RESEARCH REVIEW

Australian Cotton Cooperative Research Centre

Mirid Management in Australian Cotton

Outcomes from the Mirid Management Workshop, 15 July 2004

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Insects

Introduction:

This is a companion document to Mirid Ecology in Cotton and covers sampling and control measures for mirids in Australian cotton.

Mirid Sampling

Mirids are very mobile pests and populations can fluctuate rapidly, so sampling needs to take place every 3 days.

Using 'beat sheets' is the quickest and most consistent method of sampling these highly mobile insects. When plants have less than 9 nodes, beat sheets and visual checks give approximately the same estimates of mirid numbers. However, as plants grow beyond 9 nodes the beat sheets become more effective for sampling mirids and the ratio of mirids in visual counts to beat sheet counts is about 1:3. If using beat sheets the numbers should be adjusted accordingly as the thresholds are based on visual sampling. Sampling should occur 2-3 times per week, becoming more frequent when approaching a control decision.

Figure 1: Sampling for mirids using the beat sheet (Photo M. Dillon)

The number of beat sheet samples per management unit should be no less than what would have been done by visual sampling. Research is continuing to determine the number of beat sheet samples required per field. Research is also currently being undertaken to calibrate 'sweep nets' as a method of monitoring mirid populations.

Thresholds

Pest thresholds

Thresholds for mirids vary between warm and cool season areas due to the cotton plant's ability to compensate for damage. Thresholds early in the season are quite well established (Table 1). Thresholds mid-season are still being developed. At present during the mid-season the thresholds for early-season can be used as a trigger to look more closely for mirid damage. The need to control should be based on a combination of:

(i) evidence of mirid numbers (i.e. Table 1) and
(ii) evidence of damage exceeding guideline levels (below).

Control decisions for mirids should use a combination of plant damage and insect population data. For example, if early-season fruit retention is very low (<40 %) then mirid thresholds may need to be lowered to prevent further loss. Alternatively, in crops with very high retention (>80 %), thresholds may be lifted.

The use of thresholds, based on mirid numbers, is complicated by the ability of mirids to feed on both plant and prey. Although no work has been done in Australia, research in the US and Israel on similar species shows that the presence of prey can result in reduced levels of plant feeding by mirids. If this is so for the green and brown mirids in Australian crops, then it may explain why in some sea-

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Table 1: Early season mirid thresholds (numbers per m). The threshold should be tempered by evidence of plant damage

	Mirids / Metre	
	Warm Area	Cool Area
Visual	1.0	0.5
Beat Sheet	3.0	1.5

sons high densities of mirids can be tolerated without incurring damage to squares or fruit/bolls. The sudden appearance of plant damage in these instances may be associated with a reduction in the availability of prey – as a result of spraying, a change in the suitability of the crop, or some other factor.

Plant damage thresholds

Tip Damage: Cotton plants have a very good ability to recover from early season terminal damage. Terminal damage may be less prevalent in Bollgard II®, due to control of *Helicoverpa* spp. and tipworm which are the most common cause of tip damage. For simple tip damage a threshold of 100 % of plants damaged once could be used with little risk of yield loss or maturity delay. For heavier tip damage, where more than just the terminal is destroyed, the threshold should be reduced to 50 % of plants.

Fruit Retention: Extensive research and experience over many years has shown that crop yield and maturity are not affected if first position fruit retention is maintained around 60 % at the time of flowering. This is very relevant in Bollgard II®, cotton as theory would suggest that allowing the loss of some early fruit may decrease the chances of early cut-out and reduced root development that may result if retention on young plants is too high (i.e. the demands for assimilate from the fruit are too great so the plant curtails further growth).

Monitoring for fruit retention should be done at least every 7 days or prior to an insect control decision. If the level of retention falls below 50-60 % it may be worthwhile to calculate the fruiting factor. This takes into account the total fruit load of the plant to see if it is on track.

A description of fruit retention monitoring and the use of the fruiting factor can be found in the IPM Guidelines(www.cotton.crc.org.au/publicat/pest/) and in the Cotton Pest Management Guide, both available from the Cotton Technology Resource Centre at Narrabri and from the Australian Cotton CRC Website.

Boll damage (flowering - defoliation)

Feeding damage from mirids results in shiny black spots on the outside of the bolls at the feeding sites, which are easily mistaken for normal blemishes. Boll damage is monitored by cutting open 12-15 day old bolls, 100 bolls per management unit and inspecting for internal warty growth or stained lint. External spots are not always indicative of feeding. A tentative threshold of 20 % of bolls with damage is suggested based on research with green vegetable bug.

Figure 2 Black spots on the surface of a boll caused by mirid feeding and warts found on the inside wall of the boll (Photo M. Khan)

Management

Trap Crops

Cotton is not the most preferred host for mirids. Planting crops that are more attractive to mirids close to cotton crops may reduce populations in cotton. Lucerne has been shown to be an excellent trap crop for mirids. When maintained well, lucerne strips within a field or on borders or as larger blocks on the farm can reduce mirid populations within cotton crops. Further information: See IPM Guidelines for Australian Cotton. or the Cotton Pest Management Guide, both available from the Cotton Technology Resource Centre and the Australian Cotton CRC website (www.cotton.crc.org.au).

Insecticides

A range of insecticides is available to control mirids. The need to use an insecticide should be based on objective sampling of both mirids and plant damage. When selecting insecticides it is important to consider other factors:

1. I**mpact on other pests**: Most insecticides registered for control of mirids and stink bugs have moderate or high impact on beneficial insect populations and their use may contribute to flaring some pests late

in the season, especially when multiple applications are made. The relevance of this may vary from region to region, depending on the pests. For example:

•Fipronil will kill thrips which are an important predator of mites.

•Organophosphates will kill parasitoids that attack silverleaf whitefly.

•Early season use of omethoate or dimethoate can select for organophosphate /carbamate resistant cotton aphids.

Try to conserve beneficials by using the most selective option available early season, moving to harder insecticides later in the season if required. This helps to reduce the risk of:

(i) secondary pest outbreaks that will also prove difficult and expensive to manage and,

(ii) selecting for pesticide resistance in the secondary pests.

Use of reduced rates of insecticides combined with salt or petroleum spray oils (PSO's) may also reduce impacts on beneficials. Further information: See 'Impact of insecticides and miticides on predators in cotton' in the IPM Guidelines.

Figure 3: Lucerne strip planted as a trap crop for mirids and as a beneficial refuge Strips need to be well maintained
(Photo R. Mensah)

Strategies for use of insecticides are still being explored. However, one possibility when there are high numbers is to control the mirids twice, at about a 7 day interval. This allows the use of lower insecticide rates with an additive (see below), which will have less residual activity but also less impact on beneficials. The second application is to control young nymphs emerging from eggs. The second application is only necessary if subsequent sampling detects enough mirids to justify a spray. Alternatively, when adults start to be found in the crop it is prudent to assume they will lay eggs. If detected early it may be possible to control the adults with a reduced rate insecticide before there is significant egg lay. This will reduce the chances of nymphs hatching, escaping the spray and leading to population build-up.

Table 2: Insecticides for mirid control ranked from softest to hardest as per IPM Guidelines support Document 1 - 2002 update

	Name	Chem Class
Seed applied		
1.	aldicarb	Group 1A Insecticide
2.	carbosulfan	Group 1A Insecticide
Foliar		
1.	indoxacarb	Group 22A Insecticide
2.	endosulfan(Low rate)	Group 2A Insecticide (NSW)
3.	fipronil (Low rate)	Group 2C Insecticide
4.	endosulfan(High rate)	Group 2A Insecticide (NSW)
5.	fipronil (High rate)	Group 2C Insecticide
6.	imidacloprid	
7.	OP's	Group 1B Insecticide
8.	pyrethroids	Group 3A Insecticide

2. **Resistance:** There is no known resistance to any insecticide in green mirids. However, repeated use of any one insecticide group to control mirids and stink bugs may select for resistance in mirids as well as other pests. Similar species in the USA such as *Lygus lineolaris* (tarnished plant bug) have developed resistance to insecticides such as pyrethroids & OP's.

3. **Seed Treatment and In-Furrow Insecticides Pre-Planting :** Some insecticides applied at planting can suppress or control mirids during the early period of crop growth. The period of control will depend on application effectiveness, uptake of the product by the plant and the rate used. However, none of the options available applied at planting will provide control into the fruit-setting period.

As the options used at planting may also affect other pests and select for resistance in other pests, especially aphids, care is needed in selecting at planting insecticide options and the first insecticides used against aphids or mirids (see CRC Review 'Managing aphids in cotton').

Further Information See 'Insecticide Resistance, Where are we now?' Australian Cotton CRC Information Sheet.

Additives to Insecticides: Salt

Extensive research in cotton and pulse crops has shown the addition of table salt to some insecticides will increase their efficacy allowing lower rates to be used effectively. Salt mixed with a low rate of insecticide can increase the efficacy by 20 – 40% compared to the low rate of the insecticide alone and is softer on beneficial insects than the full rate of insecticide. Salt was mixed at the rate of 10 g per L of water for ground rig application or 1 kg per hectare for aerial application.

Salt itself does not cause

significant mirid mortality, but it increases the palatability of the insecticide thus encouraging mirids to probe and pick up more insecticide. Care should be taken when selecting insecticides to mix with salt. For example, indoxacarb (Steward,) is registered for control of *Helicoverpa* spp. as well as mirids, and the effect of lower rates on *Helicoverpa* spp. resistance development, is not known. Low rates of indoxacarb plus salt may not be a sound option if both *Helicoverpa* spp. and mirids are present.

In pulse crops, the addition of salt (5 g/L of water) to dimethoate has been shown to greatly improve that product's efficacy against mirid nymphs and adults, at rates as low as 33 % of the registered rate. However, the addition of salt did not improve dimethoate's efficacy (persistence) against nymphs that hatched after the spray. That is no or little residual control occured. For this reason, low rates are most likely to be successful if applied before significant egg lay occurs.

Petroleum spray oils (PSO)

In research experiments, addition of 2 % v/v PSO to half the maximum label rates of either fipronil (Regent), imidacloprid (Confidor) or indoxacarb controlled mirids to the same level as the full rates of the chemicals without the oil. These reduced insecticide rates have the advantage of allowing better survival of beneficials compared to the full rate. In addition,adding PSO's to the full rate of insecticide provided greater control than the full rate alone. Regular use of PSO's in insecticide mixtures provides the added advantage of helping with control of Helicoverpa and aphids.

Host Plant Resistance (HPR) for Mirids

Cotton varieties that are more determinant may be better able to compensate for mirid damage because they can more rapidly produce new squares. Plant breeding research is currently being undertaken on nectariless varieties of cotton that are less attractive to mirids. Other host plant resistance mechanisms such as relative hardness of the petioles may also deter green mirid egg lay. The softer the nodal petiole the more likely mirids will lay more eggs.

Management: The Future

- **Biopesticides:** There is currently work being undertaken on fungal insecticides (mycoinsecticides) and other biopesticides for green mirids. These are generally more specific in their target than conventional insecticides and may offer a more IPM compatible control option.
- **Pheromones:** There are a number of research projects currently being undertaken on sex pheromones and plant volatile attractants. A pheremone for mirids has been developed and shows promise in early field experiments. These products may be able to be used to manipulate populations within a crop and will be useful tools in an IPM-friendly management system.
- **PSO's:** PSO's have been shown to provide direct efficacy against mirids, and future management strategies are being developed for their use

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