Sweeping up mirids gives a net improvement

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Last season the 'sweep net' insect sampling technique was put under the spotlight by a CSIRO team based at the Australian Cotton Research Institute.

Leading the team was Environmental Science student from the University of Wollongong, Caragh Threlfall, who was one of 24 second and third year university students from across Australia who spent their summer working on a science project sponsored by CSIRO Plant Industry. Caragh worked alongside scientific mentors Sandra Deutscher, Lewis Wilson and Trudy Staines, with technical assistant Jacquie Barker, to evaluate the usefulness of sweep nets for sampling mirids and beneficial insects.

BACKGROUND

Bollgard II cotton has dramatically reduced the need to spray for Helicoverpa spp. and other lepidopteran pests such as tipworm. Sucking pests previously controlled by these broad spectrum sprays are now a management issue in Bollgard II crops.

Such pests include the green mirid (Creontiades dilutus) in Australia, and the equivalent in America, the Lygus bug. Accurate sampling of these pests is crucial in a successful IPM program, although this is made harder by the mirids' flighty nature.

Standard industry insect sampling techniques at present are the visual check and the beat sheet. Both of these techniques are valuable although visual checks are slow and beat sheets are difficult in wet fields.

In America the sweep net is used to sample for the Lygus bug. The sweep net is favoured because it is cheap, easy to use, quick and there are reliable thresholds available. It was the objective of this study to examine the sweep net's ability to accurately and consistently sample pest and beneficial species, particularly the mirid under Australian conditions. We also compared it to the standard techniques so we could develop conversion factors between them.

WHAT WE DID

Insect sampling took place over a 10 week period during the 2004–05 cotton season in the Namoi and McIntyre regions. Eight farms were visited fortnightly with one field sampled per farm.

TABLE 1: Number of sweep net samples required in the field for sampling mirids with differing accuracy and confidence limits

	Accuracy (total mirids per metre)		
Confidence limit	–0.5	–1	–2
95 per cent	43	12	5
80 per cent	20	6	2

For example, by taking 12 sweep net samples you will be 95 per cent confident that your count is within –1 of the actual density.

Calculated using $N = (s.d\ t_{prob} / accurancy)^2$.

CSIRO Summer Scholarship student, Caragh Threlfall puts the sweep net to the test.

Twelve samples were taken using each technique (beat sheet, visual and sweep net) in any given field. A new pounce-net technique was also used on three occasions to estimate the absolute number of insects present.

This data was used to gauge how accurately each technique sampled the insects present. We also assessed the speed of each technique over the season and compared the variability between scouts using each technique.

HOW WE SAMPLED

A standard 380 mm diameter sweep net was used. Samples were taken by walking briskly and sweeping the net in front 20 times so that the bottom of the sweep struck the canopy about 25–30 cm from the top.

The scout moved the net fast enough so that flighty insects could not fly out. Immediately after each sample was taken, some of the excess leaf material in the net was quickly removed by hand. The content of the net was then emptied onto a beat sheet to inspect and record all insects collected.

In commercial situations, a small white tray could be used to tip the sample in for counting. Or if only mirids were being sampled, the user could carefully count the mirids in the net. Counts from the sweep net are expressed as numbers per 20 sweeps, rather than as numbers per metre.

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WHAT WE FOUND

Technique speed

Results throughout the season showed that the sweep net and beat sheet methods were both much faster (three to six minutes per sample) than the visual method (15–20 minutes per metre Figure 1).

When using the visual method, every square or boll was checked and in the beat and sweep methods, all pests and beneficials were sampled. Beat and sweep samples would be considerably faster if only mirids were being scored.

Scout variability

We found that there was no significant difference between scouts for sampling mirids using the same technique (Figure 2). This means that the pest manager can be confident that the sweep net is providing consistent results between scouts.

Distribution of mirids in fields

To develop an effective sampling procedure for mirids it is important to firstly analyse how they are distributed in the field. We used 'Taylor's Power Law' to test if mirid distributions within a field are random, clumped or uniform (even).

A good example of a patchy distribution is spider mites which form 'hot spots' in fields. Taylor's Power Law uses the ratio of the variance to the mean to indicate the distribution of individuals.

When we applied it to mirids we found that the distribution of mirids in the field, when sampled using sweep nets, is fairly uniform, meaning all samples taken will yield roughly similar results.

Sample number per field

We used estimates of the variability to work out the required sample size. Preliminary statistical analysis taking confidence limits into account indicated that more samples are needed if greater accuracy is desired (Table 1). From these results, we suggest that at least six sweep samples be taken per field. This value will be updated as further information becomes available.

FIGURE 1: Time taken using each sampling technique, scoring all pests and beneficials (times would be significantly less if only mirids were recorded)

Sandra Deutscher counts insects on a beat sheet.

Conversion of sweep net counts to visual counts

With the current industry thresholds for mirids based on visual counts of mirids per metre, it is important to be able to relate sweep net counts to their equivalent visual counts. This allows management decisions to be made using the visual thresholds.

These conversions are calculated by comparing the sweep net samples (each sample consists of 20 sweeps) and visual samples (one metre) taken in the same field at the same time. Compared with the visual technique, the sweep technique recorded about three times as many adult mirids, and 1.6 times as many nymphs.

To convert mirid adult counts from a sweep sample to a visual sample divide the sweep count by three. For mirid nymphs, divide the sweep count by 1.6. A simple conversion is to pool the adult and nymph counts into 'total mirids' and divide by two to convert to a visual.

Thresholds

The thresholds for mirids are based on visual counts and sweep net equivalents are given in Table 2.

FIGURE 2: Mean (±standard error) of total mirid abundance for each sampling technique for five different crop scouts

TABLE 2: Thresholds for mirids for visual, sweep and beat sheet sample techniques (from Cotton Pest Management Guide 2005–06)

Seedling to flowering	All season		
	Visual	Beat***	Sweep***
		Cool regions	
50% plants Light* tip damage	0.5/m adults + nymphs	1.5/Sample adults + nymphs	1.5/sample for adults and 0.8/sample for nymphs or 1/sample for total mirids
or		**Warm regions**	
20% plants Heavy** tip damage	1.0/m adults + nymphs	3.0/Sample adults + nymphs	3.0/sample for adults and 1.6/sample for nymphs or 2/sample for total mirids
		and fruit retention less than 50-60% and 20% boll damage	

* Light tip damage – embryo leaves within the terminal are black
** Heavy tip damage – terminal and 2-3 uppermost nodes are dead
*** After 9–10 nodes. Before this, beat and sweep counts can be treated as equal to visual counts

IN CONCLUSION

The most effective way to sample cotton is by using a range of sampling methods. The visual technique is the most effective way to sample *Helicoverpa spp.*, mites, aphids, whitefly and thrips and is an effective way to sample other pests and beneficials, but can be time consuming.

The beat sheet and sweep net methods are quick, reliable ways to sample the larger and more mobile pests such as mirids and are more effective than the visual technique for finding beneficial insects. The sweep net is a good alternative to the beat sheet particularly in wet fields. Insect densities found using a sweep net can be easily converted back to industry thresholds for management.

We would like to thank CSIRO Plant Industry for funding and managing the summer scholarship scheme. We would also like to thank all collaborating growers in the Boggabilla and Merah North districts, Jackie Barker for her assistance with data collection, Warwick Stiller for his advice with analysis and Judy Nobilo for her help in the scout bias study.

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