REAPPRAISAL OF SAMPLING PROCEDURES FOR *HELIOTHIS* SPP. IN COTTON

G.E. Dillon and G.P. Fitt
CSIRO Division of Entomology
P.O. Box 59, Narrabri, NSW.

Efficient and reliable sampling procedures provide the basis for effective pest management in cotton. SIRATAC, a computer based pest management system for cotton was released commercially in the early 1980's. The sampling procedures used in this system have provided a standard sampling method for the industry and are still widely used. However since the development of these sampling methods there have been several agronomic changes (eg. new varieties and reduced plant stand densities) which may have implications for the sampling program being used. This study was designed to evaluate the impact of some of these factors on the validity of existing sampling regimes and if necessary to develop new procedures.

Over the last two growing seasons, sampling studies have been conducted to compare the distribution and abundance of *Heliothis* on different cotton varieties and to test the validity of the SIRATAC equations which express the relationship between the number of infested plant terminals and the mean number of *Heliothis* per plant. Results to date show that the current SIRATAC equations are indeed robust under current conditions and do provide an adequate estimate of insect density, calculated from the proportion of infested terminals. Differences between the number of *Heliothis* found on the two main cotton varieties (Siokra and Sicala) was minimal. It should be noted however, that the past few cotton growing seasons have been characterised by very low *Heliothis* pressure, this has meant that our analysis has been based on samples of low density populations. It has not yet been possible to evaluate the validity of the SIRATAC relationships at high insect pressure and conclusions on varietal differences therefore remain tentative.

WITHIN FIELD DISTRIBUTION OF PESTS:

The broad scale distribution of *Heliothis* eggs and larvae within a 100ha field was investigated by weekly sampling of fixed grid points, distributed evenly across the whole field. This sampling regime allowed us to investigate the spatial distribution of *Heliothis* and to determine if these distributions change throughout the growing season. Sampling has been carried out in both Siokra and Sicala fields and the results were very similar for the two varieties. Analysis has indicated that significant small scale clumping of both *Heliothis* eggs and larvae does occur, but there was no consistency in the spatial distribution of these clumps in the field throughout the season. For example, higher numbers of *Heliothis* may have been detected in the tail drain region of the Southern end of the field during one of the weekly checks, but subsequent checks did not show this area to have higher *Heliothis* numbers than other areas of the field on a regular basis. The patchy distribution of *Heliothis* eggs and consequently larvae did not consistently favour any one area of the field.

EFFICIENCY OF SAMPLING PROCEDURES:

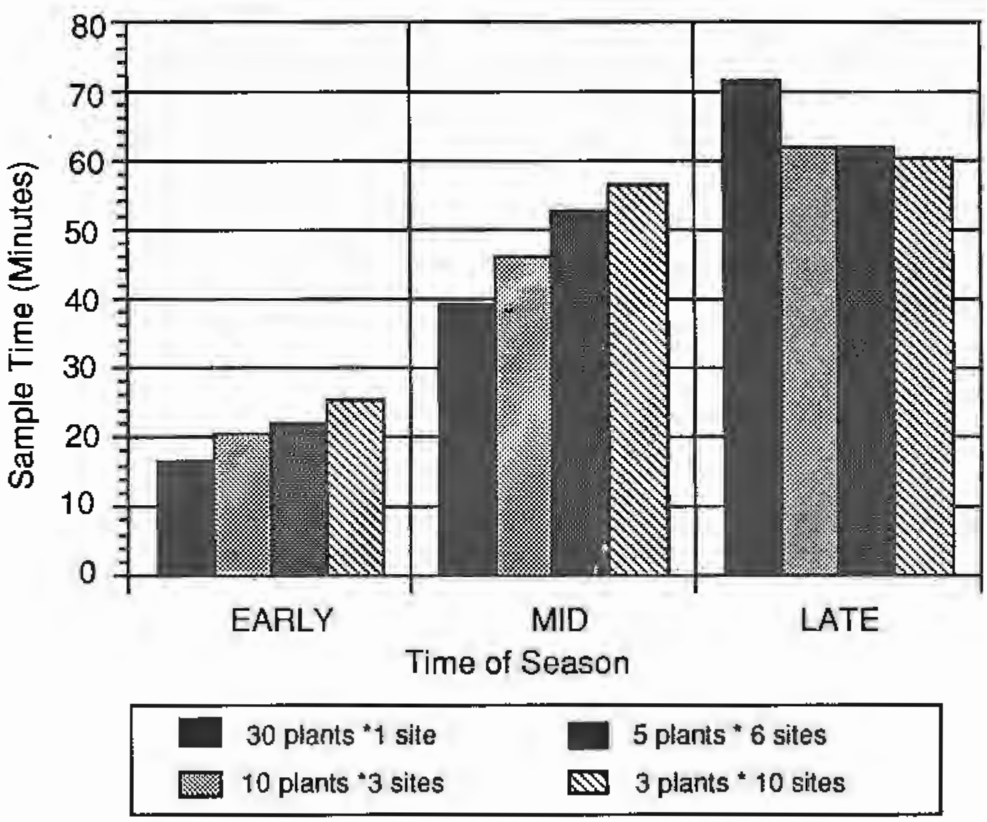
Current sampling methods are based on scouting a minimum of 30 plants per 50 Ha of cotton. The more widely distributed these plants, the better the representation of insect activity across the whole field. However, the time spent moving between sample plants must also be considered, especially in the commercial context where scouts have to sample many fields in a day.

Comparisons were made between four sampling strategies involving different distributions of 30 sample plants across a field. The studied distributions were: 30 plants at 1 site, 10 plants at 3 sites, 5 plants at 6 sites and 3 plants at 10 sites. The distance between sample sites was constant and was that distance currently used by the Siratac sampling regime. The time taken to complete each 30 plant sample was also recorded. During this experiment whole plants were sampled, in contrast to the terminal sampling normally used in SIRATAC checks. In addition to this, the position of each individual egg and larvae on the plant was recorded. Thus the total time taken to complete these checks was greater than a normal SIRATAC check. However the relative time differences between different types of samples and the time taken to move between sample sites will still be relevant to sampling in a commercial context.

The low overall *Heliothis* numbers made statistical comparisons between the sampling methods difficult, but analysis showed no significant differences in the number of *Heliothis* found using the different sampling strategies.

The timing data (Figure 1) indicates that in early and mid season samples, time spent walking between sample sites adds significantly to the overall sample time. Late in the season, when plants are large, time spent moving between samples was an insignificant part of the total sample time. Results in fact indicate that spreading sample plants across several sample sites may reduce the overall sample time. The reasons for this are not clear, but the psychological hurdle of having to sample a large number of plants in a single site may be important when plants are large and difficult to search thoroughly. Moving between sample sites provides a break from the repetitive and tedious task of insect scouting and so may help to keep the observer alert and more efficient.

Figure 1: Mean time taken to complete each type of 30 plant sample throughout the season.



IMPLICATIONS OF VARYING PLANT DENSITIES:

Variable or low plant stand densities may arise from a number of different causes e.g germination failure, seedling disease etc. We were interested in determining if low plant densities require different sampling methods or different thresholds for *Heliothis* control than stands of higher plant density.

The problem of studying plant density effects in cotton is complicated by the ability of cotton plants to compensate for low plant stand density by increasing the fruit load per plant. Thus any given area of cotton may be capable of producing a similar yield despite varying plant stands. This was the case in this experiment, fruit counts indicated no significant differences in the number of bolls counted in the different plant density treatments (Table 2). Unfortunately the experimental plot was badly damaged by hail in mid February, so fruit counts and extensive insect sampling was not continued through to harvest.

There is a time lag before compensation occurs, and in this pre-compensation period early in the season, the insect load **per plant** is the important factor and thresholds should probably be expressed in these terms. Damage at this stage may prohibit low plant stands from adequately compensating at a later date, thus reducing the potential yield. By mid season (mid January) plants have compensated for their planting densities and (assuming adequate pest control) an average metre of cotton would be similar, both vegetatively and in terms of fruit load, despite varying planting densities. Thus later in the season, following compensation, the number of insects **per metre** is an appropriate measure of insect pressure.

The possible influence of varying plant density on the number and distribution of *Heliothis* eggs and larvae was investigated in replicated plots with low, medium and high plant densities. The variety used in this experiment was Siokra. Results are separated into early season counts (prior to Jan 1), expressed as insects per plant (Table 1), and mid /late season counts (after Jan 1) expressed as insects per metre (Table 2).

Table 1. Early season *Heliothis* numbers on plots of different plant density.

Plant density	Mean plants per metre	Mean eggs per plant	Mean larvae per plant
Low	4.3	0.13 a	0.06 a
Medium	7.4	0.07 b	0.04 a
High	12.5	0.06 b	0.02 a

Within each column, means followed by the same letter are not significantly different at P = 0.05

Table 2. Mid/late season *Heliothis* numbers on plots of different plant density and numbers of squares per metre at peak count (23 Jan) and bolls per metre at peak count (6 Feb - last count prior to hail damage).

Plant density	Mean plants per metre	Mean eggs per metre	Mean larvae per metre	Mean squares per metre at peak	Mean bolls per metre at peak
Low	4.2	3.71 a	1.38 a	122.0 a	115.6 a
Med	6.8	1.53 b	0.85 a	135.6 a	131.1 a
High	10.7	3.06 ab	1.12 a	170.3 b	117.7 a

Within each column, means followed by the same letter are not significantly different at $P = 0.05$

Early in the season, there were differences in the mean number of *Heliothis* eggs per plant across the different density treatments. As might be expected, low density plots showed significantly higher mean egg numbers per plant than either the medium or high density plots. These differences were not reflected in significant differences in numbers of larvae, though there was a trend towards more larvae on the plants at low density. This relation between egg and larval numbers continued in the mid and late season checks, but further sampling at higher *Heliothis* pressure will be needed before definitive conclusions can be drawn about the effects of plant density on *Heliothis* numbers. If it can be demonstrated that low density stands carry a significantly higher larvae load per plant then the question of different insect thresholds for these plants prior to compensation becomes important.

FUTURE PLANS:

One aspect of sampling which has not yet been investigated is the differences between insect numbers found by different observers. Field experiments to quantify the variation between observers are planned for this coming season. It is also planned to repeat several of the experiments outlined here in the hope of encountering higher *Heliothis* pressure next season. Unlike the growers, we at least are hoping for a bumper *Heliothis* crop in the 1990/91 season.

ACKNOWLEDGEMENTS:

We thank Auscott Narrabri for allowing work on their property and the Cotton Research Council for providing funding for this project.