

The Mirid Problem and Options for Management

Melina Miles¹, Bruce Pyke², Gimme Walter¹ and Mali Malipatil³

¹ Dept. Entomology, CRC for Tropical Pest Management, University of Qld, Brisbane

² Cotton Research and Development Corporation, Narrabri

³ Institute for Horticultural Development, Dept. Agriculture, Victoria

Introduction

The potential for mirids to damage cotton terminals and fruit buds has been known since the mid to late 1970's (Bishop 1980). Recent research has continued to improve our knowledge of these sap sucking insects. However, as with many biological investigations, mirids have proven difficult insects to study and as will be shown here, the answers to some important questions are still to be resolved.

This paper considers some recent research on mirids, in particular thresholds, sampling and control of the green mirid. It also considers the industry's views of mirids as pests, sheds some new light on the taxonomy of the green mirid and summarises the direction of current research.

Mirid Pest Status - the industry's view

In 1993 consultants in N.S.W. and Queensland were surveyed to determine their attitudes to mirids as pests. Table 1 summarises their responses to a number of questions on green mirids. This species is regarded as a pest that warrants control, either alone (primary) or in conjunction with other pests (secondary), by about 80% of respondents. It is also apparent that mirids are regarded as more significant pests in Queensland than N.S.W. both in terms of status and frequency.

Defining the Mirid Problem.

Research has been able to resolve the debate over which of the mirids and related species found in cotton are pests. The green mirid (GM) and apple dimpling bug (ADB) feed on cotton and damage it, whereas the brown smudge bug, also a mirid, is predatory and the Rutherglen and grey cluster bugs are benign visitors to cotton crops (Chinajariyawong *et al.* 1988, Chinajariyawong *et al.* 1989; Chinajariyawong

and Walter, 1990). Both GM and ADB will take prey (mites and *Heliothis* eggs) when it is offered to them in the laboratory (Miles *et al.* 1992) and it is possible that these insects require some prey or protein source to survive and reproduce. This requirement has presented researchers with a major problem - both GM and ADB are difficult to maintain under laboratory conditions. Rearing GM in the laboratory has been only partially successful but ADB has resisted almost all attempts so far (Chinajariyawong and Walter, 1990). Most of the research to date has concentrated on GM which is partly because of the greater difficulty of maintaining ADB in the laboratory and also the accumulating circumstantial evidence from the field that GM is the more significant pest.

Table 1. Results from Consultants Survey on Mirids 1993

| | % of Survey Respondents | |
|--------------------------------|-------------------------|------------|
| | NSW (n=38) | Qld (n=13) |
| Pest Status* | | |
| Minor | 27 | 5 |
| Secondary | 31 | 37 |
| Primary | 42 | 58 |
| Pest frequency | | |
| 3 years in 5 or less | 81 | 63 |
| 4 years in 5 or more | 19 | 37 |
| Thresholds | | |
| < 1 per m | 46 | 93 |
| 1-3 per m | 50 | 7 |
| 4-6 per m | 4 | 0 |
| Confidence in threshold | | |
| Confident | 47 | 46 |
| Not Confident | 47 | 54 |
| No answer | 6 | 0 |
| Sampling technique | | |
| Visual/terminal inspection | 82 | 69 |
| Plant shaking | 8 | 31 |
| Sweepnet | 10 | |

* Minor = control not required; Secondary = controlled with other pests;
Primary = control required in own right

Thresholds

Due to their mobility, it has been difficult to attempt threshold research on mirids in open field experiments. Consequently, the best guide we have to date comes from two field cage studies. Table 2 compares the results of these experiments on irrigated cotton at Biloela. Both experiments showed that mirid damage in early squaring is associated with maturity delays, but not with significant yield losses. Maturity delays varied from less than one week in trial 1 to over three weeks in trial 2. Higher losses of fruit were recorded in both trials as pest density increased, but yield compensation occurred up to the highest density of 16 GM/m². In both experiments mirids were present for the first 40 days of squaring. Insect-induced maturity delays of over 7 days are commercially unacceptable to many cotton growers. Therefore, to avoid such delays mirid thresholds need to be set at 4 GM or less per m² - at least between first square and first flower.

GM can also damage young growing tips in seedling cotton. Cage experiments suggest that delays of one week or more could be caused by population densities over 4 per m² (Chinajariyawong *et al* 1988). An unreplicated pest management trial was conducted at Theodore in 1992. Mirids were either sprayed (commercial) or unsprayed during third to fifth true leaf stage and it was found that population densities of 2-3 GM per m² in the unsprayed area (estimated by the "absolute" method - described next section) caused damage to all primary tips and 50% of the secondary tips. Commercial crop tipping out reached approximately 50% of primary tips. Subsequent management of mirids and *Heliothis* was sound in both crops yet the commercial crop was one week earlier and yielded 8.9 bales/ha which was 12% higher than the crop not sprayed for early seedling mirids.

Table 1 also includes a summary of the range of, and confidence in, thresholds used by respondents to the consultants survey. It shows that thresholds used commercially are generally much lower than those suggested by research and the confidence in them is low. One of the major reasons for the use of low thresholds

appears to be the difficulty of achieving accurate population estimates with commercial checking methods.

Table 2. Effect of Green Mirid Feeding on Caged Cotton Plants in the Field

| Character | GM Density /m | | | | | |
|---------------------------------------|---------------|------|------|------|------|------|
| | 0 | 1 | 2 | 4 | 8 | 16 |
| <i>Trial 1 Biloela 1987 - DP 90 *</i> | | | | | | |
| Damaged squares/m | 0 | 46.6 | 48 | 60.6 | 68.4 | - |
| Days delay (80% open bolls) | 0 | 2.6 | 3.4 | 5.4 | 6.6 | - |
| Lint yield (Bales/ha) | 6.86 | 6.53 | 6.63 | 6.64 | 6.01 | - |
| <i>Trial 2 Biloela 1993 - L22 **</i> | | | | | | |
| Damaged squares/m | 15 | - | - | 23.5 | 29.3 | 48.6 |
| Days delay (80% open bolls) | 0 | - | - | 23 | 21 | 25 |
| Lint yield (Bales/ha) | 7.66 | - | - | 7.07 | 6.80 | 8.23 |

* Chinajariyawong

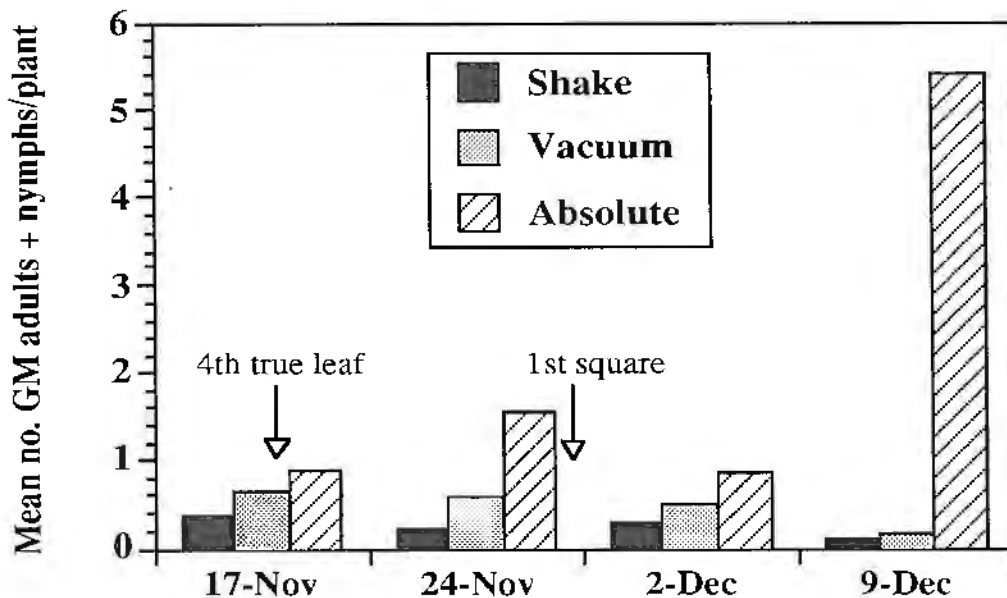
** Miles

Sampling

Over 90% of respondents to the consultants survey used either visual terminal inspections or a plant shaking method for GM (Table 1). There has also been a recent trend for consultants to use small vacuum samplers in line with the widespread use of these devices for sampling predators and mirids by researchers. Figure 1 provides a comparison of three different sampling methods for estimating GM populations in the same field of cotton at different intervals over a three week period. The methods were: "absolute" (very careful single whole plant visual inspections); vacuum sampled; and commercial (a modified plant shaking method). Population estimates from commercial and vacuum sampling were significantly lower than the 'absolute' method, ranging from, at best, 75% of absolute by vacuum sampler at fourth true leaf down to, at worst, only 2% of absolute by commercial sampling at early squaring (December 9).

Vacuum and shake sampling are much faster methods than careful visual inspections, but the fact that the two former methods provide poorer estimates of mirid numbers as the plant grows makes accurate predictions of the true population density from them quite difficult. On the other hand, visual inspection is not necessarily the best sampling method either because under commercial conditions visual inspections will be less rigorous than the 'absolute' method discussed above. It should be possible to devise a correlation for any given sampling method to provide an estimate of the true mirid population, but this will require further investigation of the variables that influence catches through the season.

Figure 1. GM Sampling Comparison, Theodore - 1992



It is becoming more common for commercial monitoring of mirids to include some degree of plant damage assessment or plant mapping. This needs to be cautiously encouraged because mirid populations entering cotton do not always reach economically damaging levels. Caution is required because we still do not have definitive relationships between mirid numbers and damage and it is difficult to distinguish if small square loss is due to mirid damage or physiological factors (Fitt *et al.* 1992). Related to the presence of mirids in cotton and their damage potential are some interesting questions. In particular: where do the mirids entering cotton come from; is there more than one species; and are there 'sibling species' of GM?

Green Mirids or Brown Mirids?

Chinajariyawong *et al* 1988 reported that there appeared to be two forms of the GM - a green form and a less common brown form. These two forms they suggested were different species. Recent taxonomic studies have now shown that there are two species - the green form or the GM is *Creontiades dilutus* (Stål) while the brown form is *Creontiades* possibly *pallidifer* (Walker) or an undescribed species. These forms can be easily distinguished in the field and the GM (*C. dilutus*) is the most common species. Frequency of the brown mirid is apparently much lower in NSW than Queensland.

Sibling Species of GM?

There is uncertainty about where green mirids come from when they invade cotton. Although other crops, mainly lucerne and (in NSW) safflower, harbour mirids at high densities, it is not yet certain that either of these hosts or other crops (e.g. field legumes and sunflower) contribute to the early cotton-invading populations. Mirids are also present in high densities on certain abundant weed species (e.g. *Psoralea*) in the channel country of western Queensland (and NSW - Fitt, pers. comm.).

We have indirect evidence that the green mirids in lucerne are not the source of cotton mirids and the one on lucerne is possibly a sibling species (= a similar-looking species having few differences except in mating behaviour, host plant(s) and ecology) that does not enter cotton. There is also evidence that the early cotton-invading mirids arrive on storm fronts from the west or north-west.

The species status of the lucerne, safflower, cotton and western Qld/NSW mirids is now under investigation using biochemical techniques.

Control of Mirids

When a GM population requires control there are currently very few options available and the most effective ones, such as the organo-phosphates ("OPs" e.g. dimethoate, omethoate and chlorpyrifos) and the synthetic pyrethroids, are

disruptive to beneficial species. Respondents to the consultants survey made use of the following chemicals for controlling mirids : endosulfan 25%, foliar OP's 57% and soil applied granular insecticides 18%. A small plot replicated trial at Biloela comparing endosulfan EC with dimethoate as a representative OP showed that the efficacy of endosulfan on GM is much lower for adults (Figure 2) and only improves slightly for nymphs (Figure 3). Similar observations have been made under commercial conditions when endosulfan EC has been used to attempt control of GM at high population levels or when reinvasion of the crop after chemical treatment is frequent. There is some limited evidence, however, to indicate endosulfan ULV is more effective than endosulfan EC. Granular insecticides applied at planting provide some control or suppression of GM during seedling growth, but this seldom lasts into early squaring. With the possible extension of synthetic pyrethroids into stage I of the insecticide resistance strategy, good control of GM would be expected, but again these products are very disruptive to beneficials.

When transgenic cottons are introduced the associated reduction in insecticide use for *Heliothis* control could increase the impact of sucking pests, particularly mirids. In order to make use of beneficial species, to help suppress pests such as mites or to assist with *Bt* resistance management in *Heliothis*, it will be important to develop mirid control methods that are less disruptive than the OP's and pyrethroids of today.

At the recent World Cotton Research Conference -1 in Brisbane Watkinson (1994) highlighted a range of new chemistry, some of which control certain sucking pests without impacting significantly on beneficials. It should be a research priority for these new products to be tested on mirids under Australian conditions.

Current Mirid Research.

Current research on GM is looking to exploit means other than conventional insecticides for control as well as studying the physiology, biology and ecology of

Insecticide Efficacy Trials on GM - Biloela 1992/93

Figure 2. Adults

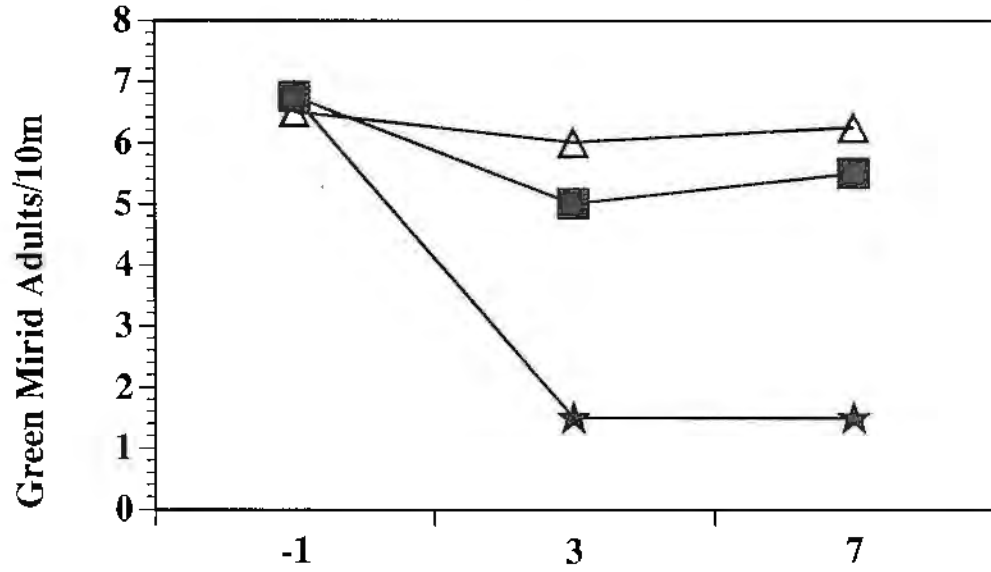
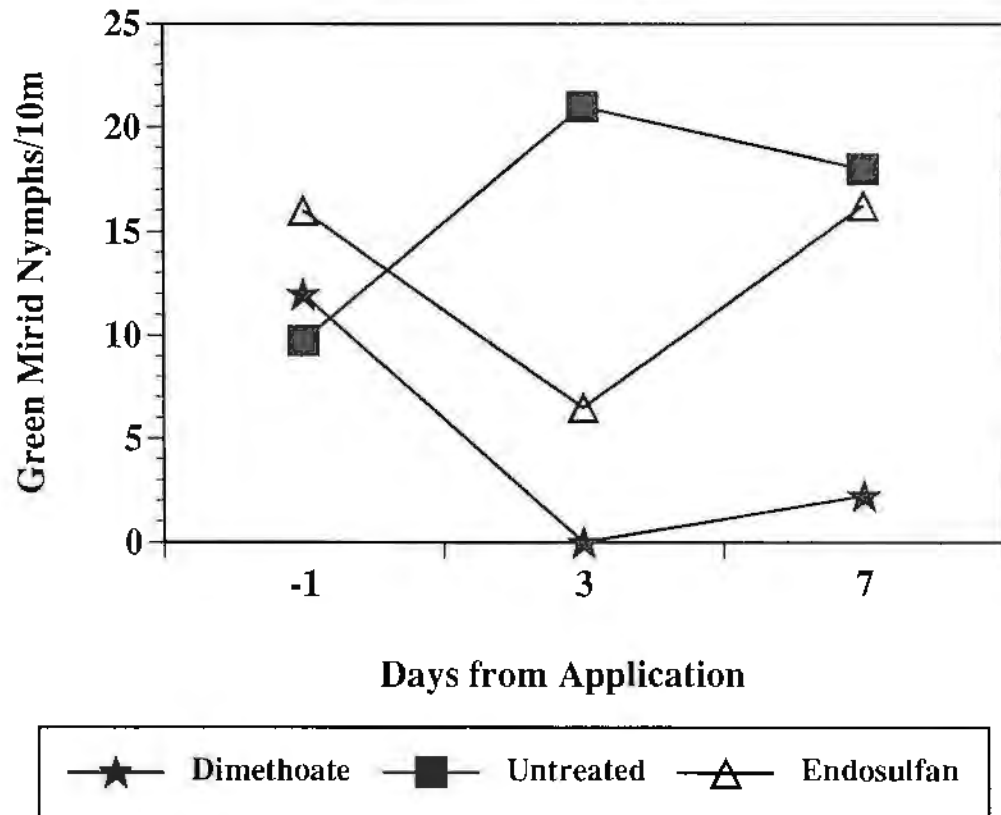


Figure 3. Nymphs



this pest to establish if there are weak links we can target to improve their management. Table 3 provides a summary of a number of current mirid research projects, indicating principal researchers and expected year of completion.

Mirids will continue to be significant cotton pests into the foreseeable future. At present there is little we can do about this since our control options are limited. Until effective and less disruptive alternative control methods are developed, it will be important that we establish where our most damaging mirid populations are coming from and develop better, and perhaps standard, monitoring techniques. In order to better determine what maximum mirid densities can be tolerated, we need to develop thresholds that are more fine tuned to growers expectations of yield or maturity date and can also take into account other factors such as water availability .

Table 3. Current Mirid Research

| Description of project | Principal Researcher(s) | Organisation (Location) | Completion date |
|--|--|-------------------------|-----------------|
| Investigating proteins orally toxic to GM | Dr Valerie Baule | CSIRO (Canberra) | 1995 |
| Physiology of GM | Gillian Colebatch (PhD - supervisor Dr Baule) | (Canberra) | 1996 |
| Lucerne as a trap crop Flight phenology | Dr Robert Mensah " | NSW DA (Myall Vale) | 1995 |
| Host Plant Resistance to mirids | Dr Gary Fitt | CSIRO (Narrabri) | 1995 |
| Population regulating factors and control with min. disruption | Mozzem Khan (PhD Student - supervisors Drs Mensah & Gregg) | (Myall Vale) | 1997 |
| GM hosts & sources sampling, thresholds and control* | Melina Miles (PhD - supervisor Dr Gimme Walter) | Uni. of Q. | 1995 |
| Taxonomy of Mirids* | Dr Mali Malipatil | Vic. DA | 1995 |

* Reported in this paper

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