CHEMICAL CONTROL AND SPECIES COMPOSITION OF THRIPS IN ARKANSAS COTTON FIELDS

Marwan S. Kharboutli
Arkansas Cooperative Extension Service
Monticello, AR
Charles T. Allen
Texas Boll Weevil Eradication Foundation
Abilene, TX

Abstract

Field trials were conducted in 2000 on the Southeast Branch Experiment Station near Rohwer, AR to examine the efficacy of seed treatment, in-furrow, and foliar insecticides against early-season thrips on cotton. The effect of the treatments on stand count, thrips damage, and lint yield was also examined. All treatments controlled thrips compared with the untreated check. However, seed treatments (Adage and Gaucho) and in furrow treatments (Temik 15GR) were more effective against thrips than a single application of foliar treatments (Orthene 90SP, Centric 40WG, Actara 25WG). After three applications were made, foliar treatments tended to give better thrips control than the in-furrow or seed treatments. Thrips damage was significantly lower in the Adage ST, Gaucho ST, and Temik 15GR plots than any other treatment. Lint yield was not statistically different among treatments including the untreated check. However, the seed treatments (Adage and Gaucho) yielded numerically higher than all other treatments while Actara 25WG (0.0473 lb ai/ac) produced numerically the least yield.

Western flower thrips were the predominant thrips species early in the 2000 growing season in Arkansas cotton fields. Because of the western flower thrips tolerance to many of the insecticides used against thrips, control failures of standard thrips insecticides were reported from many areas in the state. Accurate species identification of thrips infesting cotton is the key to any successful management program.

Introduction

Thrips cause damage to early-season cotton each year in Arkansas. These insects infest seedlings immediately following emergence and feed on the sap of young, tender tissues of the newly emerged seedlings causing discoloration and malformation in leaves and stunted plants. Feeding on the terminal bud can cause it to be aborted which results in excessive branching which delays crop maturity and may reduce yield (Micinski et al. 1990). Although cotton plants are able to outgrow and compensate for some thrips injury, infestations can sometimes reach high levels and reduce yield if left unchecked (Herbert 1995, Roberts and Rechel 1996). Estimated yield loss in Arkansas due to thrips damage in 1999 was about 5,756 bales (Williams 2000). Insecticides are the major tools used in controlling thrips in cotton, and an in furrow placement of Temik 15GR is the standard at-planting treatment. There are, however, concerns related to the at-planting treatments such as the length of time thrips are controlled, the cost of treatment, phytotoxicity, and plant stand loss effects. In addition, newer compounds are periodically introduced for thrips control and a comparison of old and new compounds is needed so that farmers can make an intelligent choice when selecting chemicals for thrips control. The objective of this study was to examine the efficacy of various insecticides and application methods for thrips control. We also looked at how insecticidal treatments against thrips influenced stand count, thrips injury, and lint yield.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1026-1029 (2001)
National Cotton Council, Memphis TN

Moreover, Arkansas cotton farmers experienced unusual difficulties controlling thrips early in the 2000 growing season and reported control failures of insecticides that effectively controlled thrips in previous years. In responding to farmers concerns and trying to explain those control failures, we set out to examine the thrips species complex in Arkansas cotton fields. Because different species of thrips that attack cotton may respond differently to insecticides, it became vital for us to examine the thrips species composition and identify the predominant species. Likewise, damage to cotton seedlings may be a function not only of the thrips density but also of the species involved. We launched a survey early in the 2000 growing season that covered the various cotton growing regions in Arkansas and examined the species composition of thrips in those areas.

Materials and Methods

This study was carried out during the 2000 growing season on the Southeast Branch Experiment Station near Rohwer, AR. Paymaster 1218 BG x RR was planted on 5-16-2000 and maintained using standard production practices. Plots were four rows wide and 40 ft long and were arranged in a Randomized Complete Block Design with four replications. Seed treatment, liquid, and granular insecticides were evaluated in this study. The seed treatment insecticides used in this study, Adage ST and Gaucho ST, were applied by the dealers. Temik 15GR was the only granular insecticide evaluated and was dropped in-furrow at planting using the granular applicator on the John Deere Max-Emerge planter. Foliar treatments (Actara 25WG, Centric 40WG, and Orthene 90SP) were applied at 40 psi and 10 gpa on 30 May, 6 and 12 Jun, 2000 using a two row back pack sprayer with 2 Tx4 hollow cone nozzles/row.

Thrips samples were taken on 2, 9, and 15 Jun, 2000. Ten plants per plot were cut about an inch above the soil line, placed in Ziplock plastic bags and taken immediately after collection to the plant pathology lab at the Southwest Research and Extension Center in Hope, AR for processing. At the lab, samples were processed using a modified washing technique that included a centrifugal flotation procedure (Micinski et al.1995). Briefly, cotton seedlings were placed into glass jars (0.95 liters) into which the following was poured: 50 ml of sodium hypochlorite (5.25%), 3-4 drops of Tween 20 (J. T. Baker Chemical Co., Phillipsburg, NJ), and 500 ml of tap water. After agitating jars vigorously for about 30 seconds, the contents of the jars were poured onto a no. 30 metal sieve (C-E Tyler Inc., Gastonia, NC). A sink sprayer was used to thoroughly wash plants and dislodge remaining insects which were funneled into 300-mesh sieves (Humboldt Manufacturing Co., Norridge, Ill). To eliminate the soap foam from collecting on the 300-mesh sieve and to immobilize insects, a mist of 95% ethanol was sprayed on the sieve with a hand-operated mist sprayer immediately following collection. Contents of the 300-mesh sieve were backwashed into 50-ml neoprene centrifuge tubes with a sucrose solution (673 gram/liter). The tubes were then shaken and centrifuged (Model K, International Equipment Co., Needham Hts., MA) at 1500 rpm for 2 minutes. Following centrifugation, the supernatant was poured into 100-ml containers and brought to the entomology lab at the Southeastern Research and Extension Center in Monticello, AR for thrips filtration and counting. Insects in the supernatant were collected on 7 cm filter paper through a Buchner funnel connected to a vacuum pump to facilitate rapid filtration of thrips. Thrips were then counted under 10 and 20x magnification in the laboratory using a dissecting microscope. Adult thrips were then mounted on microscope slides with CMC-10 mounting media (Masters Co., Inc., Wood Dale, IL) and covered with 22 mm diameter glass slips. Thrips were identified to species with the aid of a Zeiss compound microscope.

Stand counts were made by counting all plants in 6 row feet per plot on 7 Jun, 2000. Damage due to thrips injury was visually evaluated on 7 and 14 Jun, 2000. Each plot was rated on a scale of 1-5, where 1 indicated no damage and 5 indicated severe damage, indexing plant height, vigor and foliage distortion. Cotton yield was determined by machine harvesting the middle 2 rows of the plots on 10 October, 2000.

For our thrips survey, we collected cotton seedlings from 30 locations across the state (Table 3) in order to examine the thrips species composition. Five plants were collected from each site, placed in Ziplock bags and brought to the Entomology lab at SEREC for processing. We used a plant washing technique (Burris et al. 1990) to extract thrips from cotton seedlings. Adult thrips were then mounted and identified to species as described earlier.

Data were processed using the Agriculture Research Manager (ARM) and CoStat. Analysis of Variance was run and Least Significant Difference (LSD) was used to separate the treatment means. Correlation analysis was also run on thrips counts, damage and lint yield.

Results and Discussion

All treatments controlled thrips on every sampling date, though to varied degrees, as indicated by the generally fewer thrips counts in treated plots than in the untreated check plots (Table 1). On 6-2-2000, the first week of sampling, all treatments significantly reduced thrips counts compared with the check (Table 1). However, Adage ST treatment was the most effective treatment on 2 June while Orthene 90SP (0.20 lb ai/ac) and Centric 40WG (0.0625 lb ai/ac) were the least effective ones. Thrips counts in plots that received foliar treatments (Orthene 90SP, Centric 40WG, and Actara 25WG) tended to be numerically higher than in those receiving in-furrow (Temik 15GR) or seed treatments (Adage and Gaucho). Only one foliar application had been made by the first sampling date which partly explains the better level of control obtained with seed and in-furrow treatments which were applied at planting. On the second and third sampling dates (9 and 15 June, respectively), all treatments except for Gaucho ST significantly reduced thrips counts compared with the untreated check (Table 1). Foliar treatments on both sampling dates tended to give better thrips control than was obtained from the in-furrow or seed treatments. No significant dosage response was seen with Centric; increasing the rate from 0.0473 to 0.0625 lb ai/ac did not provide more thrips control on any sampling date (Table 1).

All treatments except Centric 40WG (0.0473 lb ai/ac) and Orthene 90SP (0.20 lb ai/ac) provided thrips damage protection statistically better than the untreated check on 7 June, the first rating date (Table 2). On the second rating date (14 June), all treatments suffered significantly less thrips damage than the untreated check (Table 2). On both rating dates, however, thrips damage was significantly lower in the Adage ST, Gaucho ST, and Temik 15GR (0.53 lb ai/ac) plots than those that received foliar treatments (Table 2). The better thrips damage protection afforded by the in-furrow treatments was partly due to their at-planting placement affording them more time to act on thrips than the later-applied foliar treatments. The apparent paradox in results with Gaucho, poor thrips control on the last two sampling dates yet providing high level of protection against thrips damage is not well explained in this study and deserves further research. It is possible that Gaucho may have had an anti-feeding effect on thrips which did not die quickly but were nevertheless harmless to cotton. Correlation analysis showed thrips damage on both rating dates (7 and 14 June) to correlated positively with thrips count on 2 June ($P<0.001$, $r^2=0.35$ and 0.61, respectively). Stand counts were statistically similar among all treatments including the untreated check (Table 2).

Lint yield was not statistically different among all treatments including the untreated check (Table 2). Plant compensation for early season thrips damage / phytotoxic effects undoubtedly obscured any effects insecticide treatments might have had on yield. However, the seed treatments (Adage and Gaucho) yielded numerically higher than all other treatments (Table 2). The better protection against thrips damage provided by the seed treatments compared to the other treatments partly explains the numerically higher yields obtained with Adage ST and Gaucho ST. Also, both Adage and Gaucho are new and broad-spectrum insecticides that act on sucking pests. Thus, their effect the other early-season insects may also have contributed to their better yield. Hofer et al. (2000) discussed the residual activity of adage and reported that Adage ST can be effective for up to 45 days. Actara 25WG (0.0473 lb ai/ac) produced numerically the least yield among all treatments including the untreated check. Yield did not significantly correlate with any of the parameters examined in this study.

The species composition of thrips infesting seedling cotton in Arkansas is given in Table 3. Western flower thrips, *Frankliniella occidentalis* (Pergande), and tobacco thrips, *Frankliniella fusca* (Hinds), were the two major species found in Arkansas cotton fields. Similar findings were reported from Louisiana (Cook et al.2000), Oklahoma (Karner and Cole 1992), and South Carolina (DuRant et al. 1994). What is striking about this year's thrips species composition in Arkansas cotton fields (Table 3) is the unusually high percentage of western flower thrips early in the growing season. Infestations of the western flower thrips usually occur later in the growing season in cotton blooms while those of the tobacco thrips occur in early season. Actually, the makeup of the thrips species complex in the 2000 growing season was the reverse of what we had in 1999 (Table 4). It is not fully clear as to what caused the western flower thrips in 2000 to be the predominant thrips species early in the cotton growing season. It is possible that environmental conditions along with the availability of winter host plants may have influenced the species composition of thrips infesting seedling cotton.

The implications of this drastic change in thrips species composition go beyond its taxonomic dimension into the pest management applications. Western flower thrips rapidly acquire resistance to new insecticides and are known to be more difficult to control than the other thrips that infest cotton. In addition, their damage potential was reported by Faircloth et al. (2000) to be greater than that of the tobacco thrips. This, at least partly, explains the control failure of standard insecticides that farmers encountered in the 2000 growing season. It also shows the importance, from a pest management point of view, of accurately identifying the thrips species that infest cotton seedlings due to their dissimilar response to insecticides. Indeed, the accurate identification of thrips is the key to their successful management which is by no means a new concept. Watts (1937) expressed the importance of knowing the species composition of thrips as it relates to their control. However, thrips surveys to determine species composition and seasonal changes in species composition in cotton have not been done in Mid-South and Southeastern cotton production since the 1920's and 1930's. This year's control failures of insecticides simply show the importance of conducting such surveys and point to the conceptual error made by lumping into one group all thrips, possessing various traits of resistance to insecticides, when reporting on insecticide efficacy trials.

Summary

Chemical control is the primary method used to keep thrips under check and prevent damages from occurring. There are several products that cotton producers can use to control thrips. Seed treatments (Adage ST and Gaucho ST) and in furrow treatments (Temik 15GR) were more effective against thrips than a single application of foliar treatments (Orthene 90SP, Centric 40WG, Actara 25WG). After two more applications were made, foliar treatments tended to give better thrips control than was obtained from the in-furrow or seed treatments. Thrips damage was significantly lower in the Adage ST, Gaucho ST, and Temik 15GR (0.53 lb ai/ac) plots than any other treatment. Lint yield was not statistically different among all treatments including the untreated check which is mainly due to plant's abilities to compensate for early season thrips damage. However, the seed treatments (Adage and Gaucho) yielded numerically higher than all other treatments while Acatara 25WG (0.0473 lb ai/ac) produced numerically the least. The better protection against thrips damage provided by the seed treatments partly explains the numerically higher yields obtained with Adage ST and Gaucho ST. Also, both Adage and Gaucho are broad-spectrum insecticides whose effect on the other early-season sucking insects may also have contributed to yield enhancement.

Cotton fields in Arkansas had an unusually high count of western flower thrips early in the growing season. This thrips is more difficult to control and causes more damage than the other thrips that infest cotton. Such high counts of the western flower thrips early in the growing season were at least partly responsible for the control failure of standard insecticides that many Arkansas cotton producers encountered in the 2000 growing season. Thus, accurate identification of thrips species found on cotton is the key to any successful management program.

References

Burris, E., A. M. Pavloff, B. R. Leonard, J. B. Graves, and G. Church. 1990. Evaluation of two procedures for monitoring populations of early season insect pests (Thysanoptera: Thripidae and Homoptera: Aphididae) in cotton under selected management strategies. J. Econ. Entomol. 83:1064-1068.

Cook, D. R., E. Burris, and B. R. Leonard. 2000. Thrips species infesting seedling cotton in Louisiana, 1996-1998. pp. 979-981. *In*: P. Dugger and D. A. Richter (eds.). Proc. Beltwide Cotton Conference. National Cotton Council, Memphis, Tennessee.

DuRant, J. A., M. E. Roof, and C. L. Cole. 1994. Early season incidence of thrips (Thysanoptera) on wheat, cotton, and three wild host plant species in South Carolina. J. Agric. Entomol. 11: 61-71.

Faircloth, J., J. R. Bradley, and J. Van Duyn. 2000. Reproductive success and damage potential of tobacco thrips and western flower thrips on cotton seedlings. pp. 1108-1111. *In*: P. Dugger and D. A. Richter (eds.). Proc. Beltwide Cotton Conference. National Cotton Council, Memphis, Tennessee.

Herbert, D. A. 1995. Insect pest management in Virginia peanuts, soybeans, and cotton. Virginia Tech, Tidewater Agricultural Research and Extension Center Info Ser. No. 372, pp. 97-110.

Hofer, D., F. Brandl, and W. Fischer. (2000). Cruiser®/Adage™ uptake dynamic and biological performance under different environmental conditions. pp. 1024-1027. *In*: P. Dugger and D. A. Richter (eds.). Proc. Beltwide Cotton Conference. National Cotton Council, Memphis, Tennessee.

Karner, M. A. and C. L. Cole. 1992. Species composition of thrips inhabiting cotton in Oklahoma. p. 820. *In*: P. Dugger and D. A. Richter (eds.). Proc. Beltwide Cotton Conference. National Cotton Council, Memphis, Tennessee.

Micinski, S., P. D. Colyer, K. T. Nguyen, and K. L. Koonce. 1990. Effects of planting date and early-season pest control on yield in cotton. J. Prod. Agric. 3: 597-602.

Micinski, S., T. L. Kirkpatrick, and P. D. Colyer. 1995. An improved plant washing procedure for monitoring early season insect pests in Cotton. Southwestern Entomol. 20: 17-24.

Roberts, B. A. and E. A. Rechel. 1996. Effects of early season thrips feeding on root development, leaf area and yield. pp. 939-941. *In*: P. Dugger and D. A. Richter (eds.). Proc. Beltwide Cotton Conference. National Cotton Council, Memphis, Tennessee.

Watts, J. G. 1937. Reduction of cotton yield by thrips. J. Econ. Entomol. 30: 860-863.

Williams, M. R. 2000. Cotton insect losses 1999. pp. 887-913. *In*: P. Dugger and D. A. Richter (eds.). Proc. Beltwide Cotton Conference. National Cotton Council, Memphis, Tennessee.

Table 1. Thrips counts following[1] following in-furrow, seed, and foliar treatments for thrips control. SEBES, Rohwer, Desha Co. AR. 2000.

Treatment	Rate lb (ai/ac)	Thrips[2]/plant 2 June	9 June	15 June
Check	-	18.7 a	8.5 a	16.1 a
Orthene 90SP[3]	0.20	7.4 b	1.1 b	4.8 b
Centric 40WG[3]	0.0625	7.4 b	1.2 b	5.0 b
Centric 40WG[3]	0.0473	7.2 b	3.1 b	5.8 b
Actara 25WG[3]	0.0473	6.6 bc	1.0 b	6.8 b
Gaucho ST	2500[4]	4.9 bcd	8.6 a	15.9 a
Temik 15GR	0.50	2.5 cd	2.9 b	8.0 b
Adage ST	3000[4]	1.6 d	3.1 b	7.0 b

[1]Means in columns followed by the same letter are not statistically different (LSD, $P = 0.05$).
[2]Adult and immature thrips.
[3]Orthene, Centric, and Actara treatments applied on 30 May, 6 and 12 June, 2000.
[4]Milligram active ingredient per kilogram seed.

Table 2. Thrips damage ratings, stand count, and lint yield[1] following various in-furrow, seed, and foliar treatments for thrips control. SEBES, Rohwer, Desha Co. AR. 2000.

Treatment	Rate lb (ai/ac)	Thrips Damage Rating[2] 7 June	14 June	Stand Count Plants/Acre 7 June	Lint Yield Lb/Acre 10 October
Check	-	3.84 a	3.86 a	59602 a	1221.0 a
Centric 40WG[3]	0.0473	3.75 ab	3.22 b	59602 a	1282.9 a
Orthene 90SP[3]	0.20	3.50 ab	2.83 c	58456 a	1281.3 a
Actara 25WG[3]	0.0473	3.46 b	2.83 c	60748 a	1158.3 a
Centric 40WG[3]	0.0625	3.45 b	2.72 c	59602 a	1229.7 a
Temik 15GR	0.50	2.55 c	2.24 d	60748 a	1238.8 a
Gaucho ST	2500[4]	2.29 cd	1.93 de	63041 a	1294.5 a
Adage ST	3000[4]	2.15 d	1.80 e	58456 a	1295.3 a

[1]Means in columns followed by the same letter are not statistically different (LSD, $P = 0.05$).
[2]Damage rating scale of 1 to 5 where 1 = no damage and 5 = severe damage and dead plants.
[3]Orthene, Centric, and Actara treatments applied on 30 May, 6 and 12 June, 2000.
[4]Milligram active ingredient per kilogram seed.

Table 3. Thrips species composition in Arkansas cotton fields by location and date. 2000

Location	Date	Western Flower Thrips	Tobacco Thrips	Other Species
Backgate	5-24	91	9	0
Boydell	5-24	56	44	0
Cross Roads	5-23	20	80	0
Dumas	5-24	77	23	0
Eudora	5-24	83	17	0
Gould	5-24	93	7	0
Grady	5-24	80	20	0
Kelso	5-24	100	0	0
Jericho	5-23	17	83	0
Jerome	5-24	100	0	0
Lake Village	5-24	43	43	14
Lonoke	5-25	50	50	0
Marion	5-23	0	100	0
McGehee	5-24	47	53	0
Montrose	5-24	67	33	0
Moscow	5-17	18	80	2
Moscow	5-24	89	11	0
Parkdale	5-24	86	14	0
Pine Bluff	5-24	43	57	0
Portland	5-24	57	43	0
Rondo	5-23	70	30	0
Sherrill	5-25	50	50	0
Soudan	5-25	57	43	0
Tillar	5-24	77	15	8
Trumann	5-23	50	50	0
Turner	5-23	37	63	0
Tyronza	5-23	50	50	0
Watson	5-24	71	29	0
Wilmont	5-24	22	78	0
Winchester	5-24	100	0	0
Yorktown	5-24	100	0	0

Table 4. Percentage of thrips species found on cotton seedlings in 1999 and 2000. Southeast Branch Experiment Station, Desha County, Rohwer, Arkansas[1]

	Western Flower Thrips		Tobacco Thrips		Flower Thrips		Other Thrips[2]	
Date	1999	2000	1999	2000	1999	2000	1999	2000
June 2	3	56	95	44	2	0	0	0
June 9	6	63	93	34	1	2	0	1
June 15	0	52	97	42	3	6	0	0

[1]This includes *Frankliniella bispinosa, Microcephalothrips abdominalis*, and *Neohydatathrips variabilis*.