Giving insects a good beating

By Sandra Deutscher, Martin Dillon, Carla McKinnon, Sarah Mansfield, Trudy Staines and Louise Lawrence*

Because of the growing popularity of the beat sheet method to keep track of insect numbers in cotton, we have initiated studies to compare current insect sampling methods, and determine conversion relationships between them.

Accurate sampling of pest and beneficial insect populations in cotton crops is an important part of an Integrated Pest Management (IPM) strategy, as it provides the foundation for pest management decisions. It is important that growers and consultants have fast and effective methods of quantifying insects so decisions are timely and accurate.

Among most cotton consultants, the beat sheet technique is gaining popularity as a useful sampling method, particularly for monitoring beneficial insects. But the higher counts of beneficial insects found by beat sheet sampling compared with other methods have implications for the use of the predator-prey ratio in pest management decisions as the ratio in use is based on visual counts.

Studies carried out by Brad Scholz and colleagues at QDPI Toowoomba, compared the beat sheet method with visual and d-vac suction counts during the first nine weeks of the season (The Australian Cottongrower, September-October 2001 p 14–17). They found that the beat sheet gives a more realistic measure of the number of predators in cotton at this time of the year and provides on the spot information.

The Australian Cotton CRC awarded a Summer Scholarship to Carla McKinnon from the University of Western Sydney for a study which compared beat sheet, visual and suction (d-vac) insect sampling methods over the whole season, and determined conversion factors between the methods. The work also involved examining the relative efficiency and reliability of the various ways of sampling throughout the season.

What we did

Sampling was conducted in 12 fields on six farms in the Namoi and Macintyre Valleys with each site being sampled fortnightly. To make data directly comparable between the sampling

Trudy Staines and Sandra Deutscher using a beat sheet.

FIGURE 1: Comparison of sampling methods for total predator numbers per metre against the pounce-net absolute counts (black bars) taken at the same times

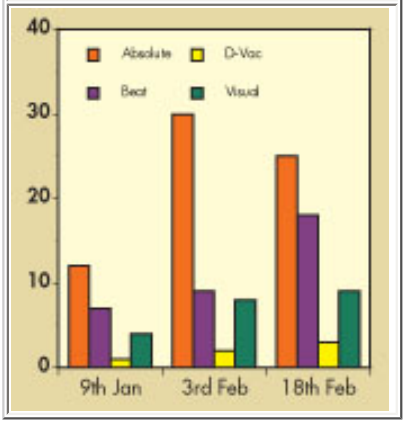


FIGURE 2: Comparison of beat sheet and visual counts of total predator numbers per metre at different stages of crop development

methods (visual, beat sheet and d-vac), all collections were made on a per metre basis.

During each visit to each field we sampled 12 metres visually, 12 metres with beatsheets and 12 individual metres with a d-vac. Just over two km of cotton row were sampled and almost 50,000 insects counted throughout the season.

To simulate conditions that pest managers would normally experience, samples were processed in the field and only those insects visible to the naked eye were counted. Previous research by Mark Wade and his colleagues (The Australian Cottongrower, November–December 2001, p 41-42) has shown that sampling results are sensitive to the time of day.

Less insects are found during the hottest parts of the day. To avoid this bias we completed all sampling for this study during the morning or very late in the afternoon.

The beat sheet measured 1.5 metres by two metres and was placed in the furrow so it extended up and over the adjacent row of cotton. A one metre stick was used to vigorously push and shake the plants 10 times against the plastic sheet, with the beats moving from the base to the top of the plants. All insects dislodged onto the yellow canvas were counted immediately. The beat sheets were washed and sterilised with Farmcleanse between sites.

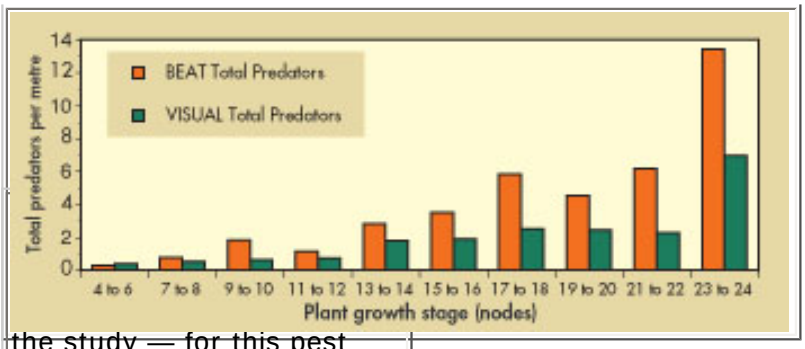
'Pounce-net'

In addition to the three sampling methods under study, an absolute count was carried out to try and obtain the actual numbers of insects per metre for comparison with the relative numbers collected from the other methods. To achieve this we developed a new technique using what we have called a 'Pounce-net'.

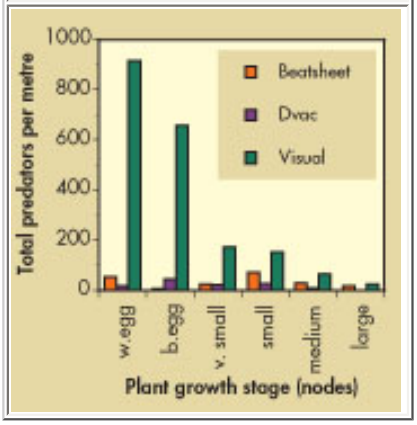
The 'Pounce-net' is a large elasticized gauze bag which two people stealthily and swiftly placed over one metre of row, while another two people cut the plants off at the base while drawing the net closed. In the laboratory, the bags were fumigated to allow a comprehensive count of all captured insects visible to the naked eye.

What we found

Results indicated that the beat sheet method was very effective for sampling predatory insects and spiders. Beat sheet counts consistently detected a higher proportion of the 'absolute' count of total predators based on pounce-nets than other sampling methods (Figure 1), which confirms previous findings by Brad Scholz and colleagues.

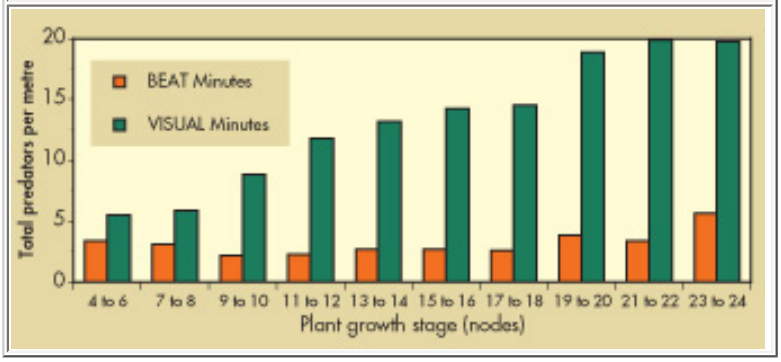


the study — for this pest visual checks are superior



Carla McKinnon doing a visual check.

FIGURE 4: Average time taken to sample one metre of row for beat sheet and visual sampling methods at different stages of crop development



The differences between the absolute counts and the other sampling methods were not attributable to any particular insect group, but were spread across all types of predatory beetles, bugs, lacewings and spiders. At the start of the season (eight plant nodes or less), all sampling methods produced similar results, but as the cotton grew the beat sheet generally found twice as many predators as visual samples (Figure 2).

Our visual samples were undertaken very carefully and involved thoroughly checking every part of every plant within each metre sampled.

Different types of insects vary in their detectability by different sampling methods. For example, eggs tend to stick to the plant and may not be easily dislodged or may be difficult to see on the beat sheet.

Similarly, grubs may burrow into squares and bolls and may not be easily beaten or sucked out. Conversely, mobile insects such as green mirids and red and blue beetles are flighty and easily dislodged from the plant.

They may also actively hide and/or escape undetected. Our results confirmed that visual sampling is clearly superior to d-vac or beat sheet for monitoring all Helicoverpa spp. life stages (Figure 3). Visual sampling is also best for mites, aphids, thrips and whitefly — for which standard sampling protocols are available.

In contrast, beat sheets are more effective for counting mobile predators like beetles, bugs and spiders and some pests such as mirids. So sampling methods may need to be combined in order to get an accurate assessment of the overall insect populations.

Perfect timing

Our results showed beat sheets are faster than visual checks. They took between three to five minutes throughout the season, while the visual checks took increasingly longer as the crop developed (Figure 4).

Anyone can beat sheet!

A secondary study looked at the variability between the performance of different crop scouts for beat sheet and visual sampling. We wanted to establish which method was the most reliable regardless of the scout. In an experiment designed by Dr Sarah Mansfield, five scouts with a range of checking experience conducted equal numbers of visual and beat sheet samples.

Swiftly stretching the pounce net over a metre of cotton row.

Drawing the pounce net closed.

This experiment was conducted in January and repeated in February in a field of unsprayed conventional cotton. The results clearly showed that there was a statistically significant difference in the number of predatory insects and spiders that different scouts were finding using visual checks.

On the other hand, there were no significant differences between checkers using beat sheets to count total beneficials. Beat sheets are less subject to scout bias because they do not require the same amount of experience and skill as visual searching.

Making decisions with beat sheet data

Beat sheets provide a fast, effective and robust method for monitoring predatory beetles, bugs, lacewings, ants and spiders in cotton. They are also an effective method for sampling mirids, and we will present our mirid results and recommendations in a future Cottongrower article.

Visual checking of insect densities in cotton is still essential, particularly for Helicoverpa and other lepidopteran pests like armyworm and tipworm. Visual checks are also required for pests that are small or have patchy distributions such as aphids, mites, thrips and whitefly.

For a reliable estimate of insect densities it is a good idea to regularly beat a similar number of metres to the visual checks. Beat sheet counts of predators should be converted to visual densities before use in management decisions.

Our results suggest that once a crop reaches nine nodes or more, beat sheet predator numbers can be converted to an approximate visual count equivalent by dividing the beat sheet counts by two (Figure 2). The converted count can then be used with the predator to pest ratio calculation described in the IPM Guidelines.

For example, a beat sheet sample that detected 10 predators per metre would on average be equivalent to five predators per metre counted in a visual sample.

*CSIRO Cotton Research Unit and the Australian Cotton Cooperative Research Centre, Narrabri.

Many thanks to the Australian Cotton CRC for sponsoring the project, the owners and management at Scotsburn, Sandhurst, ACRI, Eumorella, Korolea and Morella. Thanks to Christine Richards and Anne Sullivan for their help with sampling.

Contacts: Martin Dillon Email Martin.Dillon@csiro.au; ph 02 6799 1518; fax 02 6793 1186..

Sandra Deutscher, Email Sandra.Deutscher@csiro.au; ph 02 6799 1589; fax 02 6799 1582.