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Controlling cotton pests with egg parasites

By W. Woods*

The failure of the cotton industry at Kununurra, on the Ord River in North Western Australia, is now a part of Australian history. It is well known that one of the most important reasons for this failure was the development of resistance to insecticides, by the cotton bollworm, Heliothis armiger. During the 1974 cotton season, most farmers sprayed 40 times against this pest, but did not achieve satisfactory control. Thus commercial cotton production ceased.

Not so well known is the success achieved on the Ord in 1975 and 1976 in large-scale experiments in which cotton was grown using an integrated control approach to pest management. Integrated control can be defined as "a pest population management system that utilises all suitable techniques either to reduce pest populations and maintain them at levels below those causing economic injury, or to so manipulate the populations that they are prevented from causing such injury" (Huffaker 1974).

On cotton at Kununurra this involved:

- regular sampling to determine numbers of pests, beneficial species and crop damage;
- mass culture and release of millions of tiny parasitic Trichogramma wasps, and
- the use of the selective insecticide chlordimeform (Trade name Fundal) and the biological insecticide Bacillus thuringiensis (Trade names Dipel, Thuricide).

Integrated control in practice

Every day entomologists would go out into the cotton crop, count insects and record crop damage. Both damaging and beneficial insects were counted. In this way they made an estimate of the 'balance' between beneficial and harmful insects. If beneficial insects were containing the pests, they took no action. But if pest numbers were beginning to outstrip those of the beneficials, or if economic damage was occurring, then a selective spray and parasite release was used to redress the balance.

Past experience, during the days of commercial cotton, had shown entomologists that native wasps of the genus Trichogramma would effectively reduce H. armiger numbers. Sorghum crops grown at this time, without insecticide application, escaped with little insect damage (Michael 1973). The pests were controlled by these minute wasps, so small that three could live inside each host egg. The adult wasps lay their eggs inside the cotton bollworm eggs, then the developing wasp larvae eat the contents, finally emerging as adults. In the days of commercial cotton crops, these wasps were killed by the insecticide applied against the pest.

To supplement these native wasps in the trial programme, Trichogramma species were imported from America, and millions were bred in insectaries at the Department of Agriculture, South Perth (Grimm and Lawrence 1975), and released at Kununurra.

Eggs of a grain moth were used as hosts. These eggs (containing developing wasps) were glued to cardboard and air freighted to Kununurra. There the cardboard was cut into 25 mm squares and placed in empty waterproof matchboxes, which were then distributed on a grid pattern throughout the cotton crop. On emergence, the tiny wasps would fly or walk through the cotton foliage, looking for H. armiger eggs to parasitise. Once parasitised these eggs acted as reservoirs of new parasites.

WaspS often parasitised over 90 per cent of the pests' eggs (Fig 1).

However the high number of H. armiger eggs laid on cotton at Kununurra allowed enough eggs to escape parasitism for the emerging larvae to destroy the crop. So from this point, the selective spray mixture of chlordimeform and Bacillus thuringiensis was used to redress the balance.

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*thuringiensis* was used to kill these unparasitised eggs and young pest larvae.

The mixture was very selective, only killing unparasitised eggs, while *Trichogramma* developing in parasitised eggs of *H. armiger* or another pest, *Anomis*, the cotton looper, were not harmed. The large numbers of *Anomis* eggs present were beneficial, as they enabled many more wasps to breed in the crop.

Entomologists calculated that up to sixteen million *Trichogramma* were emerging every week from pest eggs from each hectare of crop.

The effectiveness of this integrated control approach is obvious from a comparison of yields and pest numbers in the 1975 trial (Michael and Woods 1980). The broad spectrum insecticides parathion and chlorcam were applied to one area, and the selective spray mixture to another (Figs 2, 3).

Many people, reading this article, will wonder why, if the system worked so well, no cotton is grown commercially on the Ord today. The answer to this is that in 1976 another pest, the pink bollworm *Pectinophora gossypiella* emerged from under the insecticide umbrella, to become the key pest under the new system. It destroyed 100 per cent of cotton bolls in an unsprayed area and 40 per cent of the bolls in an area sprayed twenty four times with uneconomically high rates of the mixture.

This insect, a world-wide pest of cotton, always posed a serious threat to cotton production in the Kimberleys (Jenkins 1945) but was kept at low levels by the sprays used against *H. armiger*.

Thus cotton production at Kununurra remains trapped in a cleft stick. With spraying, pink bollworm could be controlled, but the resistant *H. armiger* would destroy the crop. If the crop were left unsprayed then pink bollworm would be very damaging. Meanwhile, entomologists the world over are seeking parasites to control the pink bollworm. Unfortunately their prospects of success seem remote.

However, the success in containing *Heliothis armiger* using integrated control, led the way to the present approach to pest control at Kununurra, (Robertson 1977) where many crops are being grown without resort to insecticide sprays, and *H. armiger* has become a minor pest.

References


