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CONTROL OF THRIPS IN COTTON WITH CONVENTIONAL AND ELECTROSTATIC AERIAL APPLICATION

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Abstract

Thrips in cotton can be controlled with systemic insecticides, cotton variety choices, or foliar applications of insecticides. In the event of thrips outbreaks, foliar applications can be rapidly made with aerial applications. The use of aerial electrostatic application equipment on agricultural aircraft has shown that deposition of crop protection materials can be increased; therefore, studies were conducted to investigate the effectiveness of conventional and electrostatic aerial application of bifenthrin in controlling thrips.

Conventional and electrostatic aerial applications of the insecticide were effective in controlling thrips on seedling cotton. The electrostatic application increased the deposition by 23.8-206.1% over conventional application of the material tested. Although the electrostatic application significantly increased the deposition, there was no significant increase in control of thrips on seedling cotton over conventional aerial application in the three studies conducted.

Introduction

Thrips (*Thripidae)* damage to early season cotton (*Gossypium hirsutum* L.) results in significant leaf reduction, delayed maturity, and retarded plant growth (Sadras and Wilson, 1998, Harp and Turner, 1976, and Hawkins et al., 1966). The extent that thrips are able to cause significant damage can be influenced by the variety of cotton (Sadras and Wilson, 1998, Terry and Barstow, 1988, Quisenberry and Rummel, 1979, and Rummel and Quisenberry, 1979). Many cotton producers use a systemic insecticide at planting to reduce thrips damage (Leser, 1986 and Scott et al., 1985); however, some of these systemic insecticides may not be available to farmers in the future due to reregistration as required by EPA. Foliar applications of many different insecticides by ground application equipment also provide effective control (Scott et al., 1986, and Leser, 1986). Tests of aerial applications, and particularly electrostatic aerial applications, of insecticides for thrips control have not been reported. Aerial application is particularly suited to treat large areas rapidly if an economic infestation occurred.

The use of electrostatics in crop spraying relies on the application of an electrical charge to spray droplets; increasing their affinity to a grounding source (e.g. a plant surface). Electrostatic aerial application has been investigated by several researchers (Carlton et al., 1995a, and Inculet and Fischer, 1989) and has been shown to increase the deposition of some insecticides (Kirk and Harp, 2000, Kirk et al., 2000, Carlton et al. 1995b). The objective of this study was to compare conventional and electrostatic aerial application of an insecticide for controlling thrips in cotton.

Materials and Methods

Two rows of Roundup Ready® Deltapine® 436 cotton were planted at the Blackland Research Center at Temple, Texas on 20 April, 4 May and 15 June, 2001. Rows were situated N-S and E-W on the East and North sides, respectively, of a wheat field. For each treatment, there were four plots along the N-S rows and two along the E-W rows for a total of six treated replications (Fig. 1). There were two untreated plots, or checks, along the N-S rows and one along the E-W rows. Plots were 2 rows x 65 ft in length. During each treatment application, all other plots were completely covered with 4-mm plastic sheeting to prevent cross contamination. After a test was completed and sampled for the appropriate time (3-4 days), the plots were plowed and replanted for the next test.

Aerial application treatments were (1) a conventional spray boom with 40 flat fan 8004 nozzles at 40 psi and (2) an electrostatic boom system (Spectrum Electrostatic Sprayers Inc., San Antonio, TX) with 100 hollow cone (TXVK8 orifice) nozzles at 70 psi. Capture (bifenthrin) 2 EC, (FMC Corporation, Philadelphia, PA, EPA Reg. No. 279-3069) at 0.05 lb AI/acre and Caracid Brilliant Flavine 01YE007-000-FFS (Carolina Color and Chemical Co., Charlotte, NC) at 10g/acre, were applied on 30 April, 15 May, and 29 June, 2001 with an Air Tractor 402B at 120 mph delivering 1 gal/acre in a 65 ft swath, the length of each plot. Applications were made when cotton plants were in the 2 to 4 leaf stage of development. Wind speeds during the applications were 4.5, 7.2, and 10.5 mph, for 30 April, 15 May, and 29 June applications, respectively.

Pretreatment samples were taken in each plot, one sample (two cotton plants per sample) for background fluorescence and one sample (five cotton plants per sample) for thrips population estimates. After both treatments (conventional and electrostatic) were made and allowed to dry, 10 deposition samples (two cotton plants per sample) were taken in each plot. The samples were placed in 0.94 L plastic bags, stored in coolers with ice packs, and transported to the laboratory for processing. Deposition samples were washed in 20 ml of absolute ethanol. The rinsate was analyzed for Caracid Brilliant Flavine using a spectrofluorophotometer (RF5000U, Shimadzu Corporation, Kyoto, Japan). The fluorescence reading was converted to mass based on tank samples collected after each treatment. Leaf area was measured using a Li-3100 Area Meter (Li-Cor, inc. Lincoln, Nebraska). Deposition was calculated in $\mu g/cm^2$.

Thrips samples (three samples/plot with five plants/sample) were taken at 1 and 3 days after treatment (DAT) for the 15 May and 29 June test dates. The 30 April application was sampled at 2 and 4 DAT. Plant samples were placed in 38-L Berlese funnels and dried by heat from a 100-W light bulb for 24 hr. Thrips were collected in 70% alcohol in 0.24L jars at the bottom of each funnel. Samples were examined using a binocular microscope and the number of thrips was recorded.

The data were analyzed as a completely randomized design. All statistical significance refers to the $\alpha=0.05$ level. All means were separated using Fisher's Protected Waller-Duncan multiple range tests.

Results and Discussion

Deposition Results

Samples collected before each spray showed that there was no appreciable background fluorescence in the seedling cotton. The conventional and electrostatic treatments had significantly higher deposition than the Check plots (Table 1). There was no significant difference in the two application methods on the first spray date; however, deposition in the electrostatic treatment was significantly higher (62.8% and 206.1%) on the last two spray dates. The higher deposition percentages corresponded with higher wind speeds experienced on these test dates. This suggests that charging the droplets decreased the amount of material that moved out of the test plot under windy conditions.

Plant Counts

There were no significant pretreatment differences in thrips per plant between conventional, electrostatic, or check plots for the first two spray dates (Table 2), but the conventional and electrostatic spray plots had significantly higher pest populations at the start of the third test. For the three spray dates, both the conventional and electrostatic treatments significantly reduced thrips counts at 2 and 4 DAT or 1 and 3 DAT over the pretreatment counts (Table 2). These two treatments also significantly lowered thrips per plant compared to the check plots. There were no significant differences between conventional and electrostatic treatments at any of the post treatment dates.

General Discussion

The results presented are similar to those presented by others who have worked with aerial electrostatics. Kirk and Harp (2000) and Latheef et al. (1996) showed that electrostatic charging increased the deposition of the material being sprayed as compared to conventional equipment. However, this increased deposition did not translate into a significant increase in the control of the targeted pest.

It is possible that the rates of insecticides used in conventional applications are higher than the minimum effective dose needed to achieve the level of control measured in the tests. Therefore, a correlation between deposition and efficacy may not be measurable until tested rates are closer to the minimum needed to control a pest (e.g. rate needed for 80% control). Future studies for controlling thrips will focus on reduced rates of insecticides with conventional and electrostatic aerial application equipment.

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Table 1. Deposition (μg/cm²) (± SD) of Caracid Brilliant Flavine on seedling cotton with conventional and electrostatic aerial application equipment.

	Deposition (μg/cm²)*		
Treatment	**30 April**	**15 May**	**29 June**
Check	0.028±0.002b	0.001±0.000c	0.001±0.000c
Electrostatic	0.467±0.031a	0.355±0.020a	0.603±0.048a
Conventional	0.377±0.022a	0.218±0.012b	0.197±0.018b
% Increase w/ Electro	23.9%	62.8%	206.1%

* - Means in the same column for each date with the same letter are not significantly different at α=0.05, Fisher's Protected Waller-Duncan multiple range test.

Table 2. Thrips per plant (± SD) on seedling cotton.

DAT	Conventional*	Electrostatics	Check
30 April			
0†	0.60±0.29aX	0.60±0.18aX	0.55±0.35aX
2	0.20±0.24aY	0.30±0.34aY	0.70±0.30bX
4	0.07±0.14aY	0.09±0.12aZ	0.66±0.33bX
15 May			
0	1.58±0.91aX	1.68±1.20aX	1.80±1.09aX
1	0.31±0.28aY	0.30±0.35aY	2.04±1.10bX
3	0.21±0.25aY	0.40±0.52aY	2.02±1.25bX
29 June			
0	0.98±0.57aX	1.03±0.45aX	0.51±0.39bX
1	0.20±0.24aY	0.11±0.13aY	0.64±0.28bX
3	0.21±0.24aY	0.16±0.21aY	0.47±0.27bX

* - Means in the same column for each date with the same upper case letter are not significantly different at α=0.05, Fisher's Protected Waller-Duncan multiple range test.

† - Means in the same row with the same lower case letter are not significantly different at α=0.05, Fisher's Protected Waller-Duncan multiple range test.

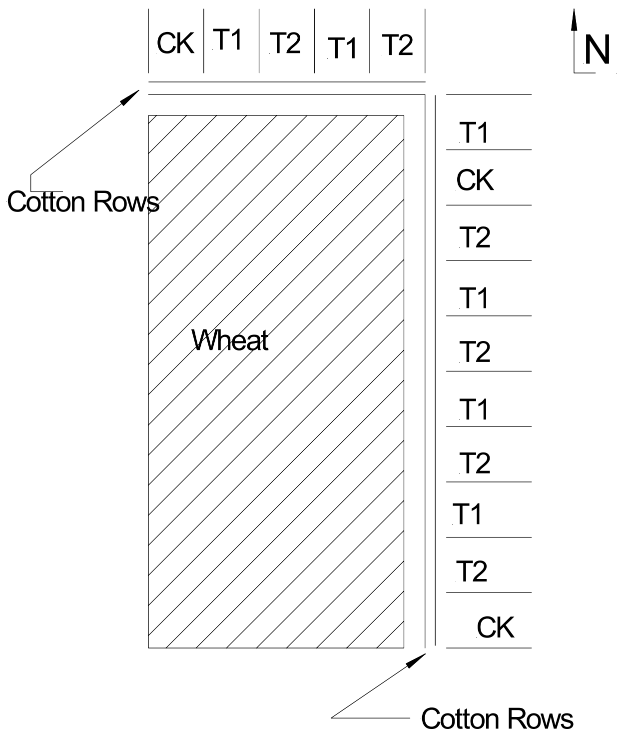

Figure 1. Plot layout for thrips control tests.