Refuge crops provide refuge for more than Helicoverpa

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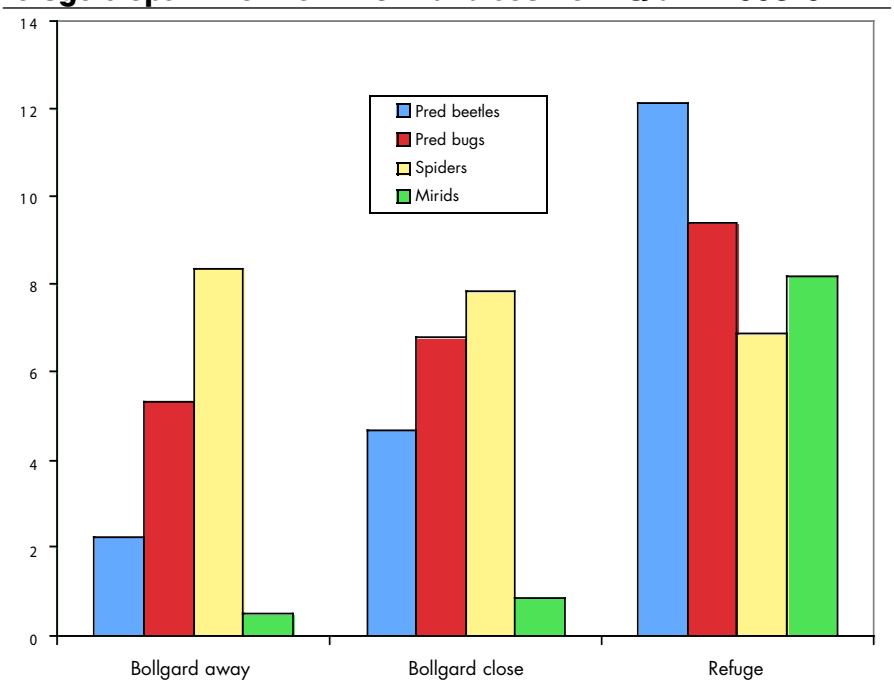
Since the introduction of Bt cottons, pest management practices in cotton growing areas have changed significantly. There has been a substantial reduction in the amount of pesticide used and the chemicals in use are generally softer and hence less disruptive to non-target species.

This has brought about a renewed interest in managing and encouraging beneficial invertebrates, both parasites and predators, as part of control management strategies for *Helicoverpa spp*. and secondary pests such as mirids. The dominance of Bt cotton on the landscape has given growers an ideal platform for IPM, but the potential for the pest moths to develop Bt resistance is a major concern.

As part of a detailed strategy to manage Helicoverpa resistance to Bt, cotton growers are required to plant refuge crops. The role of these crops is to produce susceptible moths to mate with potentially resistant moths from the Bt cotton. But refuge crops also have the potential to produce significant numbers of other invertebrates — both pest and beneficial. Secondary pests such as green vegetable bug and mirids might well take advantage of unsprayed refuges.

A red and blue beetle.

FIGURE 1: Abundance of selected canopy invertebrates in Bollgard II (and occasional Ingard) cotton crops and associated refuge crops in northern NSW and southern Qld in 2003–04



The Bt cotton crops were sampled both near the edge closest to the refuge crop with samples taken 50–200m into the cotton field and further into the field (>200m from the same edge).

In a recent CRDC-funded project looking at the efficiency of refuge crops and changes in Helicoverpa populations at landscape scale since the introduction of Bt cottons, CSIRO researchers Dr Geoff Baker and Colin Tann took the opportunity to also collect information on the abundance of these other invertebrates both in refuge crops and Bt cotton. The fields were surveyed over three growing seasons using suction sampling and visual observations.

Their results showed that, just as *Helicoverpa spp*. numbers varied markedly between years and habitats, so did their parasitoid populations. Parasitoids found attacking Helicoverpa eggs and larvae included Tachinid flies and various wasps. Field collected Helicoverpa larvae brought into the lab to be reared through to adult moths frequently died from various diseases, particularly viruses.

Table 1 lists the invertebrate groups, other than parasitoids, found during the surveys of the canopies of Bt cotton crops and their associated refuge crops (mostly pigeon pea) during one season (2003–04). In both the Bt cotton crops and nearby pigeon pea refuge crops, red and blue beetles, damsel, big-eyed and apple dimpling

bugs, lynx and flower/crab spiders, mirids, thrips, jassids and whiteflies were among the most commonly encountered groups (not including *Helicoverpa spp.*) during this particular season.

In 2004–05 and 2005–06, more or less the same groups predominated, with the exception of a relative scarcity of damsel bugs, big-eyed bugs and apple dimpling bugs, mirids and whitefly compared with 2003–04.

Figure 1 illustrates the abundance of selected invertebrate groups collected by suction sampling within Bollgard II (and occasionally Ingard) crops and their associated refuges (always pigeon pea) in 2003–04. The Bt cotton crops were sampled both near their edge (the edge closest to the refuge crop with samples taken 50–200 metres into the cotton field) and also further into the field (>200 metres from the same edge).

While there was no evidence of any difference in the abundance of spiders across these three habitats, predatory beetles were consistently more abundant in the refuge crops compared with the Bollgard II crops, and more abundant near the edges of Bollgard II crops compared with further into such crops.

Predatory bugs and mirids were more abundant within the refuge crops compared with Bollgard II crops, but there was no evidence of them varying in abundance within the Bollgard II crops in a similar way to the predatory beetles. The other two years (2004–05 and 2005–06) showed the same trends.

So the project provided data to indicate that refuge crops can support significant populations of secondary pests (such as mirids) and beneficial species (such as predatory beetles) of importance in cotton production. Refuge crops may be sources of mirid and beneficial species that are recruited to cotton crops, but direct movement studies are needed to confirm this. An alternative explanation could be that refuge crops attract key invertebrates away from cotton.

The study begs the question of whether predatory/parasitic beneficial species in refuges represent net benefits on the landscape or do they, in fact, significantly hinder the productivity of refuges — which are intended to produce high numbers of *H. armigera*.

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TABLE 1: Predatory invertebrates (and some secondary pests) in Bt cotton and associated refuges in northern NSW and southern Qld 2003–04 (numbers in brackets show sampling occasions)

Taxa	Bt Cotton (41)	Pigeon pea (34)	Unsprayed cotton (5)	Sorghum (6)
Beetles				
Anthicus sp.	19	18	3	6
Red & blue	37	32	4	6
Green soldier	2	4	0	0
2 spotted ladybird	13	8	2	4
Transverse ladybird	5	4	2	3
Striped ladybird	4	3	1	0
3 banded ladybird	7	4	2	4
Variable ladybird	2	2	0	1
Spotted ladybird	4	3	1	2
Hippodamia ladybird	14	12	2	3
Ladybird larvae	1	1	0	3
Stethorus sp.	6	2	0	2
Bugs				
Brown smudge	6	4	0	4
Glossy shield	2	5	1	0
Predatory shield	8	11	1	3
Damsel	33	34	5	2
Pirate	20	12	1	5
Assassin	1	0	0	0
Big-eyed	36	15	3	5
Apple Dimpling	36	32	3	3
Lacewings				
Green	16	19	2	2
Brown	11	6	1	4
Lacewing larvae	21	12	3	1
Spiders				
Lynx	40	33	5	6
Night stalkers	22	16	4	3
Tangle web	15	2	3	3
Jumping	27	7	2	5
Flower/crab	33	28	4	3
Orb weaver	12	6	4	1
Others				
Hoverfly larvae	6	2	1	0
Ants	10	13	1	2
Mirids	28	30	3	3
Green vegetable bug	4	4	1	0
Thrips	37	34	5	6
Aphids	13	1	1	5
Jassids	40	33	5	6
Mites	1	1	0	0
Whitefly	31	15	4	0