POPULATION DYNAMICS OF TOBACCO BUDWORM AND COTTON BOLLWORM AND THEIR NATURAL ENEMIES IN CONSERVATION TILLAGE COTTON

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ABSTRACT

Populations of the tobacco budworm, Heliothis virescens (F.), the cotton bollworm, Helicoverpa zea (Boddie), and their natural enemies were monitored from 27 April through 8 September 1993 in crimson clover (Trifolium incarnatum L.) and a subsequent conservation tillage cotton (Gossypium hirsutum L.) crop. Predaceous arthropods (mostly the big-eyed bug, Geocoris spp.) and parasitoids (Braconidae) were very active against H. zea (65%) and H. virescens (35%) populations during May. Predaceous arthropods were also very active during June and July in cotton. The parasitic wasp, Trichogramma spp., became very effective in regulating H. zea during August. Arthropod populations through the season did not differ between plots treated with herbicide and mechanically cultivated for weed control in winter covers of clover and fallow. Future research will detect pattern of moth emergence during the spring.

INTRODUCTION

There has been increased interest in conservation tillage because of its potential to control soil erosion and use energy more efficiently. Most of the cotton (Gossypium hirsutum L.) pest management research has focused on conventional tillage systems. Because of the relationship of some arthropods (both pest and beneficial) with the soil and various cover crops such as crimson clover (Trifolium incarnatum L.), it is important to explore the effects of conservation tillage on specific arthropods.

The major lepidopterous pest in cotton in South Carolina is the tobacco budworm (Heliothis virescens (F.))/cotton bollworm (Helicoverpa zea (Boddie)) complex. These pests overwinter as diapausing pupae in earthen cells as deep as six inches. Overwintered moths emerge largely during May through exit tunnels made by the prepupae the previous year (Neunzig, 1969). Through the cotton growing season, prepupae drop to the soil before pupation and tunnel about one inch deep. There can be up to four generations in South Carolina cotton fields. Roach (1981a) reported that while greater numbers of moths emerged from conservation-tillage plots, conservation-tillage and plow-tillage systems in cotton had similar Heliothis/Helicoverpa populations (Roach 1981b).

The complex of predaceous arthropods and parasitoids that attack the TBW/CBW complex has the potential to be quite effective in cotton. Higher populations of natural enemies may occur with conservation tillage (All and Musick, 1986) compared to conventional. For optimum pest control, it is important to ensure the conservation and enhancement of natural enemies (McCutcheon and Turnipseed, 1981). Therefore, we must avoid practices that interfere with biological control and utilize procedures that favor the biological potential of natural enemies. Altering diversity of vegetation will favor some biological control agents.

The purpose of this study was to document seasonal occurrence and population density of TBW/CBW and their natural enemies in conservation tillage systems.

MATERIALS AND METHODS

Eggs and larvae of the tobacco budworm/cotton bollworm (TBW/CBW) were monitored and sampled twice per week from 27 April through 8 September, 1993 in a winter cover of crimson clover and a subsequent conservation tillage cotton crop. Research was conducted at the Pee Dee Research and Education Center near Florence, South Carolina.

Treatments included winter cover (crimson clover and fallow), planting date of 'DES-119' (15

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April, 29 April, and 25 May) and midrow weed control method (herbicide-glyphosate and V-blade cultivator). Treatments were arranged in a randomized complete block design with a split plot arrangement. Winter cover and planting date combinations were the main plots, and the midrow weed control methods were subplots. Crop management and treatment applications are described by Bauer et al. 1994.

Larvae were collected from crimson clover by using a heavy sweep net (37.5 cm diameter). Eggs and larvae were collected and population estimates recorded from the visual examination of 100 cotton plants per treatment once or twice per week. Predaceous arthropod populations were estimated by using a 15 quart dishpan (14⅝" X 13" X 6⅛"). The plants were bent gently over and shaken into the dishpan in order to count predators. Two 1-m sections were sampled in each plot.

Each larva detected was placed individually in a 30-ml plastic cup containing artificial diet (Greene et al. 1976). Eggs were transported to the laboratory and placed individually in size 0 gelatin capsules. Larvae and eggs were held at 26 ± 2° C, 60 ± 5% RH, and a 14:10 LD regimen and checked every 1 to 2 d for hatching, parasitoid emergence, pupation, and disease symptoms. Egg para- sitoids were prepared and mounted on slides for identifications. Adult parasitoids that emerged from pest larvae, along with their cocoons, were preserved in vials of 95% ethyl alcohol.

Table 1. Percent composition of predaceous arthropods in crimson clover and a subsequent conservation tillage cotton crop. 1993. Florence, S. C.

	Clover - May	Cotton - June
Geocoris spp.	45.8	59.5
Coccinellidae	24.3	-
Araneida	15.3	9.7
Nabis spp.	7.6	9.7
Formicidae	4.2%	6.5
Notoxus spp.	-	13.0

RESULTS AND DISCUSSION

Natural enemies of TBW/CBW were very active during May 1993. Predaceous arthropods were prevalent in crimson clover reaching 79 per sweep net sample (100 sweeps). The big-eyed bugs, Geocoris spp., were the most abundant, comprising 45.8% of the predator complex (Table 1). Ladybird beetles (Coccinellidae) were common in the clover (24.3%). Parasitism of TBW/CBW larvae was high, reaching 66% during mid-May. Parasitoids were braconid wasps (Family Braconidae) and included Cardiochiles nigriceps, Meteorus autographae, Cotesia marginiventris, and Microplitis croceipes (Table 2).

During June, TBW/CBW larval estimates reached only 5 per 100 plants. Asana was applied on 24 June. Predators detected with the dishpan were quite abundant in cotton, reaching 37 per 8 m of row. Again Geocoris spp. were the most prevalent, and antlike flower beetles, (Notoxus spp.), damsel bugs (Nabis spp.), spiders (Araneida), and ants (Formicidae) occurred. Ladybird beetles (Coccinellidae) were not detected in the cotton during June (Table 1).

The eggs of TBW/CBW reached their peak population during late July at 84 per 100 plants. Predaceous arthropods were abundant in mid July reaching 74 per 8 m of row (Fig. 1). It appears that the high number of Geocoris helped to regulate pest population. Larval estimates reached only 2 per 100 plants. Insecticide was also used 21 (Larvin) and 27 (Scout) July. Predators followed a density dependent trend; therefore, when TBW/CBW eggs were available, predators were very abundant.

During August, egg counts were relatively low. In late August, H. zea approached economic threshold levels for a brief period of time. In addition to predators, which reached 38 per 8 m of row on 12 August (Fig. 2), Trichogramma spp. became active. Percent parasitism was high throughout the month, reaching 42% on 25 August. Trichogramma remained active following an application of Asana on 12 August. This parasitoid was rarely detected during June and July.

There were no significant differences among planting dates, winter cover, or weed control methods in arthropod populations season-long.

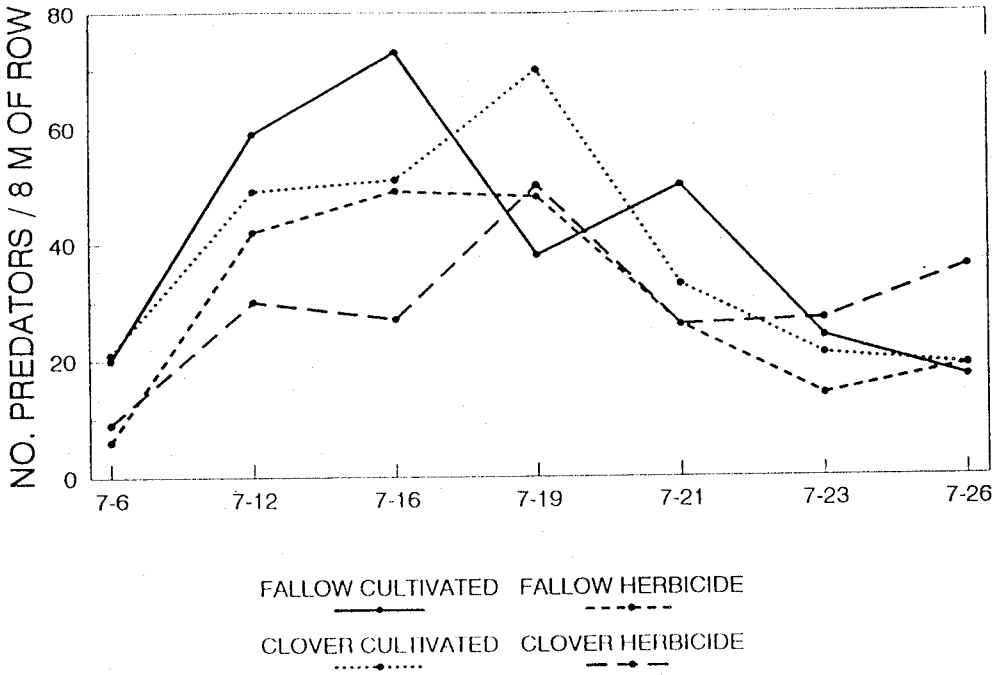

Figure 1. Population estimates of predaceous arthropods in conservation-tillage cotton. Florence, SC. July 1993.

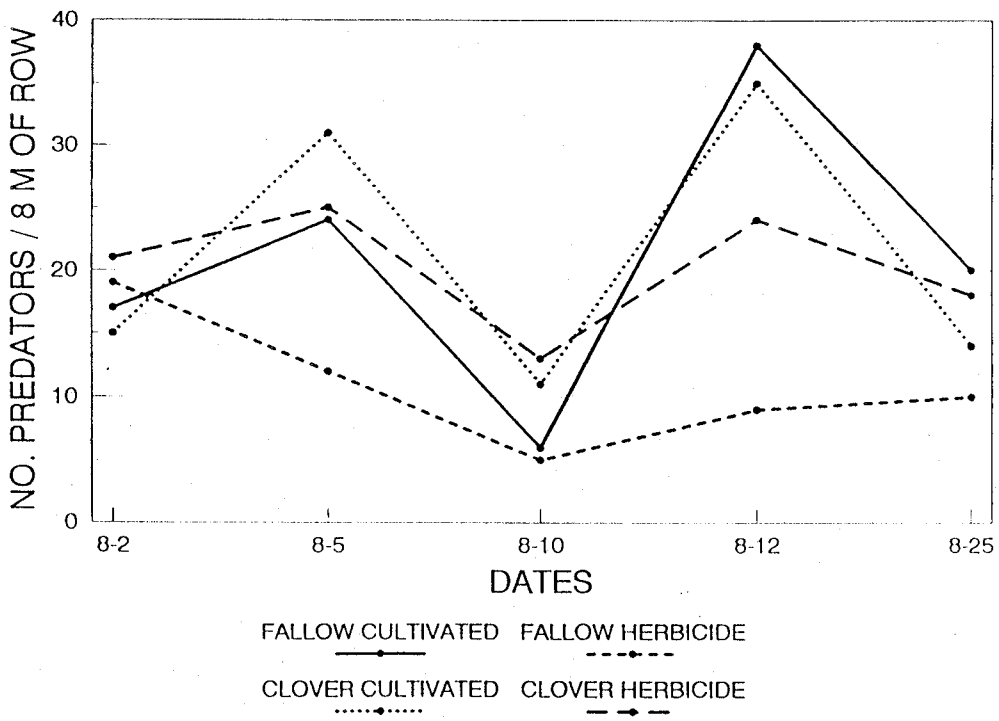

Figure 2. Population estimates of predaceous arthropods in conservation-tillage cotton. Florence, SC. August 1993.

Table 2. Percent parasitism by braconid wasps on budworm/bollworm larvae collected from crimson clover. 1993. Florence, S.C.

	n	Cotesia marginiventris	Cardiochiles nigriceps	Microplitis croceipes	Meteorus autographae
May 11	65	7.7	3.1	1.5	0.0
May 17	71	11.3	22.5	16.9	15.5
May 25	41	0.0	19.5	0.0	2.4
May 27	28	0.0	10.7	10.7	7.1
May 28	9	11.1	22.2	0.0	0.0

Table 3. Percent composition of two lepidopterous species in crimson clover during May and cotton during June, July, and August. 1993. Florence, S. C.

	n	Heliothis virescens	Helicoverpa zea
May	153	35.3	64.7
June	48	79.2	20.8
July	211	25.6	74.4
August	78	<1.0%	99.6%

Percent composition of TBW and CBW is listed in Table 3 for May, June, July, and August.

Future research will measure patterns of moth emergence in these plots. Also, in 1994, arthropod populations will be monitored.

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