THE IMPACT OF THRIPS ON COTTON PRODUCTIVITY: WHAT A DIFFERENCE A YEAR MAKES

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Abstract

Populations of adult and juvenile thrips were monitored in seedling cotton treated with insecticide applications including: Gaucho® seed treatment (4 oz./cwt. Seed), Temik® 15G (0.75 lb. ai/acre or 0.575 lb. ai/acre), or Orthene® (90 S at 0.25 lb. ai/acre or 75 S at 0.19 lb. ai/acre). Several plant performance parameters and accumulated degree-day 60's (DD60's) were monitored. In comparison, Temik and Orthene showed better thrips control than Gaucho. In 1997 (Test 1), Temik showed a better "earliness profile" (lower fruit set and more early opening bolls) than both Orthene and Gaucho while in 1998 (Test 2) there were no significant differences. In Test 1 statistically superior yields were seen in all insecticide treatments versus the untreated check (UTC). Accumulated DD60's were higher in Test 2 from the second thrips sampling date to the end of thrips sampling period. Accumulated rainfall was higher in 1997 throughout the thrips sampling period. Thrips species ratios differed between years.

Introduction

Thrips control on seedling cotton is considered an essential crop production practice by most cotton producers to minimize early season stress on the cotton plant, thus enhancing earliness and yield. Although the deleterious effects of thrips feeding on cotton seedlings have been recognized and widely accepted for decades (Newsom, 1953), many researchers have reported no yield benefits from thrips control (Beckham 1970, Harp and Turner 1976, Lentz and Austin 1994, Cook 1998). Lambert (1985) stated that 80% of all cotton grown in Georgia received a prophylactic treatment for thrips control despite the lack of information showing any benefit in yield. In contrast, other investigators have reported yield losses from thrips feeding on cotton seedlings (Race 1961, Micinski et. al. 1990, Roberts and Rechel 1996, Herbert 1998, and Van Duyn et. al. 1998). The relationship between thrips control and cotton yield is a function of many factors including thrips numbers, temperatures from planting through the seedling stage, and other plant stressors (e.g. herbicides, seedling diseases).

The objective of this report is to document how the yield impact of thrips control on cotton varies annually with thrips species, thrips population level, and environmental factors which impact cotton seedling growth, phenology, and productivity.

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Materials and Methods

Studies were conducted during 1997 and 1998 on the Tidewater Research Station (TRS) at Plymouth, Washington Co., NC. Deltapine 51 cotton variety was used in 1997 while Deltapine 436 RR was used in 1998. Test 1 was planted on 9 May 1997 and Test 2 was planted on 29 April 1998. Both test sites consisted of a Portsmouth silt loam soil (o.m.=ca.3%). Commercial planters were used. Both tests utilized the randomized complete block design with four replications. Plots were 4 rows wide (38 inch row spacing) by 45 feet long.

Treatments included in each test were Gaucho® (imidicloprid) as a seed treatment, Temik® (aldicarb) as a granule, Orthene® (acephate) as a foliar spray, and the UTC. The Gaucho (Gustafson, Inc., Dallas, TX) treated seed (4 oz./cwt.) was obtained from Deltapine and Land, Co. for Test 1. In Test 2 untreated seed was treated utilizing the method described by Van Duyn et. al. (1998). Temik 15G (Rhone Poulenc Ag Co., Research Triangle Park, NC) was applied from the planter with individual calibrated orifice, gravity flow applicators as an in-furrow treatment (0.75 lb. ai/acre in Test 1 and 0.575 lb. ai/acre in Test 2). Orthene (Valent USA Corp., Walnut Creek, Ca.) was applied as a foliar spray twice each year (ca. 14 and 28 days after planting) using a CO_2, two row, backpack sprayer with hollow cone X-14 tips (Orthene 90S at 0.25 lb. ai/acre in Test 1 and Orthene 75S at 0.19 lb. ai/acre in Test 2). Booms were calibrated before each application, varying from 10-12 GPA, with pressure set to 60 psi.

Crop maintenance including fertility, weed control and control of insects other than thrips was conducted as recommended by the North Carolina Cooperative Extension Service.

Plants were randomly selected from each plot on the four sampling dates to obtain representative samples of juvenile and adult thrips populations. A washing / filtering technique similar to the Alexington Technique as described by Irwin and Yeargan (1980) was used to sample both adult and juvenile thrips. A subsample of adult thrips were retained from each sampling date for later identification as to species. Stand counts were performed by counting the number of plants per 10 row feet and later in the season the number of open bolls per five row feet were counted. Standard plant mapping techniques were used to determine the location of the first fruiting branch. Yields were obtained by picking the two center rows of each plot with a John Deere 9920 cotton harvester equipped with a bagger attachment. Samples from each plot were weighed in the field. All data were subjected to standard ANOVA and

Duncan's multiple range ($p \leq 0.05$) using Gyllings PRM version 5 software.

High and low temperatures were obtained from the TRS. From these data, degree day 60's (DD 60's) were calculated using the following equation: **(^{0}F Max +^{0}F Min)/2-60.** Accumulated DD60's were recorded from planting until 40 days after planting (DAP) in each test. Rainfall accumulation was also recorded for the same time interval.

Results

Thrips Species Composition

During both years a subsample of thrips adults (150+) was collected from cotton seedlings, prepared and mounted on glass slides, and identified as to species. The thrips species complex differed between years. In 1997 the thrips identified were 95% *Frankliniella fusca* (Hinds), 2% *F. occidentalis* (Pergande), 2% *Neohydatothrips variabilis* (Beach), and 1% *F. tritici* (Fitch). The 1998 thrips species composition was as follows: 56% *N. variabilis*, 32% *F. fusca*, 5% *F. occidentalis*, 5% *F. tritici*, and 2% *Thrips tabaci* Lindeman.

Contrasts of Adult and Juvenile Thrips Populations

Data are presented for adult and juvenile thrips per 10 plants from four sampling dates for each year. In 1997 (Test 1) thrips were sampled at 18, 26, 33, and 40 days after planting (DAP) and in 1998 (Test 2) thrips were sampled at 19, 27, 33, and 40 DAP.

There was a remarkable difference in thrips species numbers and thrips population dynamics between years. In 1997 thrips colonized the test at an earlier stage of plant development as there were 45.8 juvenile thrips/10 plants in the UTC on the initial sampling date (18 DAP) whereas there were no juvenile thrips in any of the treatments on the initial sampling date (19 DAP) in 1998 (Fig. 3). Furthermore, juvenile thrips numbers /10 plants peaked at 147.3 at 33 DAP in 1997 (Table 1) and juvenile thrips numbers/10 plants peaked at 73 at 33 DAP in 1998 (Table 2). Thus, thrips began to reproduce at an earlier stage of cotton plant development in 1997 and there were twice as many juvenile thrips/10 plants in 1997. In both years Temik granules and the Orthene foliar spray provided the most consistent level of thrips control as measured by reductions in juvenile thrips numbers. Gaucho seed treatment had significantly higher juvenile thrips numbers than either the Temik or Orthene foliar spray after 18 DAP in 1997 and 27 DAP in 1998. Also, the juvenile thrips numbers were statistically similar between the Gaucho seed treatment and the UTC at ca. four weeks in both years. The juvenile thrips data suggest that the Gaucho seed treatment will provide predictable control of thrips reproduction for only ca. three weeks whereas Temik controls thrips reproduction for ca. six weeks.

Adult thrips numbers followed a trend similar to that of the juvenile thrips as there were higher numbers of adult thrips in the UTC and Gaucho seed treatment than in either the Temik or Orthene foliar spray treatments after the initial sampling date. However, adult thrips numbers were lower overall in 1997 than in 1998 even though juvenile thrips numbers were much higher in 1997.

Plant Stands, Fruiting, Maturity, and Yield

There were no differences in the plant populations among the treatments in either year (Tables 3 and 4); thus, thrips did not cause measurable plant mortality even though severe plant stunting occurred in the UTC in 1997.
Five plants per plot were mapped after defoliation each year to determine the fruiting and maturity profile. In 1997 when juvenile thrips populations developed earlier and to much higher numbers a significant effect on the node of first fruiting branch was observed (Table 3). There were no differences among the insecticide treatments with respect to node of first fruiting branch as they ranged from 7.25-8.1 in 1997; however, the UTC had an 11.3 average node for the first fruiting branch. There were no significant differences in the node of the first fruiting branch among any of the treatments in 1998 coincident with fewer juvenile thrips and later colonization (Table 4).

The 1997 plant mapping also revealed earlier maturity in the Temik treatment as significantly more open bolls were present in the Temik treatment than in the other treatments; the Temik treatment had five times as many open bolls as the UTC (Table 3). In 1998 there were no significant differences among treatments relative to maturity as indicated by open boll data even though the Temik and Gaucho treatments had much higher numbers of open bolls than the UTC (Table 4).

Yields in 1997 were very high for the site and all insecticide treatments had significantly higher yields than the UTC (Table 3). The seed cotton yield in the Temik treatment was more than twice as high as that in the UTC, but there were no significant differences in yield among the insecticide treatments. In 1998 the yields were statistically similar among all treatments, including the UTC, which was a reflection of fewer juvenile thrips and later colonization of seedlings by thrips.

Weather Relationships

During the first 40 days of cotton seedling development far fewer DD60's accumulated during 1997 than during the same period in 1998 (Fig. 1). This placed additional stress on the cotton plants and probably made them more susceptible to thrips feeding effects. Rainfall during the seedling development period was lower in 1997 than in 1998 which may have placed additional stress on cotton seedlings (Fig. 2). However, rainfall during the remainder of the season was adequate during 1997, but during 1998 rainfall was well below optimum which resulted in earlier maturity and lower yields.

Discussion

Differences in the thrips species composition may be very important to the damage potential that a specific number of thrips poses. For example, in 1998 there were higher numbers of adult thrips overall, but much lower numbers of juvenile thrips developed in any of the treatments, including the UTC. This phenomenon may have been the result of a much higher proportion of the total adult population being represented by adult *N. variabilis* which we do not think utilizes cotton as a host as effectively as does *F. fusca*. Most of the literature on thrips control on cotton does not include identification of the thrips species involved, thus the relative importance of various thrips species which colonize cotton seedlings is unknown.

Earlier colonization of cotton seedlings by thrips and lower temperatures during the seedling period in 1997 as compared to 1998 resulted in far greater damage potential which is revealed in the data presented on early plant growth, fruiting profiles, maturity, and yield. In 1997 thrips colonized cotton plants as soon as they emerged from the soil and lower temperatures retarded plant development. Thus, the impact of thrips on ultimate plant productivity was great as yields were reduced by >50% in the UTC when all other production factors were equal among the treatments. In contrast, thrips had no impact on plant fruiting profiles, maturity, or yield in 1998.

Our data suggest that control of thrips during the first three weeks after planting is the period most important for preventing yield loss. The Gaucho seed treatment, which did not effectively control thrips beyond three weeks in the 1997 test, had a similar fruiting profile and produced seed cotton yields statistically comparable to those of the Temik treatment. However, the maturity advantage observed in the Temik treatment in 1997 may have been a result of more effective thrips control throughout cotton seedling development.

The data presented herein demonstrate the necessity to evaluate thrips control technologies over several years before either a decision is made as to the importance of thrips control on cotton or before specific thrips controls are recommended. At the same site in a two-year study differences in the proportions of thrips species occurred, rates of thrips colonization were much earlier in 1997 than in 1998, thrips juvenile numbers were much higher in 1997, the relationship between the numbers of thrips adults and juveniles differed between years, and heat units accumulated at a lower rate during the cotton seedling stage during 1997. What a difference a year makes!

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Table 1. Adult and juvenile thrips mean numbers per 10 cotton seedlings at 18, 26, 33, and 40 days following planting. Cotton was planted on 9 May 1997. Washington Co., NC. (Test 1)

	1997 Thrips Sampling			
Treatment	Adult / juv. thrips 18 DAP	Adult / juv. thrips 26 DAP	Adult / juv. thrips 33 DAP	Adult / juv. thrips 40 DAP
Temik 15G @ 0.75 lb. ai/acre	1.8a/3.0b	6.3b/5.3b	5.8b/7.3b	28.3a/11.5b
Gaucho 480 @ 4 oz./cwt	13.0a/6.5b	22.0a/88.8a	16.8a/90.3a	36.5a/76.0a
Orthene 90S @ 0.25 lb. ai/acre	7.0a/22.3a b	2.8b/6.8b	1.8b/0.5b	6.3a/4.5b
UTC	12.0a/45.8 a	31.3a/118.3a	18.8a/147.3a	39.5a/77.5a

Table 2. Adult and juvenile thrips mean numbers per 10 cotton seedlings at 19, 27, 33, and 40 days following planting. Cotton was planted on 29 April 1998. Washington Co., NC. (Test 2)

	1998 Thrips Sampling			
Treatment	Adult / juv. Thrips 19 DAP	Adult / juv. thrips 27 DAP	Adult / juv. thrips 33 DAP	Adult / juv. thrips 40 DAP
Temik 15G @ 0.575lb. ai/acre	0.5b/0.0a	17.5c/0.5b	2.5b/5.0b	29.0ab /6.0b
Gaucho 480 @ 4 oz./cwt	2.0ab/0.0a	102.5a/12.0a b	12.5ab/44.0a	32.0ab/52.5a
Orthene 75S @ 0.19 lb. ai/acre	2.0ab/0.0a	12.5c/7.0ab	3.0b/4.0b	10.5b/1.0b
UTC	6.5a/0.0a	46.5b/50.0a	23.5a/73.0a	44.5a/63.5a

Table 3. Mean first fruiting branch, open bolls, stand counts and lint yields for cotton planted on 9 May 1997. Washington Co., NC. (Test 1)

	1997 Growth Parameters			
Treatment	stand counts / 10 feet 5-21-97	first fruiting branch 9-26-97	open bolls /5 feet 9-26-97	Yields lb. seed cotton / acre 11-22-97
Temik 15G @ 0.75 lb. ai/acre	27.8a	7.3b	22.3a	4327a
Gaucho 480 @ 4 oz./cwt.	30.0a	7.4b	10.0b	3830a
Orthene 90S @0.25 lb. ai/acre	31.5a	8.2b	11.3b	3515a
UTC	30.5a	11.3a	4.3b	2120b

Table 4. Mean first fruiting branch, open bolls, stand counts and lint yields for cotton planted on 29 April 1998. Washington Co., NC. (Test 2).

	1998 Growth Parameters			
Treatment	stand counts / 10 feet 5-26-98	first fruiting branch 10-14-98	open bolls / 5 feet 9-18-98	lint yields lb.seed cotton / acre 10-19-98
Temik 15G @ 0.575 lb. ai/acre	27.3a	6.3a	36.8a	2703a
Gaucho 480 @ 4 oz./cwt	29.8a	7.4a	35.3a	2416a
Orthene 75S @ 0.19 lb. ai/acre	33.0a	7.2a	28.0a	2531a
UTC	32.5a	7.2a	22.8a	2627a

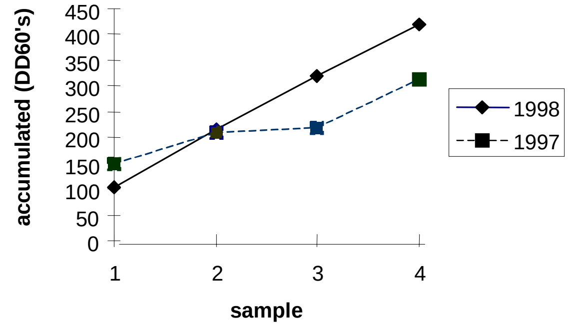

Figure 1. Accumulated DD60's for samples 1-4. Samples 1-4 correspond to 19, 27, 33, and 40 DAP, respectively.

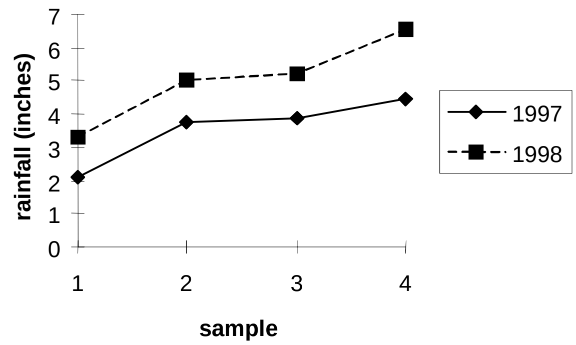

Figure 2. Accumulated rainfall for samples 1-4. Samples 1-4 correspond to 19, 27, 33, and 40 DAP, respectively.

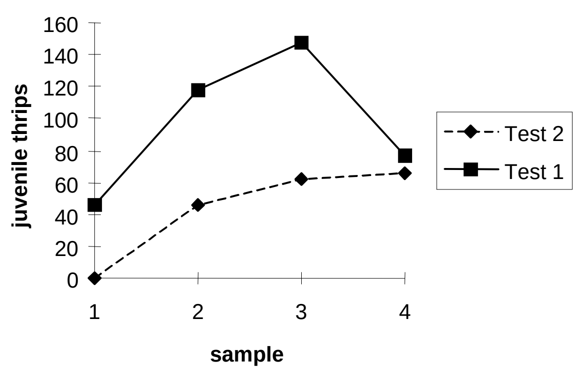

Figure 3. Mean numbers of juvenile thrips found in UTC plots. Samples 1-4 correspond to 18, 26, 33, and 40 DAT, respectively in Test 1 and 19, 27, 33, and 40 DAT in Test 2.