Catching Helicoverpa survivors on Bollgard II with green lacewing

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Widespread adoption of Bt (Bollgard II) cotton has led to a dramatic reduction in insecticide use in Australian cotton. CSIRO research has shown that Bt cotton does not affect the survival of most beneficial species, and their numbers are higher in comparison with conventional cotton because of the reduction in insecticides.

But can we be sure these beneficials are still doing the same job in controlling pests in Bt cotton? Do we know their behavioural patterns and prey consumption rates are similar in Bt compared to conventional cotton?

Some preliminary experiments by PhD student Habibullah Bahar and his supervisors at the University of New England indicate that at least one beneficial, the green lacewing, *Mallada signata*, is still doing the job in Bt cotton.

Green lacewings are commonly observed by growers and consultants in our cotton fields. The photos on page 14 show lacewing larvae avidly devouring the hapless eggs and 1st instar Helicoverpa larva. Lacewings are commonly identified as small (15 mm long), iridescent green adults flying about in fields or on windows near lights at night. Their larvae are voracious predators that move around the plant and pierce their prey from both sides with hollow mandible-like jaws, and suck the contents out.

Habibullah Bahar observing lacewing larvae as they search for Helicoverpa caterpillars on cotton in growth cabinets at the University of New England. (Photo G Henderson)

We set up eggs and newly hatched larvae on leaves or whole plants of Bt and conventional cotton, then released lacewing larvae to hunt them down. Early trials using single leaves of cotton in small arenas showed at least as many eggs and larvae were fed on by the lacewings whether the leaves were from Bt or conventional cotton varieties.

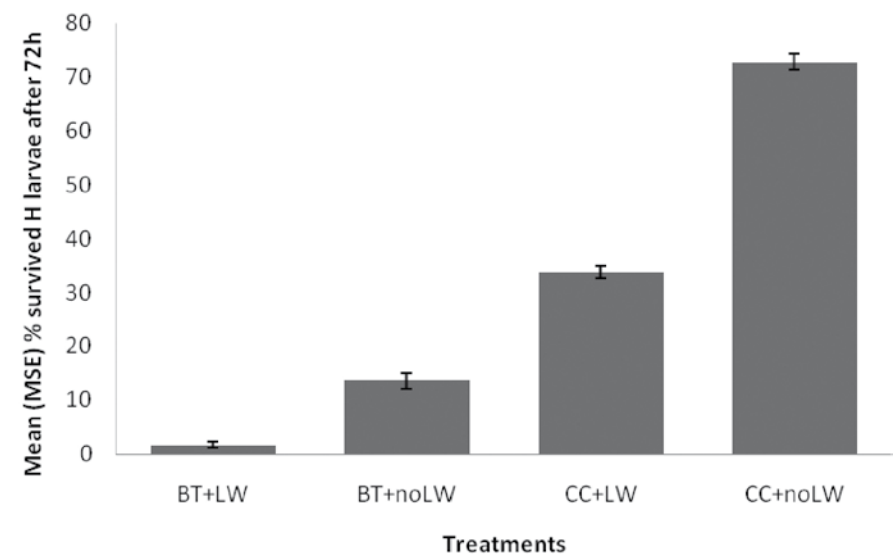
In fact, in the first experiments, feeding on 1st instar Helicoverpa caterpillars was 20 per cent greater on Bt leaves, sparking speculation that the lacewings somehow found the caterpillars more easily on Bt foliage, perhaps because the caterpillars keep moving, in search of a better place to feed on the cotton without exposure to Bt toxin.

Of interest is the ability of the lacewing larvae to search places Helicoverpa might hide across the entire plant – whether Bt or conventional.

Reports of survival of Helicoverpa larvae on Bt cotton in commercial crops have rekindled interest in finding ways to mop up those survivors.

One hypothesis to explain survival of non-resistant caterpillars on Bt cotton is that survivors might be feeding on reproductive parts (squares, flowers and bolls) where Bt toxins are less strongly expressed. If lacewings preferentially

FIGURE 1: Surviving Helicoverpa larvae on Bt (BT) and conventional cotton (CC) plants in presence or absence of green lacewing larvae (LW) after 72 hours



searched these areas, it might result in better biological control on Bt cotton than on conventional.

Behavioural analysis by Habibullah indicated no differences in the way the lacewings search both cottons, feeding on the caterpillars whether they were on the flowers, squares, bolls, petioles, leaves or stems. The lacewings spent relatively more time searching reproductive parts compared to vegetative parts, whether they were on Bt or conventional cotton.

With or without lacewings

We next did experiments to determine the survival of Helicoverpa larvae over their first three days, on Bt and conventional cotton, with and without lacewings. Figure 1 clearly shows that far fewer insects survived on Bt cotton than on conventional plants, as is expected (14 per cent compared to 73 per cent, but note that this is after only three days, and eventual mortality due to Bt is likely to be higher than this).

Similarly, lacewings alone caused 39 per cent mortality, reducing the survival of Helicoverpa larvae from 73 per cent to 34 per cent (such as from 37 to 17 surviving, out of 49 released). The encouraging result is that the two sources of mortality, Bt and lacewings, were synergistic.

Combining the two resulted in not just the sum of mortality that might be expected (that is, lacewings killing 39 per cent of the 14 per cent of larvae surviv-

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Lacewing larva feeding on 1st-instar Helicoverpa larva.
(Photo H Bahar and G Henderson)

Lacewing larva feeding on Helicoverpa egg.
(Photo H Bahar and G Henderson)

◁13...CATCHING HELICOVERPA

ing Bollgard II, leading to a final survival of about nine per cent).

But additional mortality occurred, producing a dramatic reduction in survival. The presence of two lacewing larvae reduced the survival on Bt cotton, at day three, from 14 per cent to two per cent (such as from 8.3 to one surviving, out of 49 released).

This synergistic effect between resistant varieties (whether transgenic or not) and biological control agents is at the core of many powerful IPM systems, for cotton and many other crops. How can we best exploit it for Australian cotton? Green lacewings are commercially available in Australia and while not widely used in deliberate releases in cotton, they are being released in other crops.

But it may not be necessary to release lacewings, since they may already be present in the crop. They feed on aphids and mites and as a general predator can be present in a crop feeding on these insects before Helicoverpa arrives.

Conserving green lacewings through careful choice of insecticides, avoiding those listed as having high toxicity to lacewings in the Cotton Pest Management Guide, is an obvious step.

More generally, following IPM principles is at least as important in Bollgard II cotton as it is in conventional cotton. Perhaps other beneficial insect species show the same kind of synergism with Bt as lacewings do.

Recent Cotton CRC research (Sharon Downes and Gavin Whitburn) indicates that some 15 per cent of Bollgard II cotton carried Helicoverpa larvae at threshold levels over the past three years. Many of these fields are being sprayed with cheap, but non-selective, insecticides such as pyrethroids.

In doing so, growers are being denied the benefits of the synergistic effects of predatory insects such as lacewings (not to mention the valuable contribution to control of secondary pests such as aphids, mites and whiteflies).

Further, while current research does not yet indicate a significantly higher frequency of Bt resistance among Bollgard II survivors than among the general Helicoverpa population, it is very likely that any resistance problem will arise through these survivors. We should be making more use of our beneficial allies (lacewings and others) in Bt cotton, just as we should in conventional cotton!

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