Predation of heliothis eggs in dryland cotton on the Darling Downs.

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Introduction

The current cotton industry IPM guidelines promote the use of predator/prey ratios when making pest management decisions. This involves assessing the numbers of key predators within the cotton crop. Many species of insects and spiders are known to feed on heliothis eggs and larvae, but few studies have quantified the contribution that each species makes in controlling heliothis in the field. Such studies are understandably difficult to undertake. It may, however, be worthwhile to give each potential species of predator a rating so that crop consultants and farmers do not waste time counting species of minor importance, and can focus on sampling those species that are most likely to feed on heliothis.

The aim of this study was to evaluate predation of heliothis eggs in INGARD cotton planted adjacent to lablab, and to identify the key predatory species.

Methods

The trial was carried out at St. John and Edwina Kents' property "Coondarra" near Jimbour on the Darling Downs. Heliothis egg predation was studied in four strips of single-skip Siokra V-15i (INGARD) cotton separated by similar sized strips of wheat stubble. There were 45 row-pairs of cotton in each strip, ca. 135 m wide and 1.2 km long. The eastern (upwind) edge of each strip was planted with eight rows of lablab (var. Highworth), ca. 8 m wide. The strips were sown on 18-19 October 1999. The lablab flowered on 5 Jan. 2000, and was slashed on 31 Jan. 2000. A second lablab flowering commenced on 6 March 2000. The INGARD cotton was sprayed with spinosad (200 mL/ha) and fipronil (60 mL/ha) on 4 Feb. 2000. This was the only insecticide applied to the crop.

Egg Removal Studies

Heliothis egg cards were used to assess egg predation. Adult *H. armigera* moths were placed in oviposition chambers where they laid eggs onto paper towelling. Each card was made by stapling pieces of paper towelling containing approximately 20 *H. armigera* eggs to paper strips measuring 1.5 x 7 cm. The eggs were less than 24 hours old. Each card was stapled to the upper side of a leaf at the top of a plant. Five egg cards were stapled in lablab rows 3 and 6 (10 cards total) and five cards in cotton row-pairs 2, 13, 23, 34 and 44 (25 cards total). The egg cards were 30 m apart in each row, and were placed in approximately the same location each week. They were left in the field for 48 hours. The number of eggs on each card was counted before and after they were placed in the crop, and the number of eggs removed from each card was calculated. The proportion of egg cards that displayed signs of feeding by ants and spiders (Figure 1) were recorded from December 1999 to March 2000.

Observational Studies of Egg Predators

Heliothis egg cards were also used in observational studies. Each card was stapled to the upper side of a leaf at the top of a plant, and was inspected every 30 or 60 minutes. The type and number of predators observed on each card were recorded. Four observational studies were conducted – two during daylight hours, and two at night (Table 1). The egg cards were placed in lablab and adjacent cotton during studies 1 and 2, and in cotton only during studies 3 and 4 (Table 1).

Pitfall Traps

Pitfall traps were used to collect ants from November 1999 to January 2000. Each trap consisted of a glass test tube measuring 150 x 25 mm that was held in a plastic sleeve in the soil. The test tube was filled with 70% alcohol and collected 48 hours after being placed in the ground. The test tubes were returned to the laboratory and the ants collected in each trap were identified to genus and counted. A pitfall trap was placed in every second row of lablab (8 rows wide), and in every sixth row-pair of INGARD cotton (45 row pairs wide), in each of the four strips.

Results

The majority of heliothis eggs on egg cards (47-91%) were removed during the 48 hours field exposure each week (Figure 2). More eggs were generally removed from the lablab than the adjacent cotton.

Inspection of egg remains on egg cards indicated that spiders, or another group of sucking predators with similar feeding behaviour, were active throughout the season in both lablab and cotton. Typical signs of spider feeding (Figure 1) were observed on 74-100% of egg cards weekly (Figure 3A). In contrast, signs of feeding by ants were recorded on 2-50% of egg cards (Figure 3B). Ant feeding in cotton was negligible from mid January to the end of February. Ant captures in pitfall traps followed a similar trend (Figure 4).

The numbers of ants collected in pitfall traps, and observed on egg cards, was highest in the lablab and the edge rows of the cotton, i.e. those rows closest to adjacent wheat stubble (Figure 4). Ants were generally found within the first 7 row-pairs on each side of the cotton strip, ca. 20 m in from the edge. Few ants were observed or collected in the middle 90 m of cotton in each strip. An *Iridomyrmex* ant was the only species of ant observed on egg cards and was also the most abundant species caught in pitfall traps – accounting for 86% of all ants trapped.

There were obvious differences in the species of predators observed on egg cards at night and during the day (Table 2). The black ant (*Iridomyrmex* sp.) was most commonly observed during the day in Observational Study 1 when the plants were small. However, spiders were commonly observed feeding on egg cards at night (Observational Studies 2 and 3). Seventeen spiders were collected from egg cards and all were identified as night stalker spiders (*Cheiracanthium* sp.). These spiders were the most common egg predator recorded during the nocturnal observational studies in November and January. By contrast, the species of daytime predators changed during the season. Black ants were most frequently recorded on egg cards in November, and apple dimpling bugs were most commonly recorded in January. Only two ladybirds, two pirate bugs and one damsel bug were observed on egg cards during all four observational studies.

Discussion

There was significant removal of heliothis eggs from egg cards throughout the season in both the lablab and adjacent INGARD cotton. The single spray of insecticides did not adversely affect the proportion of eggs removed. There was rarely more than 0.1 heliothis egg per plant during the season (Scholz *et al.* 2000), and natural populations of predators seemed to provide good control of these.

Night stalker spiders were identified as the key season long predator of heliothis eggs during this study. The night stalker spiders were observed on egg cards throughout the entire cotton field, whereas ants were only found in the edge rows, i.e. those closest to adjacent wheat stubble. Ants were also most commonly observed foraging on cotton plants that were small, and rarely observed when the plants had grown.

The apple dimpling bug was recorded on egg cards during diurnal and nocturnal observational studies. This species can be a pest of cotton, but appears to have a beneficial role as well. Additional work is required to quantify the pest status of this species.

The findings suggest that night stalker spiders and ants should be included as key beneficials in the current IPM guidelines. Species that have been historically reported as important predators of heliothis were rarely observed or absent during the observational studies. For example ladybird beetles, pirate bugs and damsel bugs were rarely observed on egg cards; while lacewings, red and blue beetles, big eyed bugs and shield bugs were not observed at all. It must be noted that the observational studies reported here involved observations of 'artificial' eggs, i.e. eggs on egg cards. This may not accurately reflect the natural levels of predation that occur in the field. Additional research is planned to evaluate the usefulness of egg cards as a study tool.

Night stalker spiders were rarely observed during the day, and ants were rarely observed after 9 am during summer. Consequently these species of predators may be difficult to sample during normal crop scouting routines. Many cotton consultants do not collect data on beneficial insects and spiders. If this is the case, attention must be paid to accurately recording the number and colour of heliothis eggs on plants. The presence of a lot of white eggs, but few brown eggs, is typical of egg predation. It may also be worthwhile for crop consultants and farmers to learn to recognise the signs of egg predation (e.g. Figure 1), as this may assist pest management decisions. For example, if a crop has a lot of white eggs; has few brown eggs or VS larvae; and has some eggs that appear shrivelled; then predators may be active and every effort should be made to conserve them by using Dipel® or Gemstar®.

Important egg predators are active in dryland cotton on the Darling Downs and every attempt should be made to recognise and understand their role in heliothis management.

Conclusions

- Night stalker spiders were important season long predators of heliothis eggs, and they occurred throughout the cotton field.
- Ants were important early season predators of heliothis eggs, but only occurred along the edges of fields.
- Apple dimpling bugs were observed feeding on heliothis eggs.
- Ladybird beetles, lacewings and most predatory bugs were rarely observed foraging on heliothis egg cards.

References

Scholz, B.C.G., Cleary, A.J., Lloyd, R.J. and Murray, D.A.H. (2000). An evaluation of lablab as a summer trap crop for heliothis, and nursery crop for beneficial arthropods, in dryland cotton. Proceedings of the 10th Australian Cotton Conference. *Paper in these Proceedings.*

Acknowledgements

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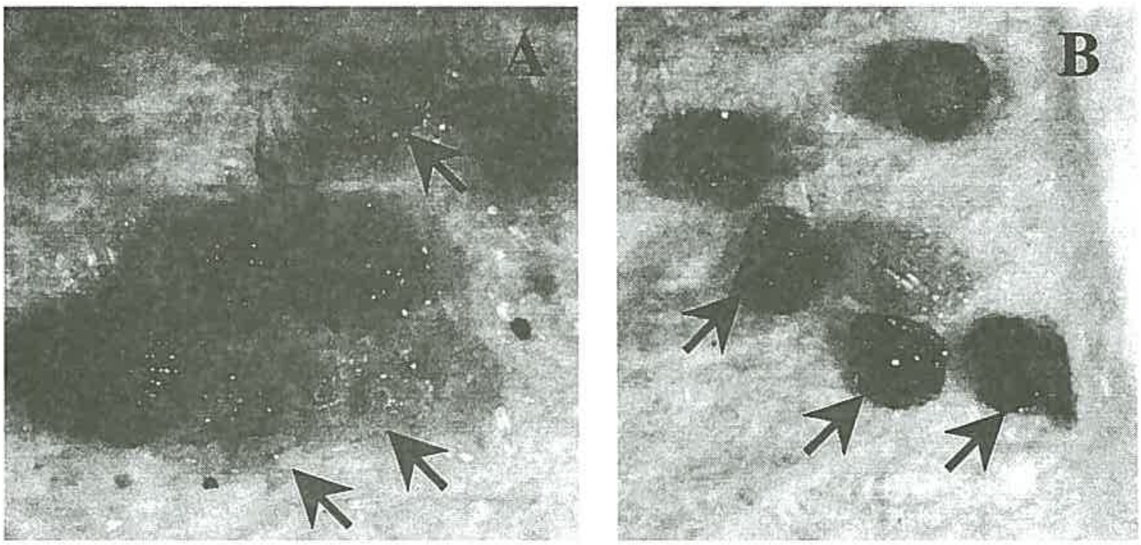

Figure 1: Heliothis eggs on egg cards that have been eaten by spiders (**A**) and apple dimpling bugs (**B**). The arrows indicate eggs that have been eaten. Typically, all that remains of an egg eaten by a spider is a clear egg shell (that may or may not be collapsed) with a small brown 'stain' near the top of the egg. Eggs that have been eaten by other sucking predators typically are discoloured and shrivelled. Ants usually remove all eggs from egg cards, leaving a 'clean' piece of paper.

Table 1: Details of observational studies.

Trial No.	Date	Time of Day	Interval [A]	Total No. Egg Cards	No. Egg Cards/ Row [D]	No. Rows
1	18 Nov. 1999	06:00-17:00	60 minutes	108 [B]	9	12
2	25 Nov. 1999	18:00-22:00	60 minutes	108 [B]	9	12
3	13 Jan. 2000	18:00-22:00	30 minutes	105 [C]	15	7
4	20 Jan. 2000	07:00-12:00	30 minutes	105 [C]	15	7

[A] Interval between observations for each egg card.
[B] In lablab rows 2,4, 6 and 8; and in adjacent cotton row-pairs 2, 8, 14, 20, 26, 32, 38 and 44.
[C] In cotton row-pairs 2, 9, 16, 23, 30, 37, 44.
[D] Egg cards within a row were 15 m apart.

Table 2: The predators observed on heliothis egg cards.

Trial No.	Predator	Scientific Name	Frequency (%) [A]	No. Cards [B]
1 (day)	black ant	*Iridomyrmex* sp.	27.8	30
	spiders	*Cheiracanthium* sp.	1.9	2
	transverse ladybird	*Coccinella transversalis*	0.9	1
2 (night)	spiders	*Cheiracanthium* sp.	14.8	16
	black ant	*Iridomyrmex* sp.	4.6	5
	small beetle		0.9	1
	thrips		0.9	1
3 (night)	spiders	*Cheiracanthium* sp.	22.9	24
	apple dimpling bug	*Campylomma liebknechti*	4.8	5
	small cricket		2.9	3
	small beetle		2.9	3
	black ant	*Iridomyrmex* sp.	1.9	2
	damsel bug	*Nabis kinbergii*	1.0	1
4 (day)	apple dimpling bug	*Campylomma liebknechti*	11.4	12
	thrips		8.6	9
	black ant	*Iridomyrmex* sp.	1.9	2
	pirate bug	*Orius* sp.	1.9	2
	striped ladybird	*Micraspis frenata*	1.0	1
	small cricket		1.0	1
	small grasshopper		1.0	1

[A] The percentage of egg cards that each predator was observed on.
[B] The number of egg cards that each predator was observed on.

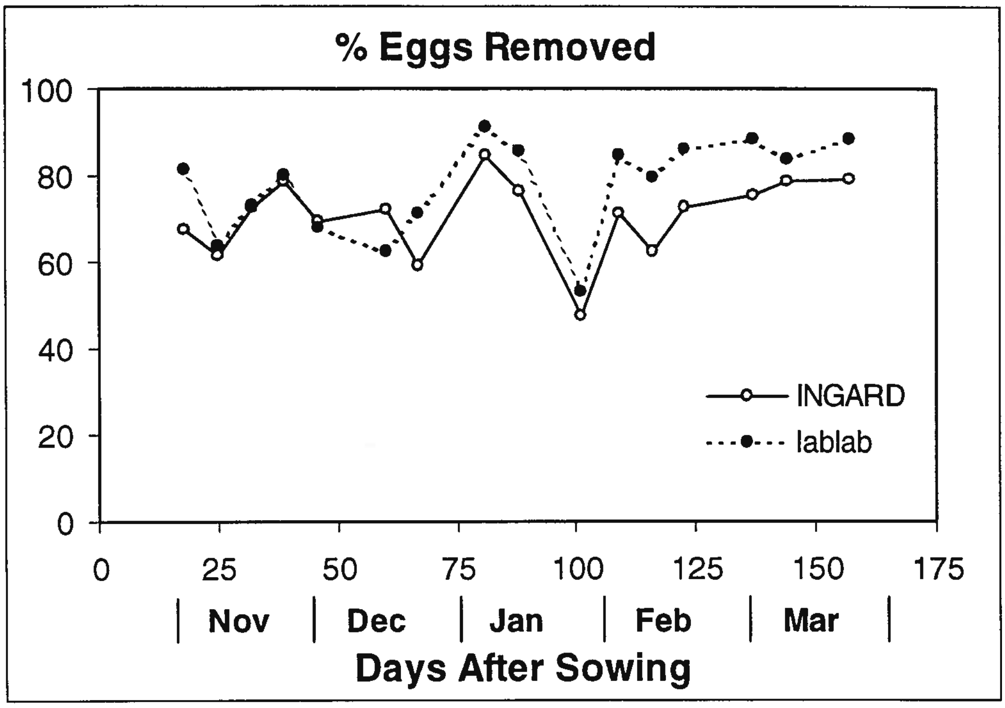

Figure 2: The percentage of heliothis eggs removed from egg cards at Jimbour during 1999/2000. The lablab was slashed on 31 Jan. 2000 (105 DAS); and the INGARD cotton was sprayed once with spinosad/fipronil on 4 Feb. 2000 (109 DAS).

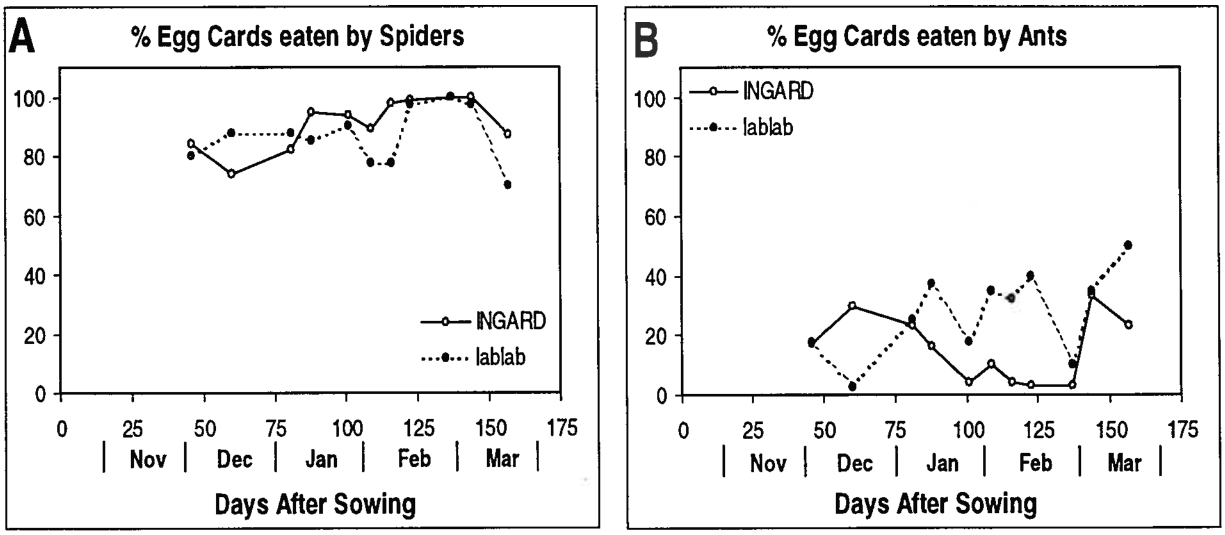

Figure 3: The percentage of heliothis egg cards showing feeding signs of predation by spiders (**A**) and ants (**B**). The lablab was slashed on 31 Jan. 2000 (105 DAS); and the INGARD cotton was sprayed once with spinosad/fipronil on 4 Feb. 2000 (109 DAS).

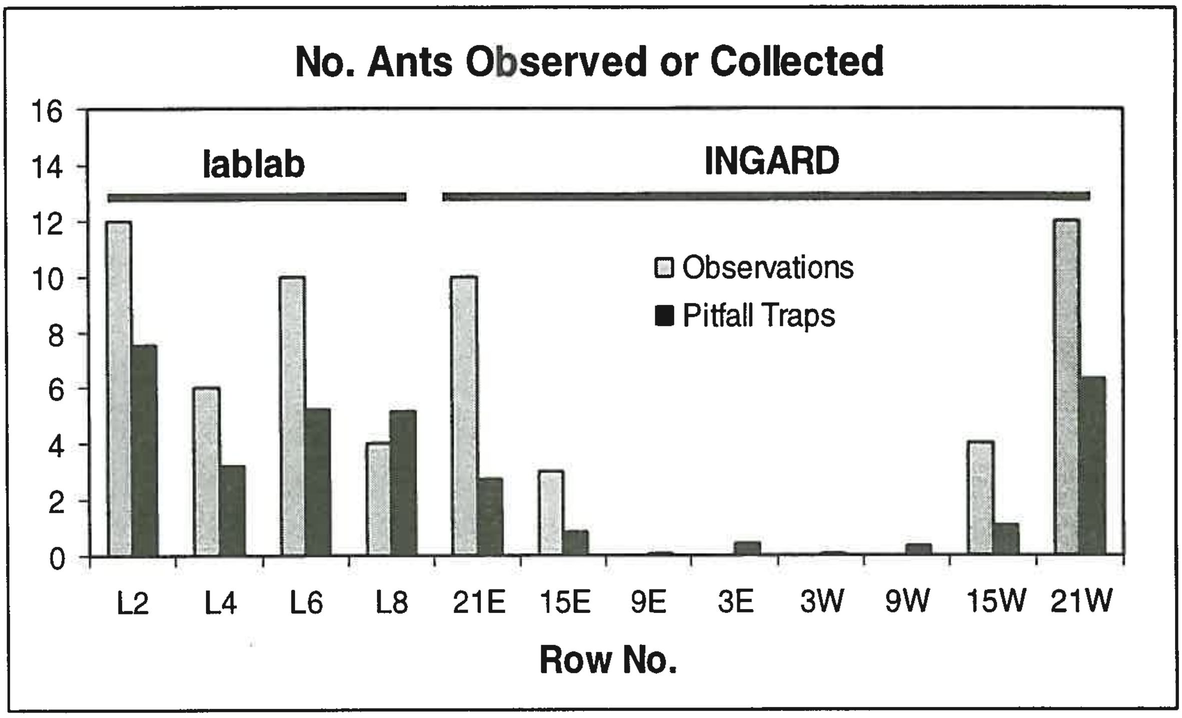

Figure 4: The numbers of ants observed on egg cards during Observational Study 1 (Table 1) and collected in pitfall traps during the season. Observational data are the number of times ants were observed on egg cards for a given row, and pitfall trap data are the mean number of ants caught per row in one trap (n = 28). A pitfall trap was placed in every second row of lablab (8 rows wide), and in every sixth row-pair of INGARD cotton (45 row-pairs wide), in each of the four strips. The cotton row numbers refer to the row position within a strip, i.e. row **9E** is the **ninth** row-pair **east** of the centre row-pair, and row **3W** is the **third** row-pair **west** of the centre row-pair. Rows L2 and 21W were nearest to the edge rows, and were closest to adjacent wheat stubble.