CONSEQUENCES OF EARLY- SEASON FOLIAR INSECTICIDES IN COTTON IN SOUTH CAROLINA

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Abstract

During 1996 and 1997 we examined the consequences of June-early July insecticidal applications on predacious arthropods, later development of the cotton bollworm (*Helicoverpa zea*), extent of damage, and effects on crop maturity and yield. Although research included conventional cotton, emphasis was on effects of beneficials on *H. zea* threshold development in B.t. cotton. Large fields (on-farm) were planted half to 'DPL 5415' and half to 'NuCOTN 33b' with half of each cultivar treated with acephate to "mimic" applications for plant bugs or other pests. These early applications decimated predacious arthropods, and consequently caused several-fold increases in cotton bollworm, fall armyworm (*Spodoptera frugiperda*) and boll damage. In B.t. cotton, without rigid control of bollworm, yields were reduced and maturity was delayed rather than advanced by early applications of acephate. In South Carolina, insecticides are seldom needed between the seedling stage and the mid-July flight of bollworm into cotton from corn. In other areas of the cotton belt where early applications are necessary for the boll weevil (*Anthonomous grandis grandis*), plant bugs or aphids, the effects on beneficials and subsequent pest development should be considered.

Introduction

In South Carolina very little cotton is sprayed during June and early July prior to the bollworm, *Helicoverpa zea*, flight in mid-July from corn into cotton. *H. zea* is our most important pest and it usually requires 4 - 6 sprays in conventional and 1 - 2 in B.t. cotton to avoid severe crop damage. There are several reasons that we do not spray prior to this mid-July bollworm flight: 1.) the boll weevil, *Anthonomous grandis grandis*, has been removed from our area and applications are not required; 2.) high retention of early squares is unimportant (Mann et al. 1997) rendering early-season control of the tobacco budworm, *Heliothis virescens*, or plant bugs (primarily *Lygus lineolaris*) unnecessary; and 3.) we usually wait for fungal epizootics to "take out" developing aphid populations. All of this allows beneficial arthropods (particularly predators) to increase before control measures are applied for bollworm. The questions arise as to the importance of beneficials and the consequences of their disruption with June - early July foliar insecticides. During 1996, three on-farm fields were split with half of each being treated in early season to disrupt beneficials. In B.t. cotton in each field numbers of *H. zea* and fall armyworm, *Spodoptera frugiperda*, were higher later in July where earlier applications of acephate had invoked high mortality among predacious arthropods. During 1997, five similar fields were used to develop treatment thresholds for bollworm in B.t. cotton. Also, a test was conducted on conventional cotton with and without plant bug control. Data from 2 representative fields for bollworm treatment threshold development in B.t. cotton and a plant bug test in conventional cotton are reported herein.

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Materials and Methods

Fields planted on one side to 'NuCOTN 33b'and the other to 'DPL 5415' on the Scott (Aiken Co.) and Nix (Barnwell Co.) farms were "split" with one half treated early with acephate (0.75 lbs. AI/ac.) to disrupt predacious arthropods and half untreated to conserve them. Fields were planted in early May with 5 lbs. aldicarb 15G in-furrow. Weed control and other management practices were applied by farmers according to South Carolina Extension recommendations. Appropriate sampling procedures (beat cloth, plant examination, fruit damage, etc.) were used during the season to monitor predacious arthropods, phytophagous species and plant damage. Yields were taken by hand-picking a randomly-selected 10 ft. section from the 4 interior rows of plots 16 rows (38 in.) wide by 50 ft. long.

A field of conventional 'DPL 5415' planted in mid-May on the Sandifer Farm (Bamberg Co.) was used for a plant bug (*L. lineolaris*) test. Square retention was low in mid-July and plant bug numbers were high for South Carolina. A paired comparison test with 16 rows treated with dicrotophos at 0.5 lbs. active and 16 rows untreated with 5 replications was applied on July 3. Square retention among major fruiting branches was 60%. Cotton had received no prior insecticide except for 5 lbs. aldicarb 15G at planting. The field was oversprayed with cyhalothrin at 0.033 lbs. AI/ac. on July 18, July 25, August 3 and 12 for bollworm control. Hand-picked yields (10 ft. X 2 rows per plot) were made on Nov. 10.

Results

In B.t. cotton on the Scott Farm (Table 1) on July 24 (12 days after a second acephate application), total predators in treated plots were less than 1/5th the number in previously untreated areas; whereas bollworms were 3 X higher and damaged bolls 2 X higher in treated plots. By July 30 there were 8 large bollworms per m of row in previously treated compared to 3.5 in untreated plots. Even more pronounced differences occurred in B.t. cotton on the Nix Farm (Table 2) where total predators on July 18 were ca. 15 X higher in previously untreated (7.8) compared to previously treated (0.5) plots. Eleven days later (7/29) there were 10 X more

H. zea larvae and 17 X more damaged bolls per 100 plants in previously treated compared to untreated plots.

Yield data from the Nix Field (Table 3) demonstrated the impact of prior applications of acephate on the development of treatment thresholds for *H. zea* in B.t. cotton. South Carolina's 75 egg threshold for bollworm control with pyrethroids was compared with other thresholds (Sullivan et al. 1998. Beltwide Cotton Conf. Proceedings, San Diego, CA. In press) and a check (no pyrethroids) under acephate-treated and untreated regimens. First, our 75 egg threshold required only 1 pyrethroid application where predator numbers were high (previously untreated) and 2 applications where predators were disrupted (previously treated with acephate). At the first picking (Table 3), without acephate, lint yields were 162 pounds lower in the check compared to the 75 egg threshold (not significant). However, with prior acephate applications check plots yielded 532 pounds less lint cotton than did the 75 egg threshold plots (significant at .05 level). At the second picking, no prior acephate check plots yielded 60% more and prior acephate check plots yielded 116% more than respective 75 egg thresholds. Combined yields from both pickings indicated the following: 1.) the 75 egg threshold without acephate plus 1 pyrethroid application produced 14 pounds more lint cotton (1114) than the 75 egg threshold with prior acephate plus 2 pyrethroid applications (1100); and 2.) checks without acephate produced 259 pounds more lint cotton (1062) than checks with prior acephate applications(803). This indicates that both maturity and yields were adversely impacted with acephate applications.

Data in Table 4 indicate that a single application of dicrotophos at 0.5 lbs. active on 7/3 gave good control of plant bugs, but caused high mortality of *Geocoris* spp., *Orius* spp., and other predacious arthropods. This resulted in an average of 95 pounds less lint cotton following the single dicrotophos application. Although this difference was not significant at the 05 level, yield was lower in dicrotophos plots in each of the 5 replicates.

Discussion

Fortunately, the use of June or early July applications of insecticides is unnecessary in South Carolina.. We do not have boll weevil and early-season applications for tobacco budworm, plant bugs or aphids have generally been eliminated. Under these circumstances, beneficial arthropods (particularly predators) thrive and invoke high mortality in initial populations of cotton bollworm and fall armyworm in mid-to late July. In situations where predacious arthropods are disrupted by early insecticides, pest populations are more intense in B.t. or conventional cotton. This will result in unacceptable damage and even delayed maturity unless the crop is carefully protected with more applications and/or higher rates of insecticides during mid-season outbreaks.

In many areas of the "cotton belt" boll weevil is still a pest requiring controls beginning at the pinhead square stage and in other areas plant bugs must be controlled. In these cases, synthetic insecticides that disrupt beneficials (Duffie et al. 1998. Beltwide Cotton Conf. Proceedings, San Diego, CA. In press) are necessary and mortality invoked by beneficials in subsequent pest populations becomes relatively unimportant. However, as the need for such applications declines (through expansion of the Boll Weevil Eradication Program or from re-assessment of treatment thresholds for plant bugs, etc.), the full benefit of beneficials can finally be realized in many other areas of cotton production.

Also, with the "nagging" problem of impending development of pyrethroid resistance in bollworm populations, we expect that conservation and enhancement of beneficials will become even more important, because beneficials apparently don't discriminate between resistant or susceptible hosts.

References

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Table 1. Influence of earlier applications[1] of acephate on mid-season incidence of predators, *H. zea* and damaged bolls in B.t. cotton. Scott farm, 1997.

	Avg. No Predators[2] in 1 m of row (7/24)	No. Per 100 plants (25/rep on 7/24) Bollworms	Damaged Bolls	Avg. large bollworms in 1 m of row (7/30)
Treated	1.4	12	30	8.0
Untreated	7.4	4	16	3.5

[1]Acephate at 0.75 lb.AI/acre on 7/1 and 7/12.
[2]*Geocoris, Notoxus, Orius,* ants and spiders.

Table 2. Influence of earlier applications[1] of acephate on mid-season incidence of predators, *H. zea* and damaged bolls in B.t. cotton. Nix farm, 1997.

	Avg. No Predators[2] in 1 m of row		No. Per 100 plants (25/rep on 7/29)	
	7/8	7/18	Bollworms	Damaged Bolls
Treated	0.7	0.5	20	34
Untreated	4.5	7.8	2	2

[1] Acephate at 0.75 lb.AI/acre on 7/1 and 7/12.
[2] *Geocoris, Notoxus, Orius,* coccinellids, ants and spiders.

Table 3. Influence of earlier applications[1] of acephate on maturity, yield and bollworm thresholds in B.t. cotton. Nix farm, 1997.

Threshold	Lbs lint per acre 10/21 (first pick)		lbs lint per acre 11/7 (second pick)	
	No acephate	Acephate treated	No acephate	Acephate treated
75 eggs[2]	930a	905a	184b	195b
Check	768a	382b	294a	421a

[1] Acephate at 0.75 lbs. AI/acre on 7/1 and 7/12.

[2] South Carolina threshold of 75 eggs or 30 small larvae or 3 large larvae or 4 damaged bolls per 100 plants (Sullivan et al. 1998 Beltwide Cotton Conf. Proceedings, San Diego, CA. In press). For *H. zea* control, plots treated with acephate required 2 applications of pyrethroid (7/25 and 8/1) and those without acephate required 1 application (7/25).

Table 4. Influence of a dicrotophos application[1] on tarnished plant bug, *Lygus lineolaris*, predators and yield in conventional[2] cotton. Sandifer farm, 1997.

Treatment	No. per meter of row (7/7)			All predators[3]	lbs. Lint[4] per acre (11/6)
	Lygus	*Grecoris*	*Orius*		
Treated[1]	0.18	0.19	0..17	1.58	834
Untreated (for *Lygus*)	1.10	0.64	0.87	4.96	929

1) Applied at 0.5 lbs. AI/ac 7/3 to 16 row plots (5 replicates) through length of field (ca. 300 m).

2) 'DPL 5415'.

3) *Geocoris, Orius, Notoxus, Nabis,* coccinellids, ants and spiders.

4) Picked two 3.2 m sections row per plot. LSD_{05} = 131.2.