THE ECONOMIC CONTRIBUTION OF BENEFICIAL ARTHROPODS IN A COTTON IPM PROGRAM

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Abstract

A field study was designed to compare Tracer™ Naturalyte™ insect control in an IPM cotton program with one that represented a conventional approach by removing beneficial arthropods from one of the plots and maintaining them in the other. Both pest and beneficial arthropod populations were monitored season long providing evidence of the impact of the beneficials as well as the dollar value added in net return per acre to the grower as a result of their presence.

Tracer (spinosad), a Trademark of Dow AgroSciences
Naturalyte, a Trademark of Dow AgroSciences

Introduction

The importance of beneficial arthropods in cotton insect pest control has been widely reported and accepted (Funderburk et al. 1993; Nuessly and Sterling, 1994; Ruberson et al. 1994) but the dollar value contributed by their presence in an IPM approach to insect control has been difficult to determine. Tracer Naturalyte insect control has been shown to be an excellent lepidopteran pest control agent in cotton while at the same time having little detrimental effect on most beneficial arthropods (Thompson, et al. 1995; Peterson, et al. 1996; Bret, et al. 1997; Peterson, et al. 1997). These characteristics, along with its favorable environmental and mammalian toxicology picture (Bret, et al. 1997; Saunders and Bret, 1997) allow Tracer to be the basis for an effective IPM program in cotton and other crops. This study attempts to use the IPM features of Tracer and place a dollar value on the role of beneficial arthropods.

Materials and Methods

Field plots were established in Calhoun County, FL, on 2 adjacent 10 acre plots of dry-land, conventional cotton. The variety, BXN-42, was planted on May 2, 1998 and was monitored in 5 sub-plots per block for both beneficial arthropods and insect pests at 3-4 day intervals all season long.

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One of the 10 acre blocks was treated with 0.625 lb ai/A of Malathion 5EC on two occasions, beginning with the first Tobacco budworm flight, to remove or reduce the presence of beneficial arthropods. This is referred to as the conventional plot.

Tracer 4SC was selected for use against worm pests in both the IPM plot and the conventional plot to limit the variability among worm control products. The beneficial arthropods were allowed to remain at their natural levels as much as possible in this plot. Pest management sprays were applied to each plot on an as needed basis, determined by the 3-4 day scouting.

Karate Z was included in the spray program for both plots on an as needed basis to either control secondary pests not controlled by Tracer, or to supplement the worm control under extremely heavy pest pressure.

All foliar applications were broadcast by tractor using hollowcone disc nozzles, 50 PSI and 5.25 GPA. Applications began in mid-June and continued through mid-August. Sprays of Malathion were made to the conventional plot on June 25 and again on July 10. Continued population monitoring determined that no additional Malathion sprays were necessary to keep beneficial numbers low. Pest management sprays were made to each block on an as needed basis (Table 1). By the end of the season, 5 applications had been made to each block. The only difference in spray applications was an additional tank-mix of Karate with one of the Tracer sprays in the conventional plot.

The cotton was scouted on 3-4 day schedule throughout the season. For worm pests, whole plant searches were made looking at 10 plants each in 5 sub-plots per block, for a total of 50 plants. Observations were made for heliothine eggs, small larvae (<3/8”), and large larvae (>3/8”). Fall armyworm larvae were also reported according to size. Data were reported as number of plants infested/plot and converted to % infestation. Aphids and soybean looper were recorded as the number present.

Beneficial arthropods were monitored using 3 different techniques. Early in the season, with cotton less than 18” high, sweep nets were used taking 10 sweeps in each of the 5 sub-plots per block.

A shake cloth technique was also used, shaking two 3 foot row samples in each sub-plot and counting the arthropods observed on the cloth.

Later in the season, a 5 gallon bucket was used. Two whole plants per sub-plot were bent over into the bucket and shaken to capture the insects.

All of the beneficial arthropods were counted, identified to species where possible and recorded by sampling technique.

For the purposes of this report, the beneficial counts from each technique were combined for that day and reported as total beneficials observed.

Yields were taken from 50 feet of row at each of the 5 sub-plots within each plot. Seed cotton weights were converted to pounds of lint using a 38% conversion factor. For calculating the economics of the 2 programs, the price of Tracer was $746.24/gallon and Karate Z was priced at $255.00/gallon. The market price of $0.68 per pound of lint was used in the calculation of net return.

Results and Discussion

The tobacco budworm moth flight occurred around June 25, at which time the first Malathion spray was made to the conventional plot. This effectively reduced the numbers of beneficials that were available to prey on the incoming pest population. The pest population was monitored routinely in both the IPM and conventional plot. The pest species that were observed are reported in Table 2.

Although the summer of 1998 was very hot and dry during most of the cotton growing season in the panhandle of Florida, there were ample numbers of beneficial arthropods available throughout the season. The breakdown of beneficial arthropods identified in the plots during the season is reported in Table 3.

The season-long population counts of total beneficial arthropods, captured by all methods, are reported as line graphs in Figure 1.

Significant numbers of heliothine eggs were counted in both the IPM and the conventional plots beginning in late June and continuing through mid-August. The egg lays were quite consistent, especially throughout July, but what stands out is that there were several peaks of very high egg counts in the conventional plot whereas the numbers in the IPM were consistently lower and without steep swings (Figure 2).

This factor is attributed to the presence of beneficial arthropods that were presumably preying on the heliothine eggs.

A similar trend was observed with the populations of tobacco budworm, cotton bollworm, Fall armyworm and soybean looper (Figure 3). Relatively high numbers of tobacco budworm, cotton bollworm and Fall armyworm were present throughout the season and treatments were required in both plots. Soybean looper appeared in small numbers and only in the conventional plot.

As with the egg laying, steep peaks of population surges took place in the conventional plot but the peaks in the IPM plot populations were much less pronounced. These peaks in the conventional plots mean that at these times there are more larvae present and this relates directly to increased insect damage taking place.

The treatments did a reasonable job of bringing the worm pests under control in both plots, but the numbers returned, rebounding more quickly in the conventional plot which also had fewer beneficial arthropods (Figure 1). It is postulated that the higher numbers of beneficial arthropods present in the IPM plots held the numbers of larvae in check and thus avoided steep population peaks and reduced crop damage.

One of the secondary pests that appeared to flare in the conventional plot was the cotton aphid. Very few aphids were recorded in the IPM plots while they did occur in the conventional plot. Figure 4 shows the relative number of beneficial arthropods per plot and the numbers of aphids per plant at 3 consecutive observation dates. The numbers of beneficial arthropods in the conventional plot between July 20 and July 27 were considerably less than in the IPM plot. Correspondingly, cotton aphids were observed in the conventional plot but were scarce in the IPM plot. The aphid population never did reach high numbers and crashed in early August, however, the differences observed between the two plots is attributed to the presence of beneficials in the IPM plot, not allowing the aphids to flare.

Yield in the IPM plot, recorded in pounds of lint per acre, was calculated to be 506.6 lb/A and that of the conventional plot was 372.5 lb lint/A. Using the value $0.68 per pound of the lint, the gross dollar returns for the two treatments were $344.50 for the IPM plot and $253.30 for the conventional plot.

Using the treatment schedule described in Table 2, the chemical costs were calculated to be $59.10 for the IPM plot and $65.73 for the conventional plot. Completing the calculations gave a net return of $285.40 for the IPM plot and $187.57 for the conventional plot. This resulted in a net positive return of $97.83 per acre in the IPM plot that can be attributed to the presence and activity of beneficial arthropods.

Conclusions

In this demonstration, using Tracer Naturalyte insect control as the foundation of a workable IPM program in southeast cotton, beneficial arthropods made a significant contribution to the economics of the cotton crop.

Beneficial arthropods reduced the target heliothine egg and larvae numbers relative to the corresponding conventional plot, as well as secondary pests Fall armyworm, soybean looper and cotton aphid. The beneficial arthropods were responsible for reducing the sharp peaks of pest populations observed in the conventional plots.

Even in drought year, like 1998, beneficial arthropods are able to add value, over $97.00 positive net return to the grower in this example.

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Table 1. Seasonal spray schedule for 1998 IPM and conventional pest management. Treatments are in lb ai/A.

IPM Plot Treatments					Conv. Plot Treatments				
#	Date	Treatment	lb ai/A		#	Date	Treatment	lb ai/A	
1	30 Jun	Tracer	0.045		1	30 Jun	Tracer	0.045	
					2	14 Jul	Tracer	0.063	+
							Karate	0.026	
2	21 Jul	Tracer	0.063						
3	28 Jul	Tracer	0.063	+	3	28 Jul	Tracer	0.063	+
		Karate	0.016				Karate	0.016	
4	04Aug	Karate	0.042		4	04Aug	Karate	0.042	
5	18Aug	Tracer	0.069		5	20Aug	Tracer	0.069	

Table 2. Cotton pests observed in the plots at some time during the season.

Cotton Pests Identified During the Season	
Heliothis virescens	Tobacco budworm
Helicoverpa zea	Cotton bollworm
Spodoptera frugiperda	Fall armyworm
Pseudoplusia includens	Soybean looper*
Aphis gossypii	Cotton aphid*
Euschistus & *Nezara* sp.	Stink bugs, mixed species

(*Note: Soybean looper and Cotton aphid were found in significant numbers only in the conventional plot)

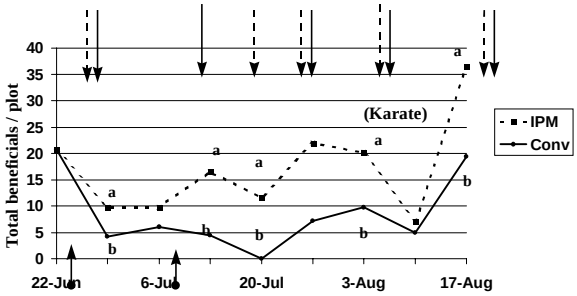
Table 3. Beneficial arthropods observed in the plots at some time during the season.

Major Beneficial Arthropods Identified in Season	
Geocoris sp.	Bigeyed bug
Solenopsis wagneri	Red imported fire ant
Hippodamia convergens	Convergent lady beetle
Peucetia virdans	Green lynx spider
Occasional Beneficial Arthropods Identified	
Chrysoperla plorabunda	Common green lacewing
Tachypompilus analis	Red-tailed wasp
Notoxus sp.	Hooded beetle
Misumenops celer	Celer crab spider

Table 4. Chemical cost, yield in lint and net return per acre from IPM and conventional plots. Altha, FL. 1998. (Means with the same letter do not significantly differ. P=0.05, Duncan's New MRT).

Control Program	Chem Cost/A	Yield in Lb lint/A	Gross Income/A*	Net Return/A
IPM	$59.10	506.6 (a)	$344.50	$285.40
Conv.	$65.73	372.5 (b)	$253.30	$187.57
		Net advantage to beneficials in IPM plot		**$ 97.82**

*Note: Cotton lint return based on $0.68 per pound.



Beneficial Arthropod Trends by Observation Date. P=.05 Duncan's MRT

Figure 1. Total number of beneficial arthropods per plot as observed by observation date. Arrows pointing down indicate pest management applications; arrows pointing up indicate Malathion application to conventional plot. Altha, FL 1998.

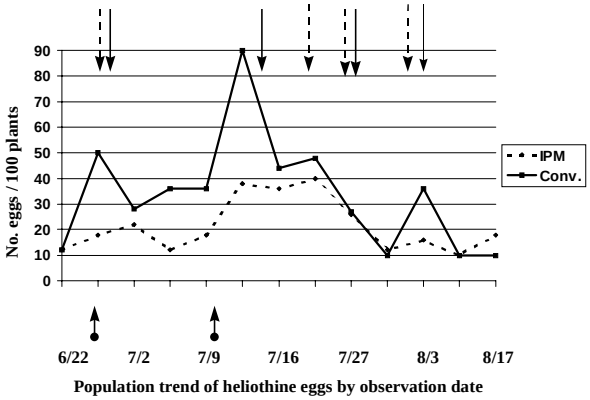


Figure 2. Season trend of heliothine egg laying in IPM and Conventional plots. Arrows pointing down indicate pest management applications; arrows pointing up indicate Malathion application to conventional plot. Altha, FL. 1998.

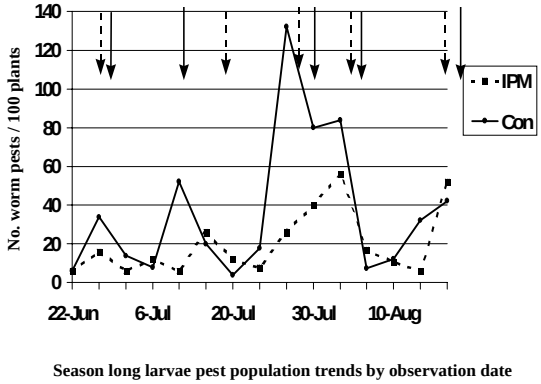


Figure 3. Season long population trend of all lepidopterous pests in IPM and conventional plots, Arrows pointing down indicate the pest management applications to each plot. Altha, FL. 1998.

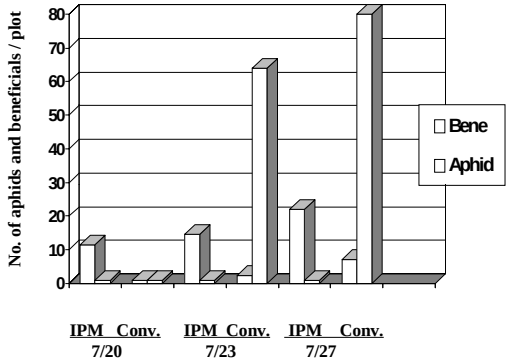


Figure 4. Cotton aphids and beneficial arthropods present in IPM and conventional plots in late July . Altha, FL. 1998 .