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RURAL INDUSTRY RESEARCH FUNDS
FINAL REPORT

Authorised Body: COTTON RESEARCH COUNCIL

Project Number: DAN 14L

Project Title: EVALUATION OF THE INSECTICIDE MANAGEMENT STRATEGY FOR RESISTANT HELIOTHIS ARMIGERA - NAMOI/GWYDIR

Field of Research: Entomology Field code: 3.1

Organisation: Department of Agriculture, NSW

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OBJECTIVES

- * To evaluate the impact of the Insecticide Resistance Management Strategy on pyrethroid and endosulfan resistance levels in Heliothis armigera in the Namoi/Gwydir.
- * To determine the main factors influencing resistance frequency.

BUDGET SUMMARY

1984/85	1985/86	1986/87
36,000	49,000	51,000

RESULTS

A new monitoring technique has been devised which enables individual larvae to be screened for pyrethroid/endosulfan resistance directly from the field without changing their genetic makeup. The technique involves screening larvae, collected as eggs in the field, with a discriminating dose of either fenvalerate or endosulfan. This new technique has proved quite sensitive in detecting even small differences in resistance levels. It has also avoided the long delay and altered genetic makeup associated with the classical F1 bioassay method.

A. PYRETHROIDS

The pyrethroid resistance levels detected over the past four seasons in the Namoi/Gwydir and the past two seasons at Emerald are:-

% Pyrethroid Resistance			
	Stage 1	Stage 2	Stage 3
Namoi/Gwydir			
1983/84	9.4	8.5	14.9
1984/85	7.2	13.1	28.2
1985/86	7.6	13.5	45.2
1986/87	33.0	36.7	42.7
Emerald			
1985/86	6.5	17.4	16.5
1986/87	8.8	27.2	32.0

The main points to emerge from this work are:-

- i) Stable Stage 1 resistance level (except for 1986/87)
- ii) Increase in resistance from Stage 1 to Stage 2, particularly at Emerald. This has been shown to be due to selection of adults prior to egg laying. This selection is most important when it occurs prior to mating at Emerald, where maize is a major alternative crop to cotton in the Irrigation Area.
- iii) Increase in resistance from Stage 2 to Stage 3 due to larval selection in Stage 2. The level of resistance in this Stage is determined by the interaction of two main factors: pyrethroid selection pressure in the previous generation and the degree of dilution from immigrating susceptibles. For example, high pyrethroid use and a summer drought in 1985/86 resulted in high pyrethroid resistance in the Namoi/Gwydir; while lower pyrethroid use and a wet summer resulted in much lower levels in 1983/84.
- iv) High Stage 1 resistance in 1986/87 due to high survival of the highly resistant overwintering pupae. This was caused by a lack of cultivation of cotton residues precipitated by record low cotton prices.

Other work has shown the potential problems with using pheromone trapped male moths to determine resistance levels, without accounting for moth age. Another significant finding has been the documentation that low rates of pyrethroids used against sorghum midge, can select for pyrethroid resistance in any Heliothis armigera present at spraying.

B. ENDOSULFAN

The endosulfan resistance levels detected in the past season were:-

	% Endosulfan Resistance		
	Stage 1	Stage 2	Stage 3
NamoiGwydir 1986/87	6.4	17.0	20.6
Emerald 1986/87	7.6	20.5	17.6

These results indicate a small response to selection pressure, which has been also demonstrated in laboratory selection experiments. However, as long as endosulfan useage patterns do not change dramatically, this level of resistance is probably quite manageable.

BENEFITS TO THE INDUSTRY

- i) The industry has regular access to the latest pyrethroid and endosulfan resistance levels. Without this information, industry compliance with the Strategy may well have quickly diminished, with disastrous consequences for the whole industry.
- ii) The efficacy of the two most cost effective insecticides for use against *Heliothis* has been maintained at an acceptable level. Without these two insecticides, growing costs would escalate dramatically, probably so much so, that cotton could only be grown profitably in the H. armigera prone eastern areas, during periods of high cotton prices.
- iii) The removal of the delay period in resistance monitoring, has allowed the forecasting of potential problem periods, giving the agrochemical companies time to respond with supplies of alternative insecticides.
- iv) The established pattern of resistance development in Stage 2 allows growers/consultants to make judicious insecticide choices in the critical Stage 2 period. Given pest pressure and a reasonable estimate of the resistance level, the only unknown factor left to determine is the percentage of H. armigera.

DIFFICULTIES

The inability to quickly determine the percentage of H. armigera in the field.

FUTURE RESEARCH

- i) The long term viability of the Strategy must be assessed by looking at the survival of the two main pyrethroid resistant genes in the unsprayed refugia. If these genes are not at a selective disadvantage in unsprayed crops, then they will gradually contaminate the refugia to such an extent, that dilution by immigrating susceptibles is no longer possible.

- ii) The relative importance of the two major resistance genes in field populations should be determined to assess the possible impact of introducing piperonyl butoxide as a synergist to counter metabolic pyrethroid resistance due to mixed function oxidase enzymes.
- iii) The pyrethroid resistance gene imparting nerve insensitivity resistance, should be isolated to determine whether it reacts similarly to the mixed function oxidase metabolic resistance gene, particularly on newly hatched larvae.
- iv) Pyrethroid and endosulfan resistance monitoring in H. punctigera should be incorporated in the current monitoring programme.

APPLICATION OF RESULTS TO INDUSTRY

- i) The voluntary Insecticide Resistance Management Strategy has been adopted by the whole industry since its introduction in 1983/84, with all but total compliance. Regular industry meetings are held, particularly each winter, to refine the guidelines of the Strategy. These meetings involve co-ordination and co-operation of every section of the cotton and grain growing industries and the agrochemical companies. The recommendations arising from these meetings are strongly dependent on the accurate, reliable information on resistance levels, made available by this research.
- ii) Cultivation of cotton residues is increasing in order to control the highly resistant overwintering population. Overwintering pupal sampling is being introduced.
- iii) December flowering crops (eg, maize/sunflowers) are being avoided in predominately cotton areas due to their role as nursery crops for resistant H. armigera.
- iv) Chemical choice in the critical Stage 2 period is now being made with regard to current resistance level, pest pressure, previous insecticide use and neighbouring crops.

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