

# The value of unsprayed strip crops as nurseries for beneficials in dryland cotton on the Darling Downs.

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## Introduction

We are currently evaluating unsprayed strip crops planted beside dryland INGARD cotton as nurseries for beneficial arthropods. In the first season of trial work (1999/2000) lablab was evaluated as a nursery (Scholz *et al.* 2000). While lablab harboured some species of predators, it supported few *Trichogramma* egg parasitoids. *Trichogramma* wasps are considered important beneficials on the Darling Downs and a nursery crop that supports them, as well as other beneficials, may be useful for managing heliothis and other pests. Consequently, during the 2000/01 cotton season we evaluated unsprayed sorghum, maize and soybean strips as beneficial nurseries for adjacent INGARD cotton.

## Methods

The trial was carried out at St. John and Edwina Kents' property "Coondarra" near Jimbour on the Darling Downs. A nine metre wide unsprayed planting of sorghum, maize or soybeans was planted on the upwind edge of some cotton strips, and three of these strips were sampled two times per week for pests and beneficials. An unsprayed INGARD strip and two sprayed conventional cotton strips were also studied. Details of the insecticides applied to each strip are provided in Table 1.

## Study Strips

**Strip 2:** Unsprayed 4.1 ha section of NuPEARL (INGARD) cotton on the upwind section of the farm sown on 10 November 2000. The unsprayed cotton was 18 row-pairs wide and was adjacent to a 30 row-pair wide section of sprayed NuPEARL, that received three sprays for the season.

**Strip 4:** Sprayed 17.3 ha of NuPEARL (INGARD) cotton sown on 10 November 2000. A 1.2 ha strip of mixed sorghum hybrids was planted on the upwind edge of the cotton. The mixed sorghum hybrids were 8118, Jackpot and Blazer. The cotton was sprayed with insecticides three times.

**Strip 10:** Sprayed 14 ha of Siokra V-16i (INGARD) cotton sown on 5 November 2000. A 1.1 ha strip of mixed maize was planted on the upwind edge of the cotton. The mixed maize hybrids were 3394, NB102 and L135. The cotton was sprayed with insecticides twice.

**Strip 12:** Sprayed 26.2 ha of Siokra V-16i (INGARD) cotton sown on 5 November 2000. A 1.8 ha strip of soybeans (var. A6785) was planted on the upwind edge of the cotton. The cotton was sprayed with insecticides twice.

**Strip 21:** Sprayed 31.0 ha of Siokra V-16 (conventional) cotton sown on 10 November 2000. The cotton was sprayed with insecticides seven times.

**Strip 23:** Sprayed 31.1 ha of DeltaOPAL (conventional) cotton sown on 10 November 2000. The cotton was sprayed with insecticides seven times.

### **Insect Assessments**

Heliothis and beneficial arthropods were counted in the cotton once or twice per week. The top 20 cm of five consecutive plants at six randomly selected sites were checked for heliothis, and all eggs and larvae were counted. A beat sheet (Scholz *et al.* 2001) was used to count predators and green mirids in a one metre length of row, at six randomly selected sites per strip.

The levels of heliothis egg parasitism were assessed weekly by collecting naturally laid brown eggs from each cotton strip. All eggs were taken to the laboratory and transferred to plastic microtitre trays using a fine paint brush dipped in water. Each tray was sealed with sticky tape, labelled, and held at 25°C until the levels of egg parasitism could be determined. Parasitised eggs typically turn black after four days at 25°C, and adult wasps emerge after another six days.

*Trichogramma pretiosum* was released into the sorghum strip on the 12<sup>th</sup> January. Approximately 600,000 wasps were released into a 0.5 ha section of the sorghum strip. *Helicoverpa armigera* eggs were collected from pre-flowering sorghum heads prior to the release on January 12, and three days after the release on January 15.

The cotton yield was estimated by hand harvesting 4 x 5 m row-pair lengths of crop, and calculating the mean value for each strip.

### **Results**

The numbers of green mirids in the unsprayed INGARD were considerably higher than those in the sprayed INGARD, peaking at 3.3 and 2.0 mirids/m respectively (Figure 1). Green mirids were recorded in the unsprayed INGARD from January to March, with high numbers found throughout February.

The total numbers of predators recorded in sprayed INGARD and conventional cotton were much less than the numbers found in unsprayed INGARD (Figure 2). The numbers

in the unsprayed INGARD increased markedly from mid-late January onwards and peaked at 19.8 predators/m in late March, whereas numbers in the sprayed INGARD rarely exceeded 5 predators/m for the majority of the season. The seven sprays applied to the conventional cotton were extremely disruptive to predator abundance, with less than 2 predators/m found throughout most of the season.

There were slightly greater numbers of predators found in the INGARD next to soybeans than in the unsprayed INGARD early in the season, e.g. 2.5 and 1.0 predators/m respectively on the 9<sup>th</sup> January.

There were high levels of heliothis egg parasitism recorded in all of the INGARD strips, with levels of 100% parasitism recorded on five occasions (Figure 3). The levels of egg parasitism were much lower in the sprayed conventional cotton, peaking at 60% in strip 21.

There were early January peaks of ca. 60% egg parasitism in the INGARD that was adjacent to sorghum and maize, but not in the INGARD adjacent to soybeans. These peaks occurred prior to the releases of *T. pretiosum* on the 12<sup>th</sup> January.

The levels of *H. armigera* egg parasitism in the sorghum strips were 23.5% and 95.0% in the control and release sorghum respectively on the 15<sup>th</sup> January (3 days after the release of *T. pretiosum*). There were only 1.6 eggs per head in the sorghum on the 15<sup>th</sup> January.

The highest heliothis egg and larval densities occurred in the conventional cotton (Figure 4). This cotton was sprayed seven times and the heliothis densities peaked at 30.2 eggs/m (strip 21) and 5.4 larvae/m (strip 23). In contrast, the INGARD cotton received much lower heliothis pressure, with heliothis densities in the sprayed INGARD peaking at 8.1 eggs/m (strip 12) and 3.7 larvae/m (strip 10). The unsprayed INGARD had the lowest heliothis pressure, with peaks of 5.1 eggs/m and 2.1 larvae/m.

The INGARD cotton produced significantly higher yields than the conventional cotton (Table 2). Of these, the unsprayed INGARD produced the highest yield (6.3 b/ha).

## Discussion

We found that beneficials can manage heliothis in dryland INGARD cotton. The unsprayed INGARD produced the highest yield, and had the greatest numbers of predators throughout the season. The levels of egg parasitism were high in all of the INGARD strips studied (up to 100% egg parasitism), and lower in the conventional cotton (up to 60% egg parasitism).

It was difficult to draw any meaningful conclusions about the value of the strip crops as nurseries for predators because different cotton varieties and spray regimes were used throughout the farm. However, the disruptive nature of insecticides to the growth of predator populations was obvious. Some INGARD strips were only sprayed twice (with Folimat® and Steward™), and the numbers of predators in these strips were much lower than those found in unsprayed INGARD cotton (Figure 2). Applying Folimat® against green mirids impeded the growth of the predator population. Consequently the decision to spray, or not spray, for mirids is very important. There were approximately two or more green mirids per metre in the unsprayed INGARD for five consecutive weeks (Figure 1), yet this strip produced the highest cotton yield. This suggests that the thresholds for mirids in INGARD cotton may need to be adjusted.

There were few predators in the unsprayed INGARD during December and early January, but the numbers rose steadily from late January onwards. This has important implications for IPM practices designed to utilise beneficials, i.e. try to avoid using chemical insecticides for as long as possible, not just early in the season.

The application of insecticides was not as disruptive to egg parasitoids as it was on predators, and there were high levels of heliothis egg parasitism in all of the INGARD strips from mid-late January onwards (Figure 3). Egg parasitoids were detected in the INGARD cotton planted beside either sorghum or maize before they were detected in the INGARD cotton beside soybeans or in the unsprayed INGARD strip. Sorghum and maize are extremely attractive to ovipositing heliothis moths at the pre-flowering and silking stages respectively. As such, these crops have the potential to produce large numbers of egg parasitoids over a short period of time.

The sorghum and maize strips planted for this study started pre-flowering/silking during the first week of January. This was approximately the same time that the first records of egg parasitism were found in the adjacent INGARD cotton. This suggests that the egg parasitoids were attracted to the sorghum and maize, and there was a 'spill over' effect into the adjacent cotton. Alternatively, egg parasitoids that had emerged from nearby sorghum crops may have migrated to the farm.

We have been releasing *Trichogramma pretiosum* in south-east Queensland since 1995. It is a new species for the region and is particularly effective against heliothis. We hope that this species will become established throughout the cotton growing districts and reduce the need to spray for heliothis. In this study the levels of heliothis egg parasitism peaked at 100% on several occasions. This is considerably higher than the previous season

(1999/2000), when the levels of egg parasitism peaked at 71% (Scholz *et al.* 2000), and may indicate that *T. pretiosum* is now well established at Jimbour. It would be worthwhile to monitor heliothis egg parasitism over the next few seasons to determine if the high levels of parasitism reported here are consistent over consecutive seasons, and under different heliothis densities and spray regimes.

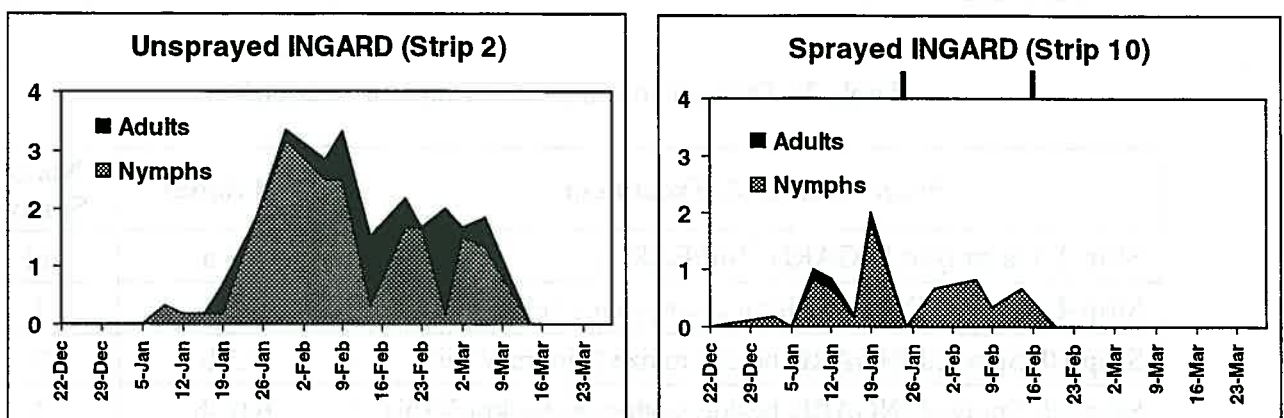
The role of unsprayed nursery strips as a source of *Trichogramma* is unclear. It is possible that nearby sorghum crops were the source of the parasitoids responsible for the high levels of egg parasitism recorded at “Coondarra”, and that the populations of egg parasitoids produced in the unsprayed strips were small when compared to those generated off-farm. Further research is needed to clarify the role, if any, of on-farm sorghum strips as sources of egg parasitoids.

### Acknowledgements

We thank St. John and Edwina Kent of “Coondarra” for cooperating in this research; Sue Maclean for providing heliothis eggs; Jamie Hopkinson, John Mundell, Peta Neale and Michelle Roberts for assisting with field work on occasions; and the Cotton Research and Development Corporation for funding the research (project DAQ 96C). This assistance is gratefully acknowledged.

### References

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- Scholz, B., Cleary, A. and Lloyd, R. (2001). Sheet unbeatable for sampling predators in cotton. *Australian Cottongrower* 22(5): 14-17.



**Figure 1:** The numbers of green mirids in sprayed and unsprayed dryland INGARD cotton at Jimbour during the 2000/01 season. The vertical lines refer to the application of insecticides (see Table 1 for spray details). Data are the mean numbers per metre of six beat samples.

**Table 1:** Details of insecticides applied to cotton at Jimbour during 2000/01. An 'X' indicates the application of an insecticide. Strip 2 was unsprayed.

Date	Product	Rate (mL/ha)	Strip Number					
			2	4	10	12	21	23
21 Dec	emamectin (Affirm®)	600						X
30 Dec	spinosad (Tracer®)	200					X	
4 Jan	spinosad (Tracer®)	200						X
16 Jan	emamectin (Affirm®)	700					X	
22 Jan	spinosad (Tracer®)	200					X	X
	omethoate (Folimat®)	200						
23 Jan	omethoate (Folimat®)	200		X	X	X		
4 Feb	bifenthrin (Talstar®)	800					X	X
	PBO	400						
13 Feb	indoxacarb (Steward™)	850		X				
	Pix	800						
17 Feb	indoxacarb (Steward™)	850			X	X		
17 Feb	chlorpyrifos-ethyl (Predator®)	5000					X	X
	methomyl (Lannate®)	1000						
	Pix	500						
23 Feb	beta-cyfluthrin (Bulldock®)	800					X	X
	amitraz (Ovasyn®)	2000						
	PBO	400						
27 Feb	dimethoate (Rogor®)	500		X				
27 Feb	chlorpyrifos-methyl (Rescue®)	2000					X	X
	chlorpyrifos-ethyl (Predator®)	5000						

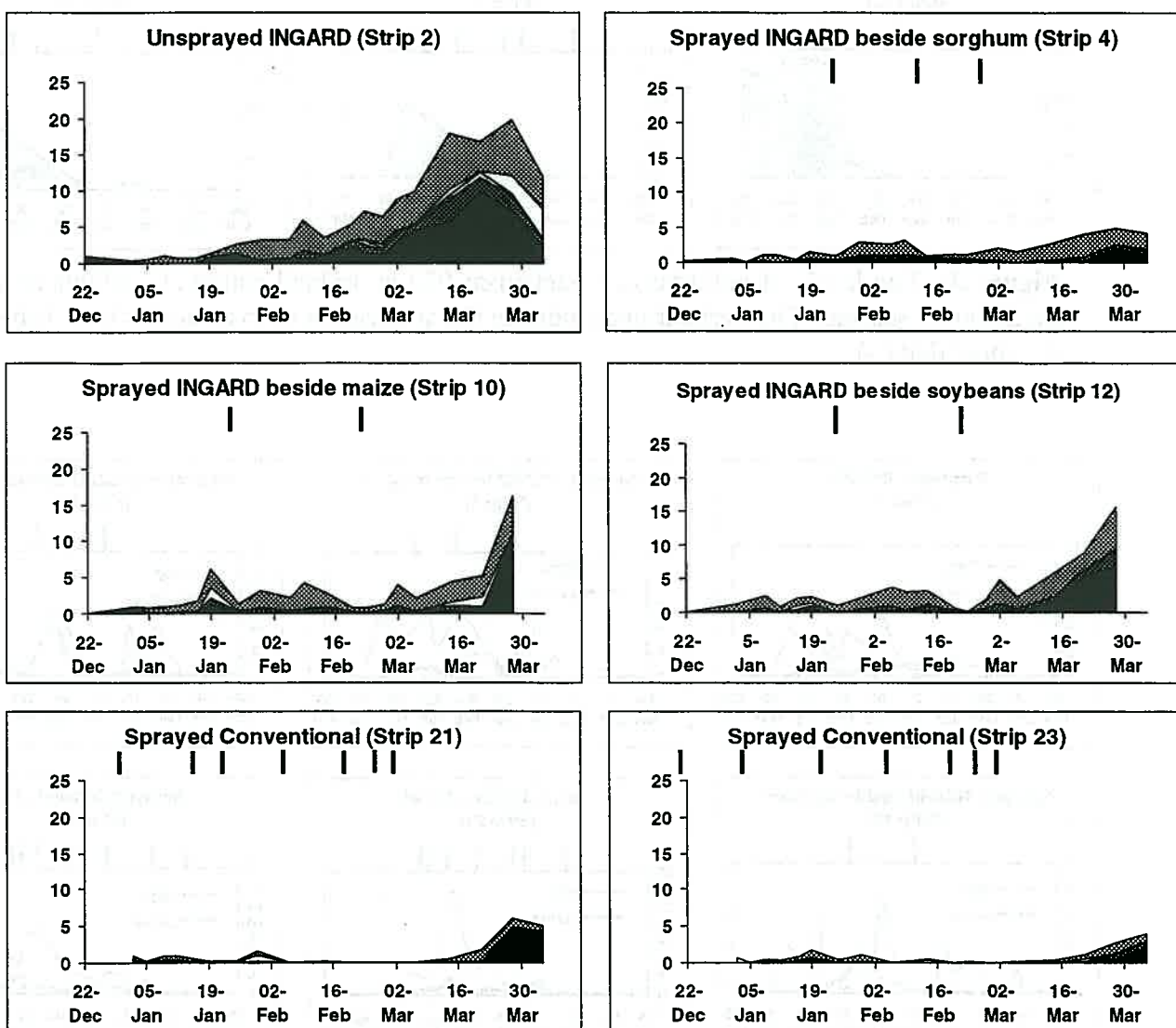
**Table 2:** Dryland cotton yields at Jimbour – 2000/01.

Strip Number & Treatment	Yield (b/ha) *	No. of Sprays
Strip 2: Unsprayed INGARD (NuPEARL)	6.3 a	nil
Strip 4: Sprayed INGARD beside sorghum (NuPEARL)	5.5 b	3
Strip 10: Sprayed INGARD beside maize (Siokra V16i)	5.5 b	2
Strip 12: Sprayed INGARD beside soybeans (Siokra V16i)	6.0 ab	2
Strip 21: Sprayed conventional (Siokra V16)	4.4 c	7
Strip 23: Sprayed conventional (DeltaOPAL)	4.8 c	7

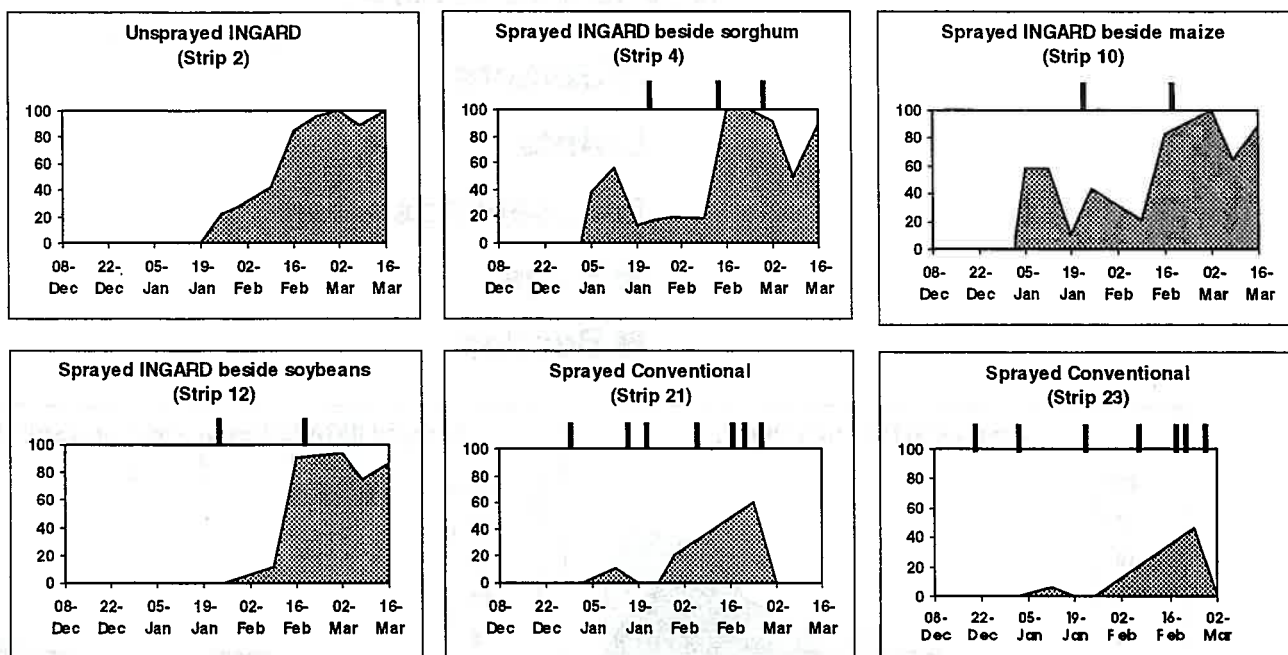
\* Data are the means of four hand harvest samples. Yields followed by the same letter are not significantly different (P=0.05, ANOVA, Fisher's LSD). Details of insecticide applications are provided in Table 1.

### Key to Predators:

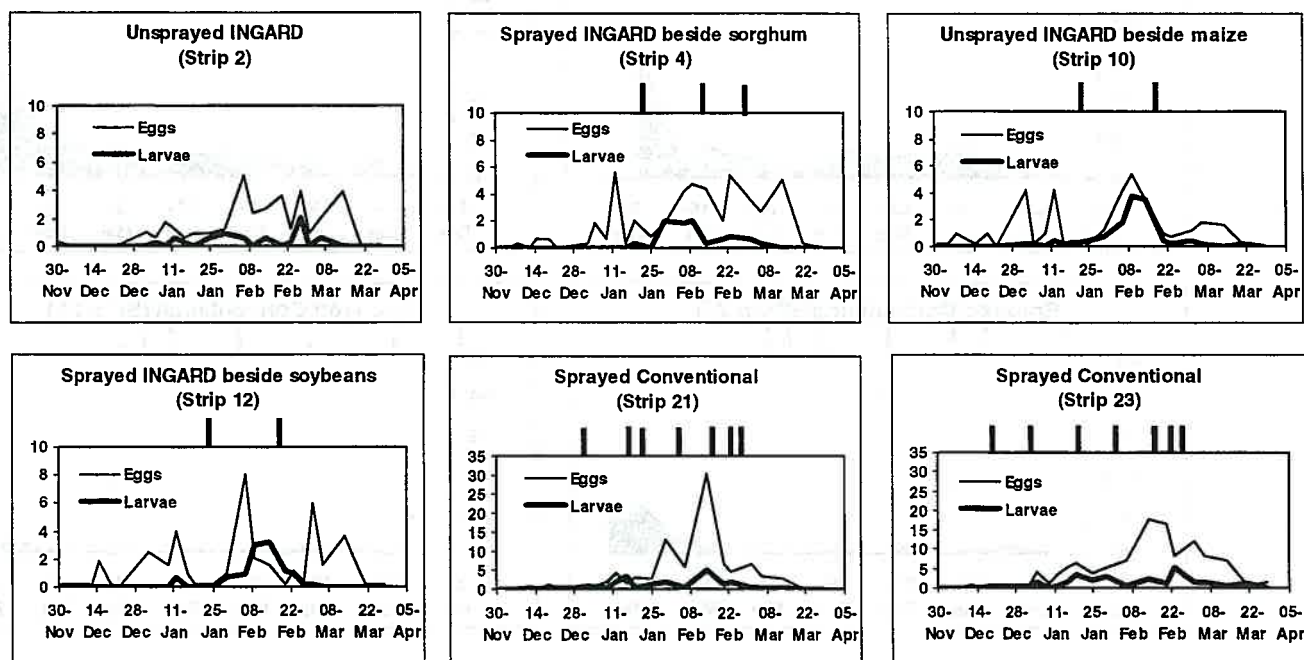
- Spiders
- Ants
- ▨ Lacewings
- Bugs
- Beetles



**Figure 2:** The mean numbers of predators per metre in dryland cotton at Jimbour during the 2000/01 season. The vertical lines indicate the application of insecticides (see Table 1 for spray details). Data are the mean of six beat samples for each sample date.



**Figure 3:** The levels of heliothis egg parasitism (%) in dryland cotton at Jimbour during the 2000/01 season. The vertical lines indicate the application of insecticides (see Table 1 for spray details).



**Figure 4:** The numbers of heliothis eggs and larvae per metre in dryland cotton at Jimbour during the 2000/01 season. The vertical lines refer to the application of insecticides (see Table 1 for spray details). Data are the mean numbers per metre of six beat samples. N.B. The y-axis varies between 10 and 35 predators/m for the INGARD and conventional cotton respectively.