

Activity of heliothis egg parasites in late season INGARD cotton.

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Introduction

As low densities of heliothis may survive on Bt transgenic plants late in the season, a specific late season control for heliothis is valuable to reduce the survival of individuals resistant to Bt toxin. Late season survivors could provide a pathway to carry resistance into the next season's first heliothis generation. Broad spectrum insecticides could target these late season heliothis, but also disrupt beneficial insects that can control minor pests at this time. Transgenic cotton is being promoted as an environmentally friendly crop and late season heliothis sprays detract from this image.

Heliothis egg parasites have a role to play in reducing late season heliothis larval numbers. How effective they may be at this role is unknown, nor do we know the contribution that each of a number of species of egg parasites makes. Scholz *et al.* (1996) released the north American *Trichogramma pretiosum* (Riley) at 1 site in February 1995 and monitored activity of this wasp over 6 days. They found that *T. pretiosum* parasitised 42.5% of eggs 2 days after release, but that the native *Trichogrammatoidea bactrae* (Nagaraja) dominated. They did not assess the introduced species further. Limited sampling by the senior author in 1997 showed that *T. bactrae* was nearly the sole species that parasitised heliothis eggs in mature cotton at two sites on the eastern Darling Downs (unpublished data). How common these and other species of heliothis egg parasites are in late season cotton was determined by monitoring their activity in INGARD cotton prior to harvest in 1998.

Methods

Paper towelling with fresh laboratory-reared *Helicoverpa armigera* (Hübner) eggs was cut into approximately 2 cm by 5 cm sections and attached to more robust paper to form a card. Variable numbers of eggs were deposited, but sections with less than 30 eggs were not used. No section had more than 100 eggs. Ten cards were used per site, distributed in two rows 50 m apart and 20 m within rows. Each card was stapled to the upper surface of a leaf at the top of a plant.

Cards were left for 2 days to allow egg laying by parasitic wasps. They were collected and held in the laboratory until wasps had emerged. *H. armigera* hatchlings were removed daily for the first few days after collecting as they can eat unhatched eggs. Sampling started in early March and continued weekly until after crop defoliation.

Six sites were used on the Darling Downs for the study. All sites, except 1, were commercially managed INGARD crops of various cultivars. The exception was an unsprayed trial area at which *T. pretiosum* had been released 3 years previously. A number of rows on each side of this block were sprayed.

Results

All wasps were identified as *Trichogramma* sp. (prob. *pretiosum*; awaiting confirmation). This species produces a mean number of 2 adults per heliothis egg (B. Scholz, pers. comm.); thus the actual proportion of eggs parasitised was assumed to be half the ratio of the number of wasps to the number of heliothis eggs. Fig. 1 shows that the parasitism levels for each site were generally low at the start of the sampling; the previous release site (Arthur) was relatively constant at *ca* 12%. The exception at Arthur occurred when crop defoliants were applied.

Parasitism at all sites suffered from defoliants some time during the sampling period. At Kummerow this is not obvious as it occurred in week 2. However, parasitism levels can recover in a short time as shown by the data from Arthur (at previous levels 1 week later) and Mason. Of interest is that this recovery occurred in crops with dry leaves that were falling from the plants. After defoliation a second, later maturing block at Kummerow was sampled, where parasitism levels continued to rise. No defoliants had been applied to the block when sampling ceased.

Not shown on Fig. 1 for clarity is the variation in the levels of parasitism per sampling. The standard error varied from 29 to 100% as a proportion of the mean. This variation was consistent in the samples taken when no defoliants had been applied. When they had been, the variation was consistently low as few egg cards had parasitised eggs.

This experiment was concerned with monitoring egg parasites. Egg predation also occurred at most sites each week, with eggs on 1 or 2 cards being completely consumed. The species responsible could not be determined in most cases, although large heliothis caterpillars were responsible at Arthur on 1 occasion.

Discussion

One species of trichogrammatid (*Trichogramma* sp.) was recovered from parasitised eggs. This is surprising given the number of heliothis egg parasites present on the Darling Downs. However, many of these species may be more active in young cotton. Also, *T. bactrae* was the predominant species recovered in a small-scale trial in mature cotton in 1997. *T. bactrae* is possibly being displaced by *Trichogramma* sp. as the main late season egg parasite.

Variable levels of parasitism were recorded at each site. Early low levels were undoubtedly influenced by the final insecticide sprays applied to each crop. Later, defoliants had the same effect. Whether this was directly due to the action of defoliants or from contamination by insecticides is unknown. In any case, parasitism levels recovered rapidly and returned to levels recorded previously. Strickland and Lacey (1996) found that there

was a rapid recovery of *T. pretiosum* at their site in the Ord River Irrigation Area following a ULV Curacron application. This species may be able to readily recolonise an area from outside following a small area spray application. What happens after repeated, large area applications remains to be seen.

Our unsprayed block was the most uniform site. This contrasts with Strickland and Lacey's (1996) observation that unsprayed cotton had highly fluctuating parasitism levels, when they had expected it to be the most uniform. However, their Figure 1 shows that late season levels were between 60 and 70% for the last 4 weeks, except for the penultimate week where levels declined to 35%. They make no comment regarding the effects of defoliants on egg parasites, nor is it possible to determine when sampling ceased with respect to crop maturity.

Egg parasitism occurred even after plants were defoliated and thus presumably there would be no natural heliothis egg laying. Eggs in defoliated crops may have been parasitised by adults emerging from wild eggs parasitised prior to defoliants being applied. We don't know how long eggs would continue to be parasitised as sampling ceased after 1 sample had been obtained from defoliated cotton. Wasp activity at this stage would be unimportant for heliothis management.

A few egg cards were completely destroyed by predators throughout the sampling period. In one case large heliothis larvae were responsible, but the predators responsible for the other sites remain unknown. Predator activity may fluctuate even more than that of parasites, but would seem to have a role to play in a late season heliothis management strategy. The cards affected by predators had every egg eaten.

Egg parasites and predators play a role in reducing the survival of late season heliothis. Their influence may not be sufficient for growers to be able to solely rely on them. However, they can be important contributors to a fully integrated pest management program.

Acknowledgements

We thank Sue Maclean for providing heliothis eggs and Brad Scholz for advice on egg parasites. John Marshall managed the wasp release site, and we thank him for allowing us to superimpose this experiment on his. The farmers on whose properties this experiment was conducted also contributed greatly. The Cotton Research and Development Council provided funding for this work (DAQ72C).

References

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Figure. 1. *Heliothis* egg parasitism in mature cotton at six sites.



