ENVIROFEAST® IPM IN COTTON: PART 2. USE OF LUCERNE AS REFUGIA FOR BENEFICIAL INSECTS IN COTTON

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Introduction

The cotton monocultural system in most of the production areas in Australia strongly discriminates against natural enemies and favours the development of pest outbreaks. Pest outbreaks in monocultural systems occur because insect predators and parasitoids usually have more complex food requirements than *Helicoverpa* spp. and most other phytophagous insects. The latter usually mate and oviposit without any feeding, relying only on reserves transferred from their larval food whereas predatory insects and parasitoids require different sources of food in larval and adult stages to develop and survive through the season. Thus pests like *Helicoverpa* spp. can rapidly infest crops through migration and lay their eggs with little opposition from natural enemies. To solve this problem the cotton system should be diversified by interplanting cotton with other crops. The alternate crop could serve as a refuge to beneficial insects. Crops like safflower, sunflower, sorghum, corn, tomato and lucerne have been studied for the past 4 years and lucerne was found to be suited for the cotton production system.

We report here studies to integrate lucerne into the Envirofeast® IPM program to serve as a refugia for beneficial insects.

HOW THE TRIALS WERE CONDUCTED?

Studies of beneficial insects on cotton and lucerne

In a study during 1992-93, lucerne was planted as strips 8 metres wide and 100 metres long in an irrigated cotton field at the Australian Cotton Research Institute. The lucerne strips were separated by 50 metre wide strips of cotton. The lucerne/cotton interplant was replicated three times across the field. The lucerne strips were irrigated at the same time as the cotton. One half of each lucerne strip were slashed every 4 weeks as in the lucerne mirid study (Mensah and Harris, 1996).

Predatory insects were sampled once every week from 2 November 1992 to 23 March 1993 using a D-vac portable suction sampler on both cotton and lucerne. At each sampling date, 20 metres of row were sampled in each crop. Predatory insects were counted and data recorded as numbers per metre.

Integration of lucerne with commercial cotton under an IPM regime

In 1994-95, a study was conducted in an organic cotton farm at Belleview near Warren. Two lucerne strips, each measuring 16 metres wide were planted as borders to 40 ha cotton. Two treatments - (1) Envirofeast® IPM managed cotton and (2) an unsprayed cotton (control) were set up in each lucerne/cotton interplant. The Envirofeast® IPM treatment was applied to 38 ha of the cotton area and the remaining area of 2 ha was left unsprayed. The reason was that the grower was reluctant to leave a larger area of his property unsprayed. The two treatments were replicated three times across the field. This was compared with three conventional insecticide managed fields located 200-400 metres from the study site and managed by the grower.

Predatory insects were sampled from 20 metres of row in each treated plot and the lucerne strips using a Dvac sampler. The samples were taken between 18 November 1994 and 22 March 1995. Insect numbers were expressed as numbers per metre.

Results

The most important predators identified from plots, are given in Table 1. High predator numbers were recorded in the lucerne strips early in the season reaching a peak of 2.25 per metre on 10 November before declining (Figure 1). The decline in the predator numbers in the lucerne strips corresponded with an increase in cotton. The number of predators peaked at 2.20 per metre on 1 December (Figure 1). This indicates that the lucerne was acting as a refuge providing a good source of beneficial insects to the cotton. The population of predatory insects in both lucerne and cotton declined after the peak densities were reached due to frequent insecticide drift into the study site. However, predator numbers in the lucerne strips was stabilized at approximately 1 per metre after 23 December even when predators were not found in cotton.

At Bellevue study site, Envirofeast® IPM sprayed plots had the highest number of predators, followed by the lucerne strips and the unsprayed (control) with the conventional managed cotton having the lowest number of predatory insects (Figure 2 A and B). At the end of the study, the Envirofeast® IPM managed plots had 4 times more predators than the unsprayed plots as a result of the Envirofeast® spray (Figure 2B). The Envirofeast® spray attracted and conserved predatory insects from both the unsprayed and the lucerne strips. At the start of the season, i.e 18 November, the lucerne strips had the highest number of predators (approximately 1.0 per metre) but this declined on 24 November and 2 December when Envirofeast® spray was applied resulting in a corresponding increase in predator numbers in the Envirofeast® IPM plots (Figure 2). The predator numbers in Envirofeast® IPM cotton peaked on 16 December at 1.5 per metre, falling slightly after this date until 24 January when severe reductions across all treatments were experienced due to insecticide drift. Numbers of beneficial insects remained very low until the end of the season, when insecticide applications around the area ceased and predator population had the chance to rebuild.

Similar results which have not been reported in this paper were obtained in trials at Alcheringa, Norwood, Auscott (Narrabri) and Auscott (Warren).

DISCUSSION

This study indicated that lucerne crop grown as strips within commercial cotton can serve as a refugia to generate beneficial insects in cotton. However, movement of predators from lucerne into cotton is unlikely to occur without the encouragement of a mechanism to move them about (Figure 1 and 2). Envirofeast® is known to attract and conserve predatory insects (Mensah and Harris, 1994, 1995) and in this study, encouraged some of the predators to move into the IPM cotton resulting in higher predator numbers than in the unsprayed cotton which had no Envirofeast® (Figure 2). The use of lucerne crops as strips to generate beneficial insects especially early in the season, as indicated in this study, is important for the management of *Helicoverpa* spp. in cotton. This is because *Helicoverpa* spp. can rapidly infest crops through migration from other sources, especially early in the season, and unless natural enemies are present and well established before the pest arrives they cannot respond rapidly enough to achieve pest control. Any technique that could establish natural enemies in high numbers in cotton farms early in the season before the major pest arrives will be beneficial to cotton production in Australia in terms of pest management (Murray and Mensah, 1996).

Cotton is grown as a short lived annual crop and so the predatory insects fly periodically to new host locations as the crop matures. The lucerne crop was a permanent refugia for the predatory insects during and after the cotton season. In this study we have artificially diversified the system to help build up beneficial insect numbers in cotton as well as control green mirids (Mensah and Harris, 1995, 1996). We therefore conclude that lucerne crop could be planted as strips within cotton to generate beneficial insects.

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Table 1. Major predators identified from study plots at the Australian Cotton Research Institute and Bellevue, 1992-94.

Order	Family	Species
Coleoptera	Coccinellidae	*Harmonia arcuata* (Fabricius)
		Adalia bipunctata (Linnaeus)
		Coccinella transversalis (Fabricius)
	Melyridae	*Dicranolauis bellulus* (Guerin)
Hemiptera	Nabidae	*Nabis capsiformis* (Germar)
	Lygaeidae	*Geocoris lubra* (Kirkaldy)
	Pentatomidae	*Cermatulus nasalis* (Westwood)
Neuroptera	Chrysopidae	*Chrysopa* spp.
	Hemerobiidae	*Micromus tasmaniae* (Walker)
Araneidae	Lycosidae	*Lycosa* spp.
	Oxyopidae	*Oxyopes* spp
	Salticidae	*Salticidae* spp.
	Araneidae	*Araneus* spp.

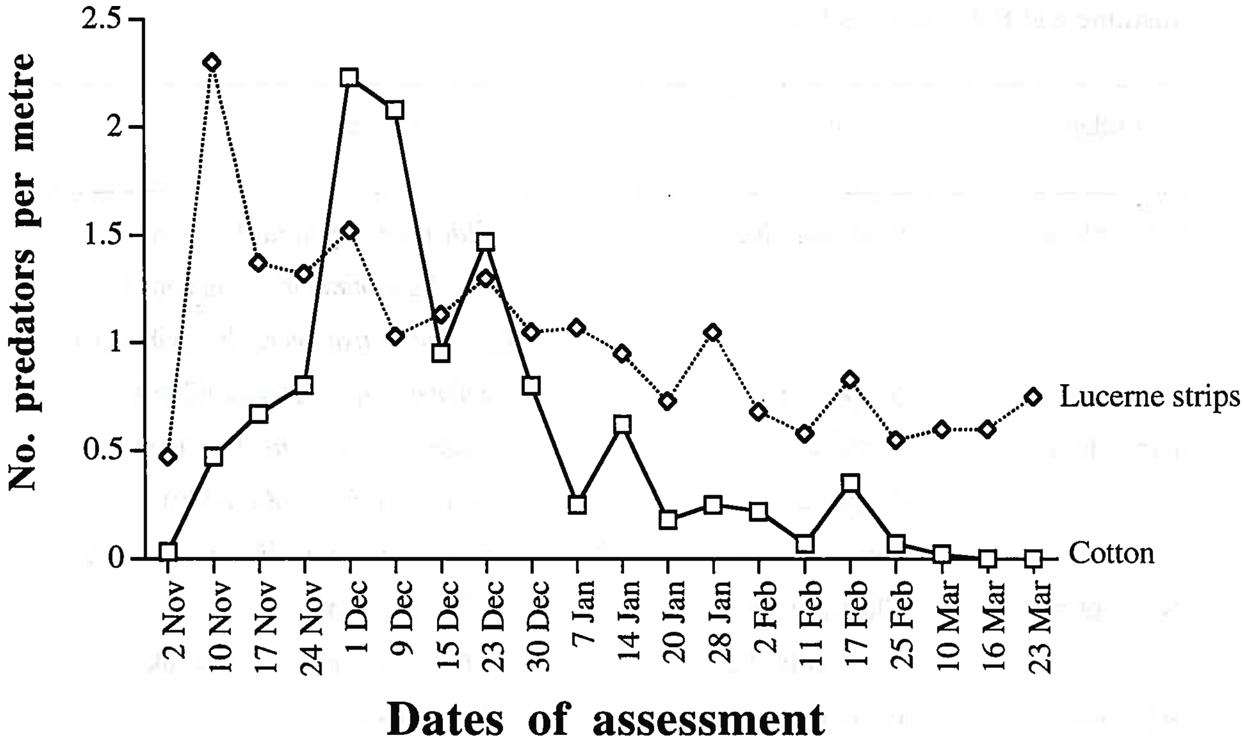

Fig. 1. Numbers of predatory insects in lucerne strips and in cotton at the Australian Cotton Research Institute farm at Narrabri, 1992-93.

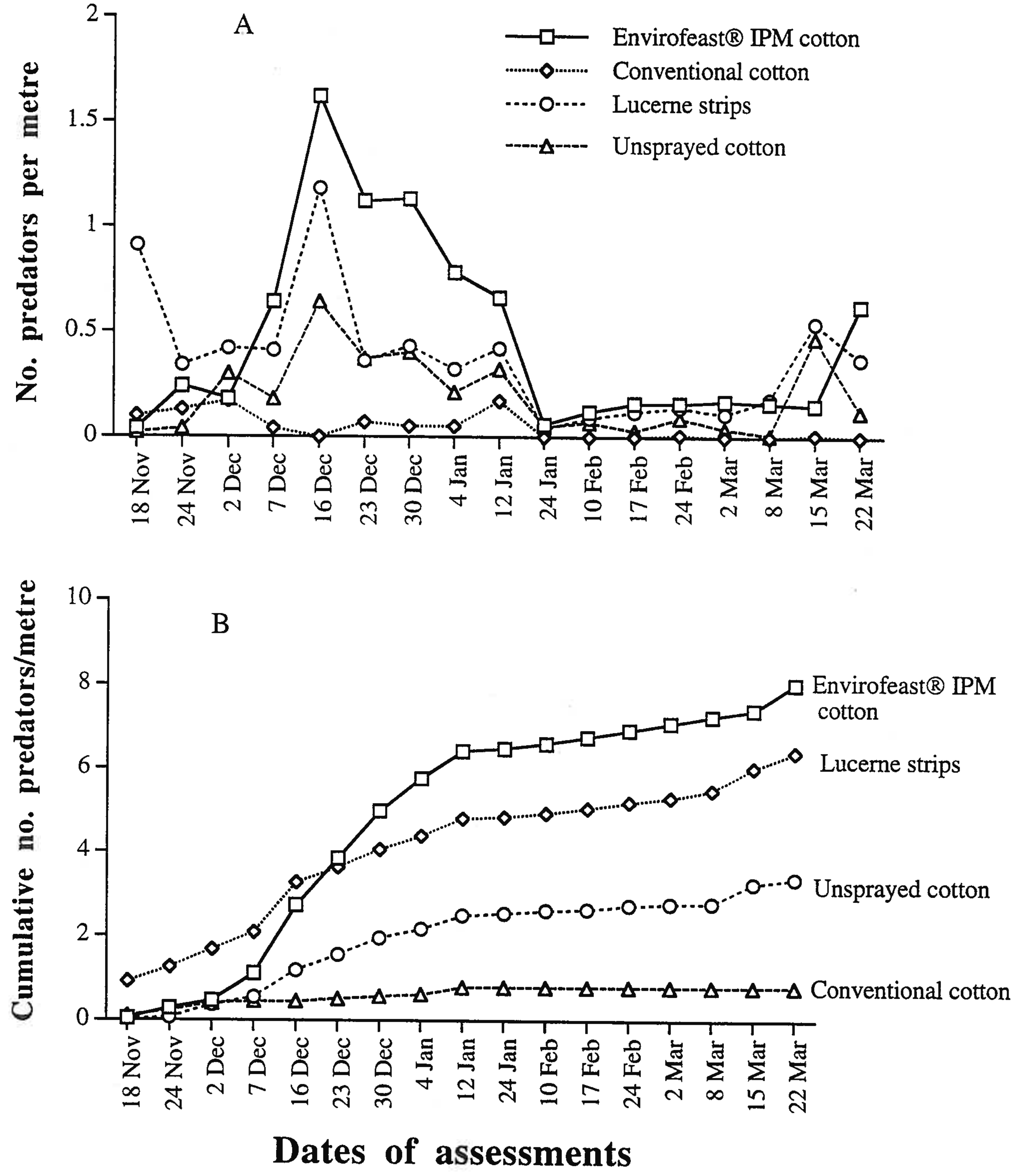

Fig. 2. Number of predatory insects in lucerne and cotton under conventional, Envirofeast® IPM and unsprayed regimes at Bellevue near Warren, 1994-95.