The use of *Trichogramma* against heliothis on the Darling Downs.

by

Brad Scholz, Dave Murray & Richard Lloyd
Queensland Department of Primary Industries
P.O. Box 102
Toowoomba Qld. 4350

Background

The Queensland Department of Primary Industries is currently investigating IPM techniques for heliothis in cotton and some vegetable crops. The research includes evaluation of native egg parasitoids as biological control agents of heliothis. In 1994 a strain of *Trichogramma pretiosum* was obtained from heliothis eggs on sunflowers at Kununurra (Western Australia). The results of initial field testing of this species of wasp as an inundative biocontrol agent are provided below.

Methods

The trial was located at Nandi on the Darling Downs, consisting of single skip cotton (CS189+) that was eight pairs of rows wide (approx. 26 m) and 870 m long. *Trichogramma* and the heliothis nuclear polyhedrosis virus (NPV) were applied to the release site (16 rows x 400 m), and NPV only was applied to the control site (16 rows x 320 m). Both sites were separated by a buffer zone of cotton 16 rows x 150 m.

T. pretiosum were released by hand on 28 February 1995. The wasps were released as pupae in grain moth (*Sitotroga cerealella*) eggs mixed with semolina. The cotton plants were misted with water from a hand held atomiser, and the *Sitotroga* / Semolina mixture was sprinkled onto a wet leaf in a shaded position. The mixture was applied every 2.5 m in adjacent pairs of rows, i.e. every five metres in a given pair of rows.

A sample of parasitised *Sitotroga* eggs was held to determine the percentage emergence of wasps and their sex ratio. The release rate was equivalent to 1.4 female wasps per cotton plant. Brown eggs were randomly collected prior to the release of the wasps, and on days 1,2,3 and 6 after the release. The eggs were incubated in a constant temperature room at 25°C and 60% R.H. to determine parasitism levels. The species of wasp emerging from each parasitised egg was also recorded.

Findings

Heliothis infestation was low during the trial (0.3-0.8 eggs per plant), but had previously been negligible. The level of egg parasitism rose markedly two days after release (DAR) in both sites (Figure 1), and was 20% higher in the release site. *T. pretiosum* was recovered from the release site only, and accounted for 42.5% of eggs parasitised 2 DAR (Figure 2). *Trichogrammatoidea bactrae* was the dominant species of wasp recovered throughout the trial, especially from the control site.

Implications fo Pest Management

The recovery of *T. pretiosum* from the release site indicated that the wasps had successfully emerged and attacked heliothis eggs in the field. *T. pretiosum* accounted for more than 40% of recovered eggs 2 DAR, and contributed an additional 20% to the overall egg parasitism. Such an increase may be important at near threshold egg densities. Interestingly, natural levels of egg parasitism, due largely to the native wasp *T. bactrae*, increased markedly approximately two days after heliothis egg laying commenced. This suggests that the wasps were attracted to the crop following the start of egg laying and, in the absence of chemical insecticides, were able to attack heliothis eggs.

The logistics involved in producing *Trichogramma* for inundative releases is a major limitation for using this tactic in broadacre cropping. Inoculative releases into crops to establish local populations of *Trichogramma* may be worthwhile, but would still require substantial production of wasps. *In vito* production of *Trichogramma* is currently being investigated by researchers at the University of Queensland and, if successful, may make wasp releases into broadacre crops a viable tactic.

The utilisation of naturally occurring *Trichogramma* seems a more realistic option for cotton. In this trial the impact of the naturally occurring wasps (up to 66% egg parasitism in the control site) and other beneficial insects and spiders, along with the use of the specific heliothis virus NPV, was sufficient to prevent heliothis from exceeding threshold densities. It seems likely, therefore, that natural populations of egg parasitoids can be used in heliothis IPM programs, particularly in Queensland where large numbers occur naturally at certain times of the year.

The successful utilisation of natural populations of *Trichogramma* wasps is dependent on the assessment of their activity. Parasitised eggs are currently recognised when they turn black, approximately 4 days after being attacked. Healthy eggs can hatch in 2-3 days during summer, i.e. they hatch before parasitism is determined. A method for discerning parasitised eggs from healthy eggs in the field would be a valuable tool for pest managers because it would provide an indication of egg mortality and evidence for not having to apply chemical insecticides.

Acknowledgements

We acknowledge the technical support of Sue Maclean, and the support of the cooperating growers Bill and Win Arthur. This research was funded by the Cotton Research and Development Corporation.

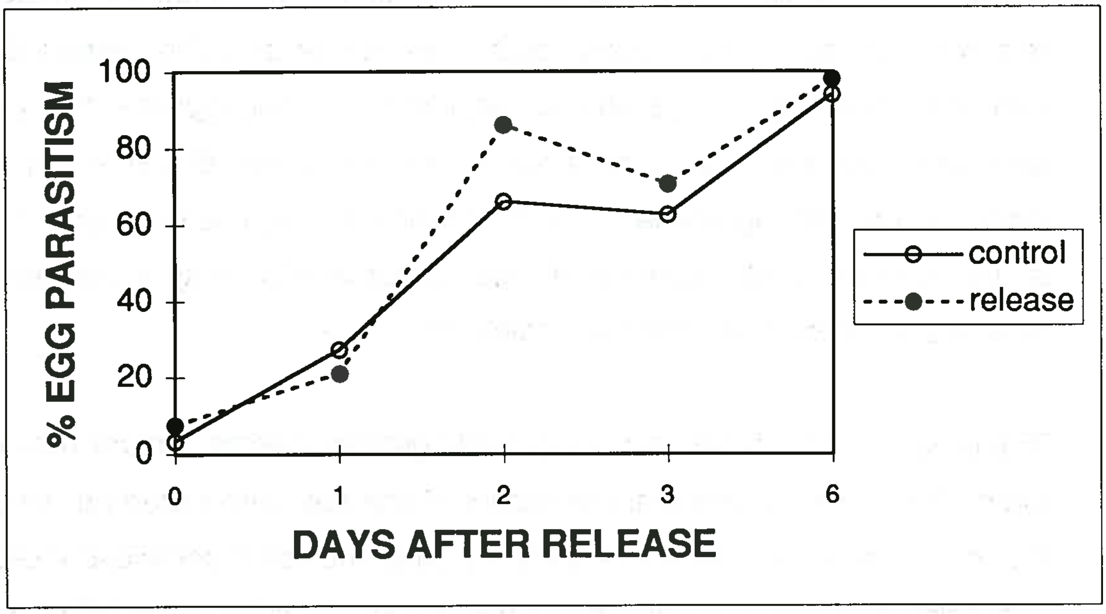

FIGURE 1: Heliothis egg parasitism in cotton at Nandi on the Darling Downs. *Trichogramma pretiosum* were released at a rate equivalent to 1.4 females per plant.

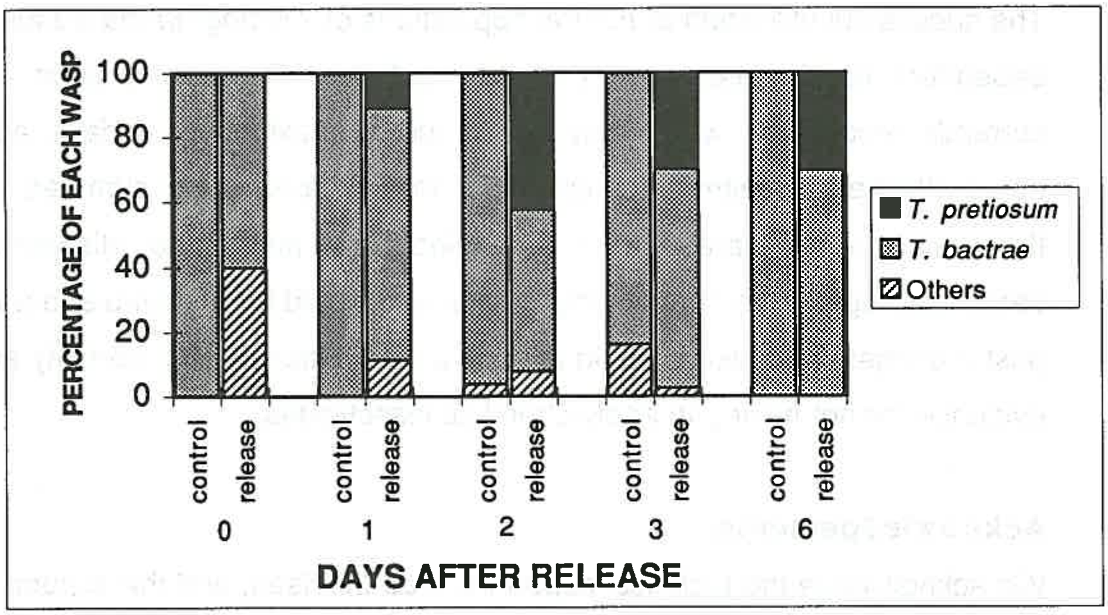

FIGURE 2: The species of egg parasitoids recovered from cotton at Nandi. *Trichogramma pretiosum* were released on 28 February 1995.

The seasonal abundance of *Trichogramma pretiosum* in cotton grown with different pest management strategies in the Ord River Irrigation Area (ORIA).

Geoff Strickland[1] and Ian Lacey[2]

[1] *Agriculture WA, Baron-Hay Court, South Perth. WA 6151*
[2] *Agriculture WA, PO Box 19, Kununurra. WA 6743*

Introduction

Following the collapse of commercial cotton production at the ORIA in 1974, two years of integrated pest management (IPM) research commenced. The project demonstrated that *Helicoverpa* could be adequately controlled through the judicious use of selective insecticides, *Bacillus thuringiensis* and releases of the egg parasitoid *Trichogramma pretiosum* (Michael & Woods, 1980). *T. pretiosum* was imported from the USA and mass reared for inundative release in the experiments at Kununurra. Very high levels (often >90%) of *Helicoverpa* and *Anomis* (cotton looper) eggs were parasitised by *Trichogramma* which was considered to be the most important beneficial insect species acting against *Helicoverpa.*

New cotton research commenced in the ORIA during 1994, and is predicated on determining a more biological stable production system than the pesticide dependent approach of the past. Key elements for the new industry will include a winter growing strategy (to minimise insect pressure); the use of transgenic varieties; a resistance management policy and maximising the contribution of beneficial insects to an IPM system. Egg parasitoids (*Trichogramma*) are abundant in the ORIA on a wide range of crops and an understanding of their biology and population dynamics is critical to the development of an IPM system. The aim of this experiment was to measure the parasitism of *Helicoverpa* spp eggs by *T. pretiosum* in three different pest management situations.

Methods

Three blocks of cotton (Siokra 1-4) were sown on 8 April, 1994 and, apart from insect pest control, were 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. In each block the crop was scouted twice weekly according to entomoLOGIC protocols but thresholds were actioned differently according to the different pest management scenarios. Obviously, the no spray treatment received no insecticide throughout. In the low spray area, mirid thresholds were ignored but *Helicoverpa* thresholds resulted in an endosulfan spray if the threshold was exceeded in two consecutive scoutings; whilst the conventionally managed area received an appropriate application of insecticide on every occasion that any pest threshold was reached. This resulted in vastly different spray frequencies - the low spray area received five endosulfan, one Bt and one pirimicarb spray; whilst the conventional spray zone had thirteen sprays of conventional insecticides.

Helicoverpa eggs were collected from each of the treatments (described above) on a weekly basis and returned to the laboratory for incubation. At least 100 eggs per treatment were collected and the eggs were individually confined to wells within a plastic tray covered with cling wrap. After approximately two weeks the eggs were examined under a microscope and recorded as “parasitised” if

Trichogramma had emerged; "hatched" if *Helicoverpa* had emerged; or "failed" if the egg was unproductive.

Results and Discussion

Parasitism of *Helicoverpa* eggs by [1]*Trichogramma pretiosum* was shown to be the most significant biological factor reducing the hatchability of the pests' eggs. Parasitism levels exceeded 90% at times and, in the low spray zone, averaged 70% throughout the season. These results are similar to those reported by Michael & Woods (1980) who conducted their research during the traditional summer cropping season and indicates that *T. pretiosum* are active parasitoids throughout the year.

Figure 1. *Trichogramma* parasitism of *Helicoverpa* eggs in cotton grown with different pest management strategies, 1994.

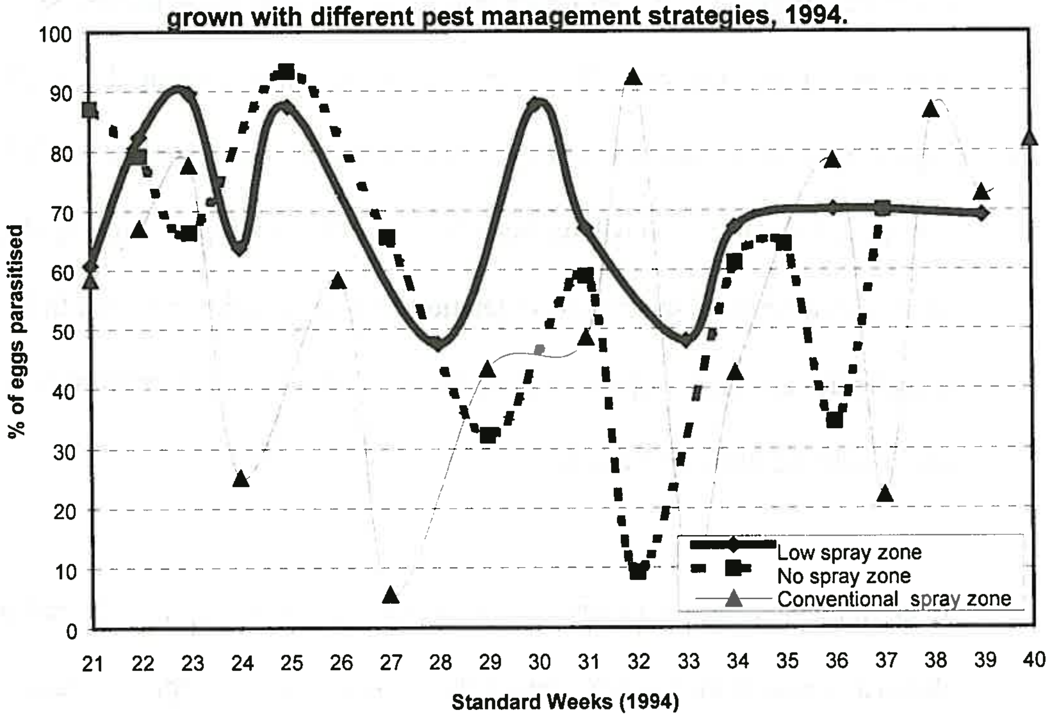

Figure 1 summarises the fluctuations in *T. pretiosum* parasitism levels throughout the season in the different pest management situations. The possible reasons for the variations in parasitoid activity are many and include host egg density, climate and several biotic factors. However it also clear that the pest management actions in the different zones have also impacted on *T. pretiosum* abundance.

The conventionally managed zone received 13 sprays of broad spectrum insecticides. This probably caused a generally lower level of parasitism than in the low spray and no spray areas, particularly in the early part of the season. Parasitism levels also fluctuated widely from week to week often in response to insecticide applications. For example, a parasitism level of 92% reduced to 9.8% nine days after an application of ULV Curacron. However, not all of this decline could be attributed to the influence of the insecticide because the low spray and no spray zones also had markedly lower levels of parasitism during that week. *T. pretiosum* demonstrated the ability to recover rapidly from chemically induced declines although this may have been facilitated by small plot sizes and large surrounding areas of unsprayed vegetation. The interaction between field applied insecticides and their impact on *T. pretiosum* population dynamics is an important area requiring further research.

Even in the absence of insecticides in the no spray zone, egg parasitism levels fluctuated widely between 9% and 93%. This result was surprising because it was assumed that *T. pretiosum* activity would be maximised and most uniform in the unsprayed cotton. The very poor, stunted growth of the unsprayed plants under

---

[1] *T. pretiosum* was identified by Pinto et al (1993) and was the dominant species from *Helicoverpa* eggs.

the burden of heavy mirid, aphid and leafhopper infestations may provide an explanation. Most plants were less than 50 cm high but the occasional plant produced a tall "shoot" of growth and it was on these "shoots" that the majority of *Helicoverpa* eggs were deposited. Honey-dew, interference from the dense populations of sucking insects, the sporadic *Helicoverpa* oviposition pattern and unthrifty plant growth may all have hampered the vigour and searching ability of *T. pretiosum* and contributed to the lower than expected parasitism rate.

The low spray zone provided the conditions which were most favourable to *T. pretiosum* activity. Egg parasitism levels ranged between 50% to 90% and were far less variable than the other treatments. It is clear that the benefits of *T. pretiosum* can be maximised by minimising the number of broad spectrum insecticide applications whilst maintaining healthy plant growth.

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.

Pinto, J.D., Platner, G.R., Sassaman, C.A. (1993). Electrophoretic study of two closely related species of north American *Trichogramma*: *T. pretiosu*m and *T. deion* (Hymenoptera: Trichogrammatidae). *Ann. Entomol. Soc. Am.* **86(6):** 702-709.