Preliminary pest management studies in winter grown cotton in the Ord River Irrigation Area (ORIA).

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Introduction

Total dependence on broad spectrum insecticides led to nerve insensitivity resistance in *Helicoverpa armigera* and, eventually, to the collapse of the previously successful cotton industry at Kununurra in 1974. The final year of production saw an average of 40 insecticide sprays per crop, at which stage the industry was no longer economically or ecologically sustainable (Michael & Woods, 1980).

New research commenced in 1994 to evaluate the potential for successfully reintroducing cotton to the Kimberley, but within a biologically sustainable framework. The new approach aims to develop pest management security for a future industry by minimising the impact of pest species, minimising pesticide inputs and enhancing the benefits of naturally occurring predators and parasitoids. Key features of the new strategy include winter cropping, the use of transgenic varieties, a resistance management policy and an integrated pest management (IPM) production philosophy (Strickland and Constable, 1995).

The preliminary studies reported here were based on conventional cotton varieties due to the unavailability of transgenic types. However, in 1995, additional

observations were made on the insect fauna in a transgenic cotton crop grown for seed production on behalf of Cotton Seed Distributors by Mr T Sass-Neilsen.

The aim of the studies was to obtain basic data on insect abundance and impact on yield for contemporary cotton varieties grown during the winter months at Kununurra. The intention was use this data as the basis for developing more detailed research on IPM systems, with transgenic varieties, when they became available from 1996 onwards.

Methods

A. 1994

On 8 April 1994, three blocks of cotton (Siokra 1-4) were planted and, except for pest control, managed identically. The three pest management scenarios were no spray, low spray and conventional spray treatments on 5 ha, 5 ha and 2 ha blocks respectively. Within each of the blocks was embedded a replicated variety trial so that agronomic comparisons between the pest management zones could be formed. Details of pest thresholds are given elsewhere in these proceedings (Strickland & Lacey) and resulted in zero; five endosulfan, one Bt and one pirimicarb spray; and thirteen conventional sprays for the three treatments respectively. Each of the blocks was scouted twice weekly according to entomoLOGIC protocols and additional suction samples (5 X 20 m) were taken weekly Pheromone traps for *Helicoverpa armigera, H. punctigera, Spodoptera litura* (cluster caterpillar) and *Pectinophora gossypiella* (pink bollworm) were checked weekly to monitor the flight activity of these key lepidopteran pests.

B. 1995

Unseasonal rain prevented the synchronous planting of different pest management blocks in 1995 and consequently direct comparisons between the management zones was not possible. Nevertheless three pest management zones were established and monitored similarly to the previous year as described above. The blocks were an "IPM zone" which included "soft" sprays combined with strips of lucerne and niger as trap crops and/or refugia ; a "conventional zone" which was sprayed on demand with broad spectrum insecticides; and a "transgenic zone" which was similarly sprayed on demand. Crop scouting, suction sampling and pheromone traps were used as monitoring tools as described for 1994.

Results and discussion

A. 1994

The pest management strategies being used on the different blocks had large effects on the abundance of both pests and beneficial species. The dominant pest species observed in the trials were *Helicoverpa* spp and mirids. *Helicoverpa* spp oviposition peaked early in the season (Figure 1) at around 190 eggs/m and control was difficult to achieve until the pressure declined. However, earlier planted cotton (15 March) attracted even higher oviposition rates of more than 500 eggs/m (Figure 2) and insecticide applications were unable to prevent serious damage to squares in this situation.

The no spray zone provided an interesting baseline scenario on which to compare other pest management alternatives. The sucking insect complex dominated the

zone with mirids, jassids and, to a lesser extent, aphids in large numbers. Mirids were abundant early (Figure 3) whilst jassids predominated mid-season (Figure 4). The combined effect of the pests was to cause very stunted plants (< 50 cm) with

Figure 1. Helicoverpa oviposition rates on cotton in three pest management zones.

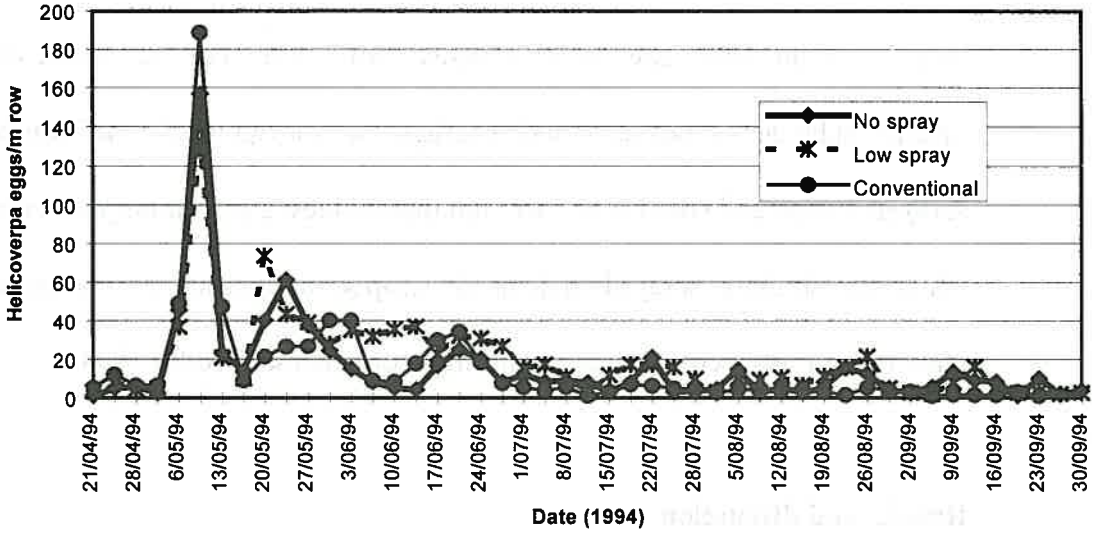
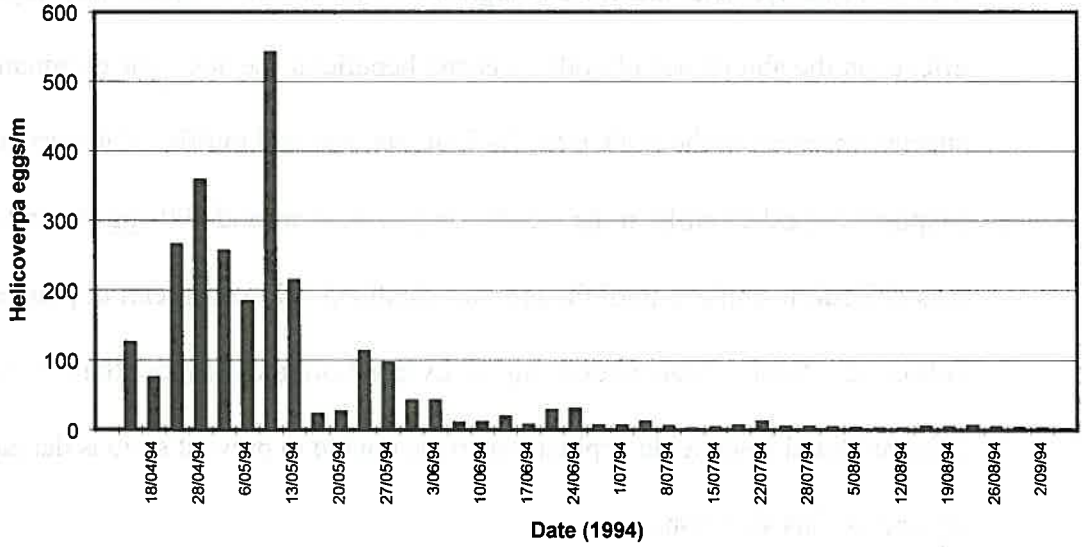


Figure 2. Oviposition by Helicoverpa on cotton planted on 15 March, 1994, at Kununurra.



thickened stems and leathery leaves. Late in the season, when sprayed cotton had already set its fruit, the unsprayed cotton "regrew" and produced spikes of growth which subsequently produced flowers and a small number of bolls.

Figure 3. The number of mirids (adults & nymphs) from suction samples in three pest management zones, 1994.

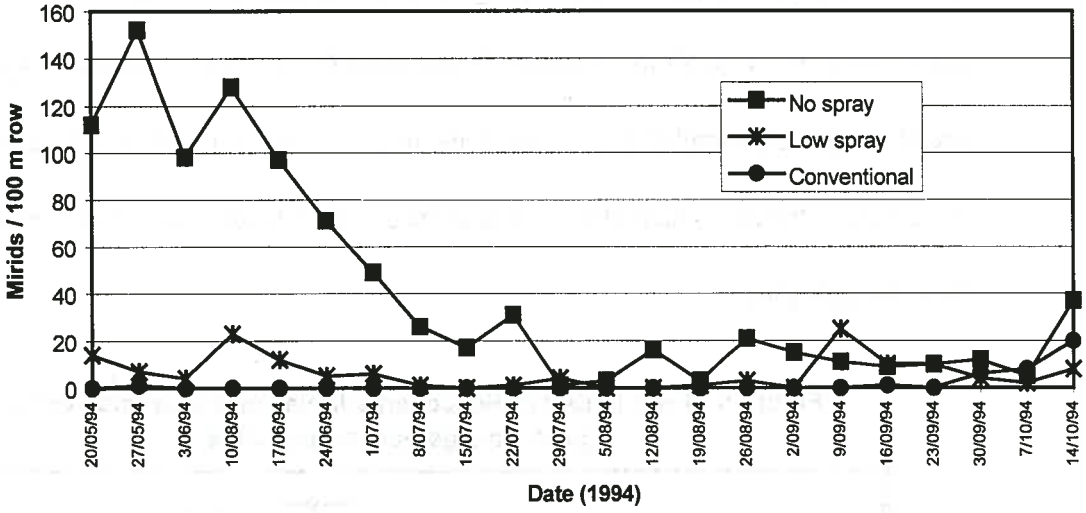
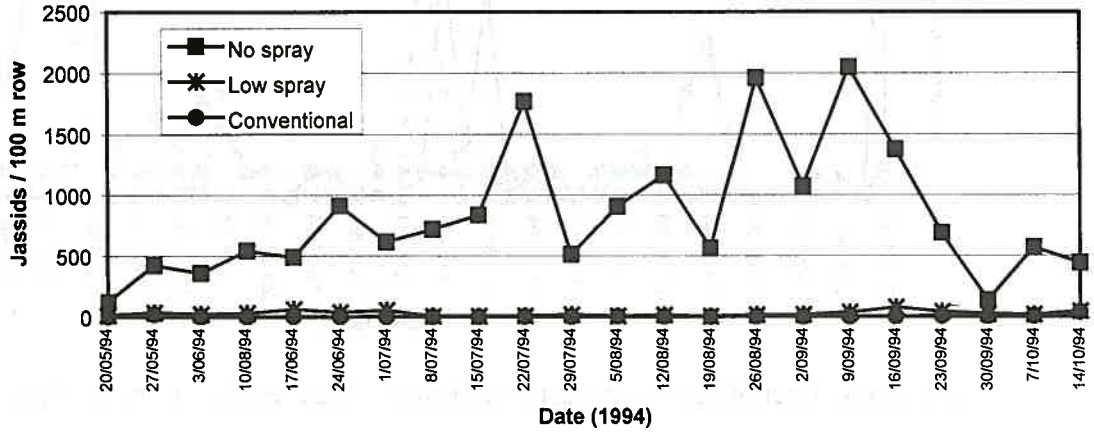


Figure 4. The number of jassids (adults & nymphs) from suction samples in three pest management zones, 1994.

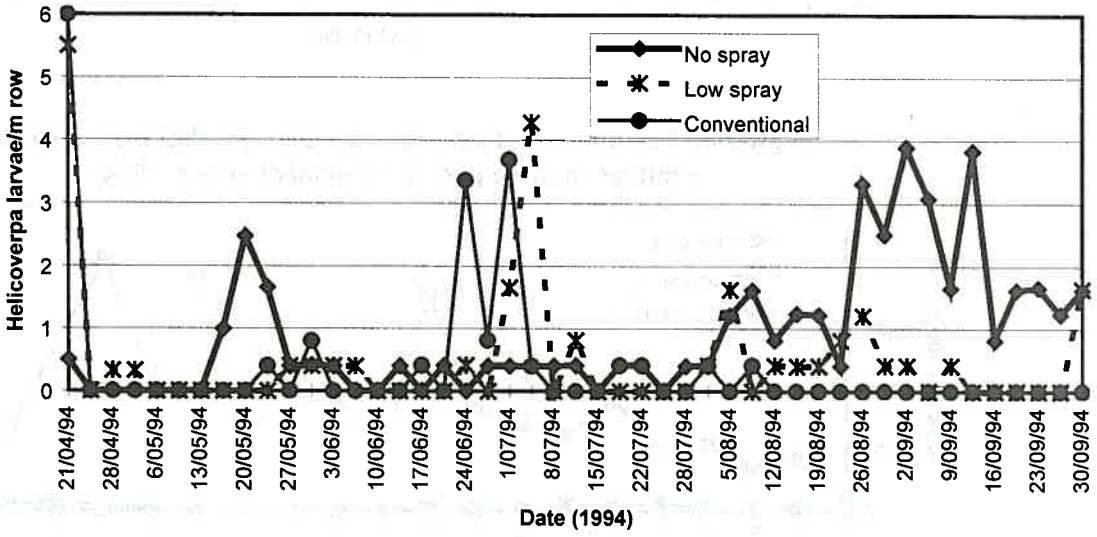


By contrast, the sucking insect pests were readily controlled in the low spray zone (5 endosulfan & 1 pirimicarb spray) and in the conventionally sprayed area (13 conventional sprays).

Helicoverpa spp were the most damaging of the lepidopteran pests and their activity in the pest management zones is shown in Figure 5. The low spray and conventionally sprayed zones were occasionally above threshold and considerable damage occurred at those times. However, the plants were able to compensate

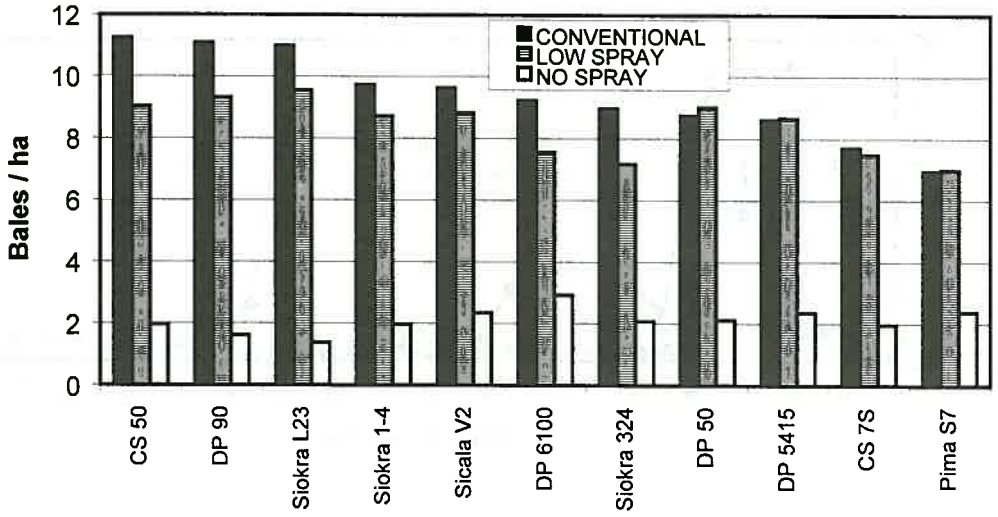
due to the long growing season available. Interestingly, major lepidopteran pests of the initial cotton industry, including *Spodoptera litura*, pink bollworm and cotton loopers, were almost entirely absent from the trails, even in the unsprayed area (Strickland, unpublished data). This observation is consistent with the winter production strategy which aims to avoid the severe pest pressure characteristic of summer cropping.

Figure 5. The number of Helicoverpa larvae/m row in three different pest management zones, 1994.



The gross effect of the insect pest complexes, which resulted from the three pest management strategies, are reflected in the yield data summarised in Figure 6. As expected, varieties grown in the no spray zone performed poorly and yielded around 2 bales/ha. However, excellent yields were obtained from both the conventionally sprayed and low spray zones. The latter was particularly encouraging as it indicated that high yields could be obtained with a low number of insecticide applications.

Figure 6. Yield comparisons for cotton varieties grown in different pest management situations, 1994.



B. 1995

As discussed previously, direct comparisons between the IPM, conventional and transgenic areas are not reliable due the variation in sowing times and consequent differences in pest abundances. However, most of the trends apparent from the 1994 trials were again evident in 1995. These included *Helicoverpa* spp again being the most serious pests whilst there continued to be an absence of *S. litura*, pink bollworm and cotton loopers. The abundance of *Helicoverpa* eggs and larvae throughout the season is summarised for the three management zones in Figures 7, 8 and 9. Of particular interest is the excellent control of *Helicoverpa* spp by transgenic plants (Figure 9). Mirids were not abundant, perhaps due to the later planting dates, but *Aphis gossypii* was difficult to control in the IPM zone.

Figure 7. The seasonal abundance of Helicoverpa eggs and larvae in the conventionally sprayed area, 1995.

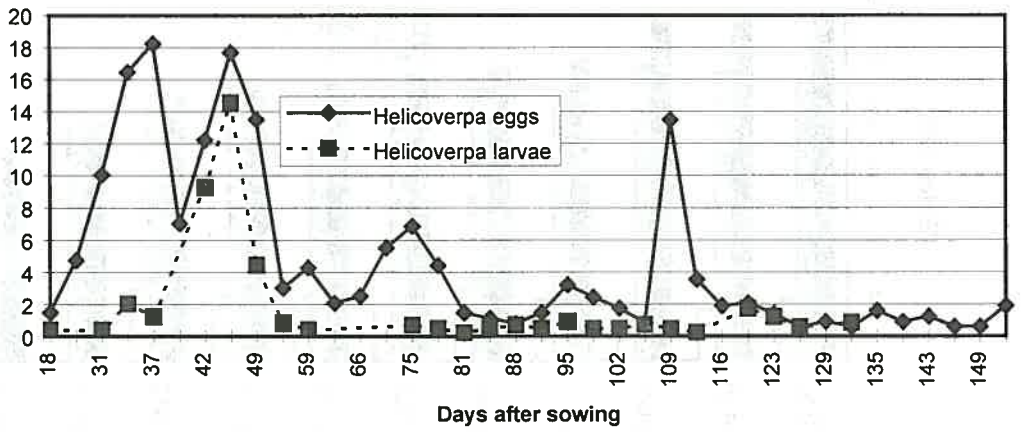


Figure 8. The seasonal abundance of Helicoverpa eggs and larvae in the IPM area,1995.

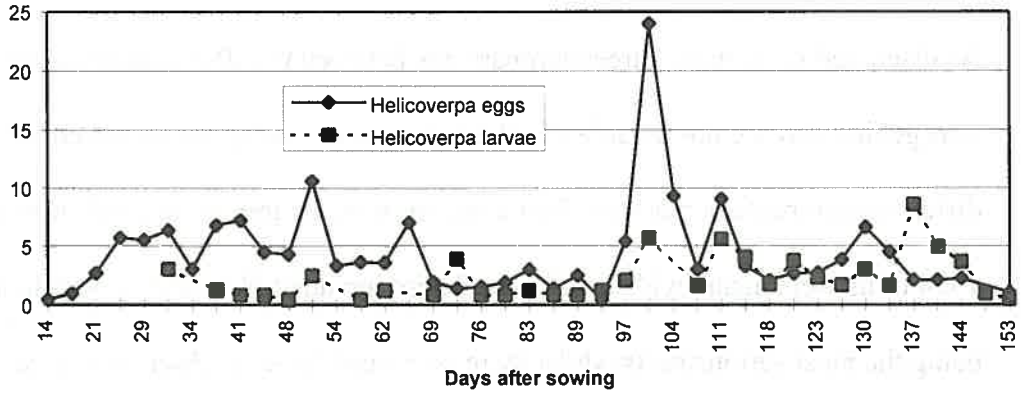
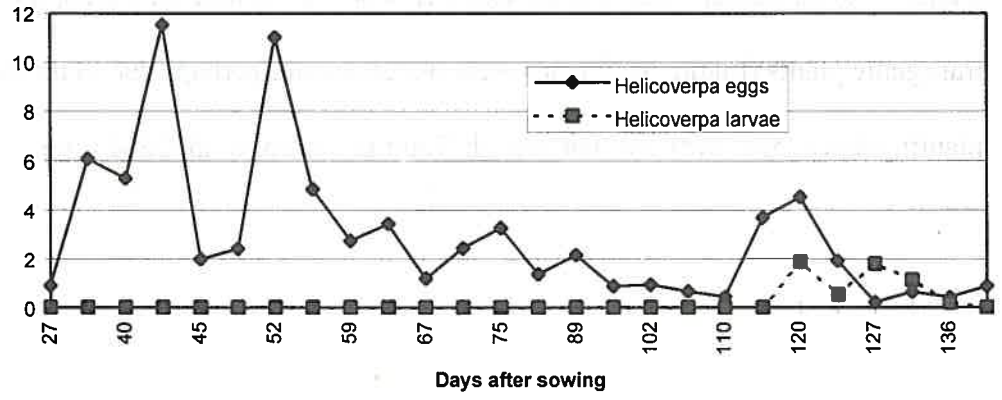


Figure 9. The seasonal abundance of Helicoverpa eggs and larvae in the transgenic area, 1995.



Yields from the IPM block are not presented here but were generally 2-3 bales/ha lower that the conventionally sprayed area. However, part of this lower yield is explained by the late planting of the IPM zone, relative to the others, which is known to limit yield potential.

Conclusions and future research

* Winter grown cotton in the ORIA has produced excellent yields despite very heavy oviposition rates by *Helicoverpa* spp early in the season.
* *Helicoverpa* spp, mirids and aphids have been the most serious pests in 1994 and 1995.
* *Spodoptera litura* (cluster caterpillar), *Pectinophora gossypiella* (pink bollworm) and cotton loopers have been almost absent from winter grown cotton.

Future research will focus on developing IPM systems appropriate to winter grown transgenic varieties. Key elements in the research will include:

⇒ evaluating the role of insect "food sprays" and trap crops in an IPM system

⇒ assessing a range of transgenic varieties for efficacy against lepidopteran pests

⇒ maximising the contributions of naturally occurring beneficial insect species in an IPM system with particular reference to *Trichogramma pretiosum*.

References

Michael, P.J. and Woods, W.M. (1980). An entomological review of cotton growing in the Ord River area of Western Australia. *Tech. Bull. 48. WA Dept. of Agriculture.*

Strickland, G.R. and Constable, G.A. (1995). Cotton on the Ord again. *The Australian Cottongrower, September - October, 1995.*