

Cotton *Research and Development Corporation*

FINAL REPORT

"Resistance monitoring of *Helicoverpa armigera* in the Macquarie Valley"

DAN 78C

December 1992 to June 1993

Dr R.V. Gunning, Agricultural Research Centre, Tamworth (067-641428)



NSW Agriculture

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Cotton *Research and Development Corporation*

Project Title : **Resistance Monitoring of *Helicoverpa armigera* in the Macquarie Valley**

Project Number: DAN 78C

Research Organisation: NSW Agriculture

Principal Researcher: Dr R.V. Gunning
Senior Entomologist
NSW Agriculture
Agricultural Research Centre
RMB 944, TAMWORTH, NSW 2340
Phone (067) 64-1428
Fax (067) 67-9370

Project Supervisor: Mr A. J. Shaw
Program Leader (Cotton)
NSW Agriculture
Narrabri Agricultural Research Station
PMB Narrabri, NSW 2390
Phone (067) 93-1105
Fax (067) 93-1186

A final report prepared for the Cotton Research and Development Corporation

SUMMARY

1. INTRODUCTION

Industry Significance

The Macquarie Valley is a southerly cotton growing area in NSW. Located some 250 Km south of the Namoi Valley, it is both climatically and ecologically distinct from the more northern cotton growing regions. Over recent years, there has been a great expansion in the area of irrigated cotton grown in the Macquarie Valley. However, insecticide resistance levels and *Helicoverpa* ecology in the Macquarie Valley are not well understood. Insecticide resistance in *H.armigera* is one of the largest threats to the profitability of the Australian cotton industry and a management strategy is used to control resistance. Regular monitoring of resistance levels is required to evaluate the impact of the insecticide resistance management strategy.

2. OBJECTIVES

1. To establish *Helicoverpa* species composition in the Macquarie Valley and to relate the data to that from other cotton growing areas in NSW and Queensland.
2. To determine insecticide resistance levels in the Macquarie Valley and to relate the data to that from other cotton growing areas in NSW and Queensland.
3. To trial biochemical resistance detection methods in *H. armigera*.

3. RESULTS AND DISCUSSIONS

Helicoverpa species composition in the Macquarie Valley comprises *H. punctigera* during early and mid season (Stages 1 and 2) with *H. armigera* appearing in considerable proportions in Stage 3. The *H. armigera* occurrence in the Macquarie happens later in summer than in more northerly cotton districts.

The frequency of pyrethroid resistant *H. armigera* from the Macquarie Valley is increasing and is similar to that found in the Namoi and Gwydir Valleys. However, Macquarie endosulfan, and organophosphate resistance frequencies are higher.

4. DISCUSSION

All objectives of this project, namely to determine the *Helicoverpa* spp. species composition and *H.armigera* resistance status in the Macquarie Valley, have been met. This project is complementary to resistance monitoring programs in the Namoi /Gwydir, Emerald and at St George. Information from the Macquarie monitoring project will assist in developing an understanding of *Helicoverpa* ecology and behaviour on cotton in Australia.

5. CONCLUSIONS

H. armigera resistance monitoring in the Macquarie Valley has shown that in some

ways, this region is distinct from the cotton growing areas of northern NSW and central Queensland. While *H. armigera* pyrethroid resistance frequencies are similar, a considerable proportion survived pyrethroid synergism with piperonyl butoxide. Endosulfan resistance frequencies in the Macquarie Valley are unusually high and as well, the area is host to populations which are strongly resistant to organophosphates. It is possible that a specific regional resistance management strategy may be needed to manage these problems. It is recommended that insecticide resistance levels in the Macquarie Valley continue to be monitored.

6. COMMUNICATION OF RESULTS

Results of this project have been directly communicated to the growers and other cotton industry personnel in the Macquarie Valley. Dr Gunning has presented talks and demonstrations about biochemical resistance detection to growers and consultants in the Macquarie Valley. In addition, results have been published in scientific papers.

7. APPENDIX

Budget

Total funds contributed to DAN 78C by the Cotton Research and Development Corporation were \$5,000. During 1992 - 94, NSW Agriculture provided approximately \$200,000 per year to support this and DAN 51C.

8. SPECIAL CONSIDERATIONS

This project would not have been possible without the help and collaboration of Mr D. Clark, Mrs W. Clark and Ms A. Wheeler (all of D.Q. Clark and Associates, Warren); Mr A. Mc Alary and Mr C. Hogendyke (both of the Macquarie Cotton Growers Association) and Mr A. Kay (NSW Agriculture). Thanks are also due to Ms M.E. Balfe, Miss N.A. Colman, Mr R.V. Hall and Mr B.C. Craswell (all of NSW Agriculture) for technical support.

ADDENDUM

Abstract

H. armigera resistance monitoring in the Macquarie Valley has shown that in some ways, this region is distinct from the cotton growing areas of northern NSW and central Queensland. While *H. armigera* pyrethroid resistance frequencies are similar, considerable proportions survived pyrethroid synergism with piperonyl butoxide. Endosulfan resistance frequencies in the Macquarie Valley are unusually high and the area is host to populations which are strongly resistant to organophosphates. It is possible that a specific regional resistance management strategy may be needed to manage these problems. It is recommended that insecticide resistance levels in the Macquarie Valley continue to be monitored.

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Insecticide resistance in *H.armigera* is one of the largest threats to the profitability of the Australian cotton industry and a management strategy is necessary to control resistance. Regular monitoring of resistance levels is required to evaluate the impact of the insecticide resistance management strategy.

2. OBJECTIVES

1. To establish *Helicoverpa* species composition in the Macquarie Valley and to relate the data to that from other cotton growing areas in NSW and Queensland.
2. To determine insecticide resistance levels in the Macquarie Valley and to relate the data to that from other cotton growing areas in NSW and Queensland.
3. To test biochemical resistance detection methods on *H. armigera* field populations.

RESULTS AND DISCUSSIONS

Helicoverpa eggs were collected each week from cotton crops in the north (Warren) and south (Narromine) of the Macquarie Valley from late December to mid March. The weekly batches of eggs were transported to Tamworth Agricultural Research Centre. After egg hatch the larval species were identified and the frequency of *H.armigera* and *H.punctigera* recorded. Resistance testing was done via a discriminating dose technique. Third instar *H.armigera* were bioassayed with fenvalerate, endosulfan and where numbers permitted, with other insecticides (fenvalerate/piperonyl butoxide, carbamates and organophosphates). Data from each stage of the resistance management season were averaged. Pyrethroid resistance mechanisms in the Macquarie material were also determined. The progressive results were communicated to growers and other cotton industry personnel.

During early and mid seasons (Stages 1 and 2), Macquarie Valley *Helicoverpa* populations comprised mainly *H. punctigera*. Frequencies of *H.armigera* were low (0.4 - 6.0%) However in late season (Stage 3), 31 - 57 % of collected eggs were identified as *H. armigera*. (Table 1).

The pyrethroid resistance frequency in *H.armigera* varied from 41-80% during 1990 - 93 (Table 1) and there has been a general increase in resistance frequency during that

time (Fig. 1). Considerable proportions of resistant individuals survived fenvalerate synergism with piperonyl butoxide, up to 50% in 1993. Pyrethroid resistance frequencies are similar to those recorded from more northerly cotton areas eg. Namoi / Gwydir and Emerald but more Macquarie *H. armigera* survived pyrethroid/piperonyl butoxide.

Dr Gunning developed inexpensive and rapid biochemical methods to detect pyrethroid resistant *H. armigera*. The biochemical methods have been tested since 1990 on Macquarie Valley *H. armigera*. Resistance frequencies, determined by biochemical or conventional bioassays are not significantly different ($P > 0.05$). The biochemical assays are in fact, more informative because they give information on resistance factors and underlying resistance mechanisms

Endosulfan resistance frequencies for Macquarie Valley *H. armigera* ranged from 48 - 75% in the 1990 / 93 period (Table 1). There were no associations between the frequency of resistant individuals and year or stage of the season (Fig. 2). These values are considerably higher than those recorded for most northern cotton areas and other parts of NSW and should be viewed with some concern, especially as the resistance seems quite stable.

There has been incipient resistance to organophosphates (sulprofos and profenofos) in *H. armigera* populations since 1985. Resistance frequencies seldom exceeded 20%. However, populations which are highly resistant to profenofos are found in the Macquarie Valley. In one population, 95% were resistant to profenofos and had a resistance factor approximately 20 - fold. It is likely that organophosphate resistance in the Macquarie Valley has been exacerbated by the use of profenofos to control mite problems.

4. DISCUSSION

All objectives of this project, namely to determine *Helicoverpa* species composition and *H. armigera* resistance status in the Macquarie Valley have been met. This project is complementary to resistance monitoring programs in the Namoi/Gwydir, Emerald and at St George. Information from the Macquarie monitoring project will assist in developing an understanding of *Helicoverpa* ecology and behaviour on cotton in Australia.

5. CONCLUSIONS

Resistance monitoring in the Macquarie Valley has shown that in some ways, this region is distinct from the cotton growing areas of northern NSW and central Queensland. While pyrethroid resistance frequencies are similar, a considerable proportion survived pyrethroid synergism with piperonyl butoxide. Endosulfan resistance frequencies in the Macquarie Valley are unusually high and as well, the area is host to populations which are strongly resistant to organophosphates. It is possible that a specific regional resistance management strategy may be needed to manage these problems. It is recommended that insecticide resistance levels in the Macquarie Valley continue to be monitored.

6. COMMUNICATION OF RESULTS

(i) Refereed Scientific Papers

Gunning, R.V. and Easton, C.S, (1993a). Endosulfan resistance in *Helicoverpa armigera* (Lepidoptera : Noctuidae) in Australia *J. Aust. ent. Soc.* (in press).

Gunning, R.V. and Easton, C.S (1993b) - Organophosphate resistance in *Helicoverpa armigera* (Lepidoptera : Noctuidae) in Australia. *General and Applied Entomology.* (in press).

(ii)

Progressive results from this project were communicated directly to growers and other industry personnel. In addition Dr Gunning has presented talks and biochemical resistance demonstrations to growers and consultants in the Macquarie Valley.

7. APPENDIX

Budget

Total funds contributed to DAN 78C by the Cotton Research and Development Corporation were \$5,000. During 1992/94 NSW Agriculture provided \$200,000 for this and an associated project(DAN 51C).

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Table 1

Macquarie Valley *Helicoverpa armigera* Resistance Monitoring 1990/93

Stage	Total No.	% <i>H. p</i> ^a	% <i>H. a</i> ^b	% pyrethroid resistant <i>H. a</i> (no tested)	% endosulfan resistant <i>H. a</i> (no tested)
Warren Sites					
Stage 1 90/91	2020	98.0	2.0	47(30)	65(10)
Stage 1 91/92	5864	99.6	0.4	59(24)	-
Stage 1 92/93			no collections made		
Stage 2 90/91	2197	94.0	6.0	41(50)	48(50)
Stage 2 91/92	1939	95.1	5.1	55(40)	75(36)
Stage 2 92/93	380	84.0	16.0	70(20)	35(20)
Stage 3 90/91	1683	43.0	57.0	61(300)	48(300)
Stage 3 91/92	2141	68.6	31.4	48(81)	67(115)
Stage 3 92/93	257	19.0	81.0	80(70)	70(70)
Narromine Sites					
Stage 1 91/92	2522	99.5	0.5	50(24)	-
Stage 2 91/92	2929	92.8	7.2	50(81)	41(54)
Stage 2 92/93	100	36.0	64.0	80(25)	29(25)
Stage 3 91/92	3384	61.0	39.0	61(54)	52(48)

^a *Helicoverpa punctigera*^b *Helicoverpa armigera*

FENVALERATE

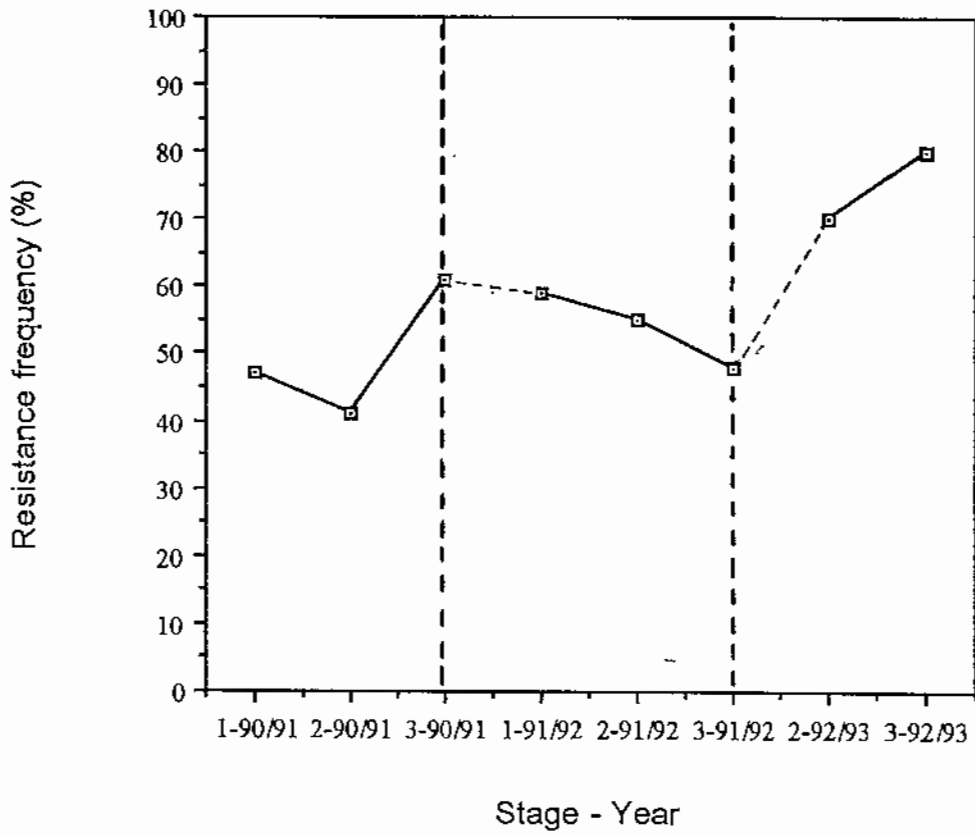


Figure 1

Mean fenvalerate resistance frequency in *H. armigera* from the Macquarie Valley 1990 -93 cotton seasons.

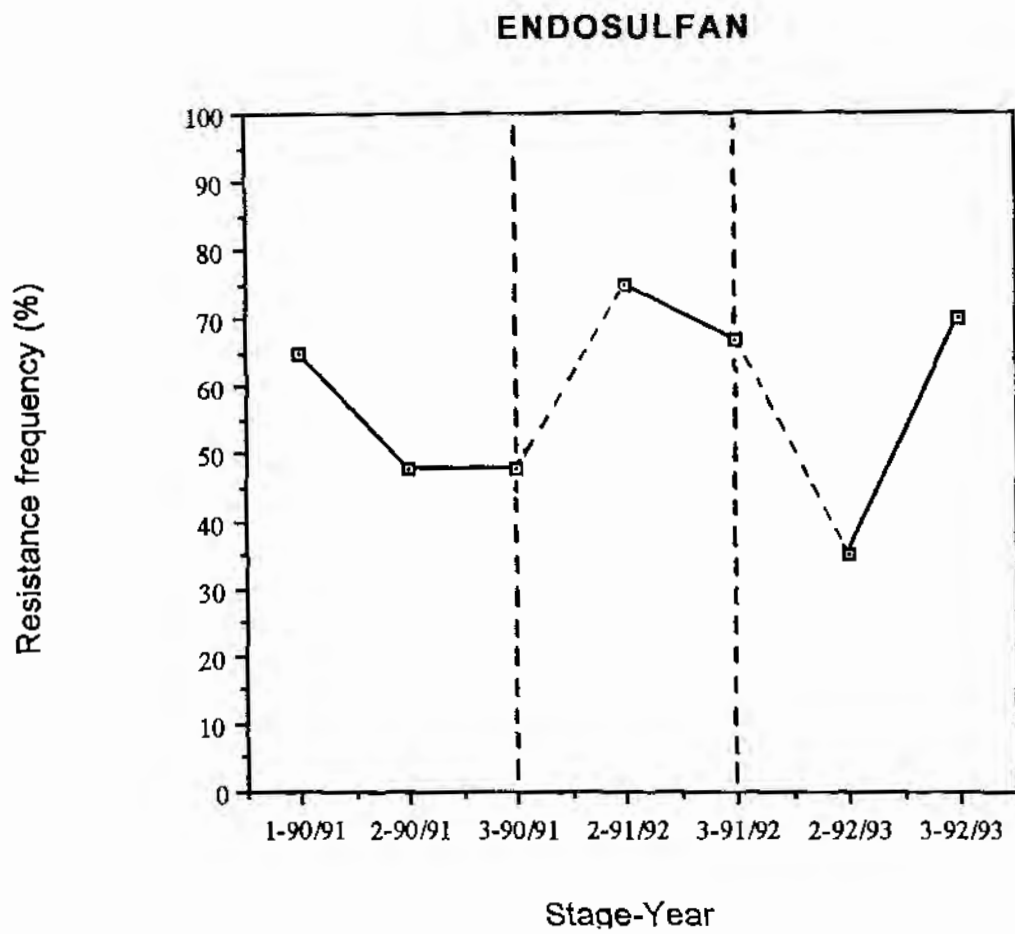


Figure 2

Mean endosulfan resistance frequency in *H. armigera* from the Macquarie Valley 1990 -93 cotton seasons.

