) Prof. Dan Gerling, Department of Zoology, University of Tel Aviv, Israel - specialist in the biology and dynamics of natural enemies of Bemisia.

WHITEFLY MANAGEMENT

For the time being this is likely to depend primarily on insecticides. The main priority will therefore be to investigate the extent and breadth of insecticide resistance already

present in B-type insects. The likely mode of introduction of B-types (in small numbers on only one or two occasions) means that B-types throughout Australia may initially exhibit a similar and predictable resistance patttern. Unfortunately, based on our experience at Rothamsted we'd expect your insects already to exhibit substantial levels of resistance to conventional insecticides such as OPs and pyrethroids. This needs to be confirmed using bioassays of the kind I discussed in Sydney and which are already being implemented in Robin's lab at Tamworth. To assist with anticipating the consequences of gene transfer between whitefly biotypes, the resistance status of indigenous Bemisia should also be investigated. Tests for monitoring resistance to more novel agents are also available and should need little work to adapt them for use in Australia. We at Rothamsted have had long-standing and productive links with resistance researchers in Australia, and welcome opportunities to collaborate further in this area.

A variety of other control agents (fungi, oils etc.) are showing promise against whiteflies and may have potential uses in Australia. However, I'd advocate very careful appraisal of their prospects in collaboration with appropriate overseas scientists before any appreciable commitment of funds to this work in Australia. There's an awful lot going on around the world, and most of what has been achieved should be transferrable without a substantial research commitment.

Finally, I need to correct one statement relating to my presentation, about halfway down p. 3:

- buprofezin (Applaud) resistance detected in Israel, UK, Netherlands (in fact resistance was detected in the UK before this product was full registered, due to the importation of resistant insects from overseas)

I did refer a great deal to the Netherlands, but the qualifier in parentheses refers to UK, not Dutch populations.

Again, I'm extremely grateful to CRDC for their support of my visit, and am delighted that issues raised in Sydney trip are being addressed so promptly.

Yours sincerely

Ian Denholm