SOME BIOLOGICAL OPTIONS

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Nowadays, most of us are aware that natural enemies (parasites and predators) sometimes play an important role in the control of pests attacking our crops. As sure as heliothis will infest our cotton next season, we can be just as sure that parasites and predators will be there too - if they are given a chance! The problem is that we simply don't have the confidence to rely on natural enemies because we don't know enough about them. Where the risk is high, producers understandably are reluctant to take chances, and opt for the tried and proven method of pest management - insecticides.

But this situation is changing. Resistance to insecticides has developed, human safety and the environment are major concerns, insecticide costs are increasing, and so on. We don't need to dwell on these issues. Opportunities are there to develop alternative management tools, and we must embrace their prospects.

Is there a place for biological control?

Natural enemies in cotton have a place only if certain disruptive insecticides are removed from regular use, or are retained only for late season use. Many of the insecticides in use today have a broad spectrum of activity, killing beneficials as well as the target pest. There are very real prospects that less disruptive (or even innocuous) yet still very effective products will become available to pest managers. For example, *Bt*'s have gained much wider acceptance in recent years, and fit in comfortably with a program that strives to retain natural enemies.

Natural enemies will certainly play an important role where yield expectations place less stringent demands on fruit retention. Where yield expectations are high, natural enemies may be less acceptable. This is because invariably some fruiting structures will be lost before parasites and predators effect control, and under high yield goals, compensation for these losses may not occur (Brook and Hearn 1992).

Which biological agents?

Natural enemies can be divided into two groups - predators and parasites. Predators seek out prey as "food". As part of their daily activities, heliothis predators consume eggs, larvae, pupae or moths. Most predators are not fussy eaters and will eat whatever prey are available. Thrips are an interesting case for as well as being important early season predators of spider mites, they are considered seedling pests (Wilson 1991).

Parasites tend to be more selective than predators and attack only a particular life stage of their host. For example, the larval parasite *Microplitis* lays its egg in the second or third instar heliothis larvae. The parasite develops inside the heliothis caterpillar, ultimately causing the host's death during the fourth instar (see Murray and Rynne 1992). There are separate egg, larval and pupal parasites of heliothis, and some of these parasites will also attack hosts other than heliothis. This feature can be useful, for it may allow the parasite to survive periods when heliothis are not abundant.

In attempting to manage heliothis in the cotton crop, the best beneficials will be those that kill heliothis larvae before they do too much damage. From that viewpoint, beneficials attacking the eggs or young larvae are preferred. Parasites attacking the pupal stage don't directly reduce damage to the crop, but they may be important in reducing the size of the population in the next generation.

How can we use natural enemies?

There are three basic ways to use natural enemies - conservation, augmentation and inundation. The main thrust in cotton has been to conserve predators and parasites already present in the crop, especially early season. This can be done by using selective insecticides; ones that will kill the target pest but not harm the natural enemies. *Bt* is the best example of a "soft" option that will conserve beneficials. Any new insecticides should ideally have similar attributes.

It is important to realise that if there are no prey or hosts in the crop, then there will be few predators and parasites there too. This presents a dilemma. Heliothis is so mobile that it can suddenly enter and rapidly increase in numbers in a crop and the natural enemies will lag behind. The delay between the arrival of heliothis and the appearance of natural enemies may result in serious crop damage. The supply of alternative "food" and application of behaviour-modifying chemicals could be used to retain natural enemies which would normally disperse if food or hosts were scarce.

In regions such as the Namoi Valley which essentially have a cotton monoculture, the refuges for natural enemies are somewhat limited. In contrast, a more diversified cropping region such as the Darling Downs provides abundant refuges where natural enemies can be conserved. However, these refuges may also serve as nurseries for heliothis.

As well as conserving natural enemies already present in a crop, augmentative or supplementary releases can be used to boost populations. This tactic is to introduce the natural enemies so that they will increase in numbers earlier than if they were left to their own devices.

The final way to use natural enemies is to make inundative releases of laboratory reared insects. Pest numbers are overwhelmed by the sudden appearance of large numbers of natural enemies. This is the tactic suggested for egg parasites. The high release rates normally used dictate that cost effective production technology must be available. Such is the case for *Trichogramma*.

What are the problems with biologicals?

When natural enemies (essentially predators) are found during scouting of a crop, what will be their impact on an egglay? The quantitative data needed to assist this type of decision-making are simply not available at present.

During normal scouting operations, there is no immediate observable difference between parasitised and unparasitised life stages. The evidence of parasite activity becomes apparent only after several days. For example, parasitised eggs turn black after about 4 days, but by this time unparasitised eggs have hatched. Given this scenario, managers need confidence in the ability of beneficials. If egg parasites are to replace insecticides, releases must achieve parasitism levels approaching mortality levels obtained with insecticides.

At present, cost effective production of natural enemies for use in cotton is achievable only for egg parasites. Other parasites are too costly to produce to consider them for inundative release. Improved rearing technology, which could involve *in vitro* methods, will assist investigations into augmentative and inundative release tactics.

Conclusion

Our knowledge of natural enemies has increased rapidly due to recent research, but we still do not have the quantitative support for biological options in cotton. Confidence in their ability to reduce pest infestations will come only through further detailed research and a better understanding of the complex interactions taking place in the cotton crop.

The future for pest management in cotton lies in totally integrated packages that pay more than just lip service to the alternatives to insecticides. Management must embrace all prospects - host plant resistance, microbials, biologicals, cultural methods, insecticides - if cotton production is to be sustainable.

References

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