EFFECTS OF EARLY SEASON THRIPS FEEDING ON ROOT DEVELOPMENT, LEAF AREA AND YIELD

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Abstract

Western flower thrips (WFT), *Frankliniella Occidentalis* (Pergande), feeding on cotton seedlings (*Gossypium hirsutum* L., var. Acala SJ-2) grown in growth chambers for 8 weeks caused significant reductions in plant root development, leaf area, and final plant dry matter of both above and below ground biomass when compared with plants protected by a systemic insecticide. Field trials showed similar reductions in early season total plant biomass and harvested lint yields from early thrips damage.

Introduction

The University of California Integrated Pest Management (IPM) Manual list thrips as the most important predators of spider mites (*Tetranychus* spp.) early in the season. The IPM Manual acknowledges that thrip feeding does cause the leaves of slow growing seedlings to become wrinkled and distorted, but this injury is of "little importance" and that the plants "quickly outgrows" this damage when the weather warms up. Kerby and Keeley (1987) reported that reductions in early season leaf area , from whole leaf removal, did not appear to limit growth as evident in plant height and main stem nodes. They did report significant reductions in total above ground dry weights from the various leaf removal combinations and suggested from this work that controlling thrips was unnecessary since thirps did not remove entire leaves. Longer, Oosterhuis and Withrow (1993) reported results from a growth chamber study that reductions of early leaf areas did significantly reduce plant heights, root and shoot dry weights and total dry weights. Both of these studies utilize whole leaf removal (cotyledon and first true leaves) as the means of achieving reductions in early leaf areas and show varying levels of plant recovery from the imposed treatments. Neither study takes into consideration the sustained damage from prolonged thirp damage (first 3-4 true leaves) and the potential cost to the young plant in maintaining and supporting the affected leaves.

A review of WFT as to plant damage and mite predation was presented by Reed and Reinecke. The results of this study suggest that competition for food between thrips and mites may be more of a factor than predation in reducing mite densities in the presence of high densities of WFT. The authors also point out from microscopic observation that the plants they examined were not able to full revitalize the damaged cells following WFT feeding. This supports the possibility of the increased respiratory cost to support this reduced and damaged leaf area.

Roberts et al. (1990) reported an 183 lb. average lint yield advantage from use of a systemic insecticide used at planting. During the five years of this study there were seasons and field locations that the authors felt were severely affected by early thrips. Therefore, the purpose of this study was to evaluate the effect of thrip feeding on young cotton seedlings. An objective was to find out if the reduced leaf area caused by thirp feeding resulted in reductions in other plant parameters such as roots, total biomass, and lint yields.

Methods

The growth chamber portion of this study was conducted at the USDA Cotton Research Station, Shafter CA. The soil used was a non-sterilized, Wasco sandy loam. The cotton seeds were planted into 2 gallon ceramic pots. The plants were grown for 8 weeks. The day/night temperature cycles in the growth chambers were based on a 7 year average temperature for an April 6 planting date. The temperature cycles were adjusted at 2 week intervals for new average seasonal high and low temperatures. Light intensity and duration was also set by the 7 year averages and adjusted on a 2 week schedule. Four separate chambers were used for this study. Data on the measurements of light intensity and temperatures from the separate chambers showed very good consistency between chambers. Therefore, each chamber represented a treatment. Temik (Aldicarb), was used to control thrips in two of the treatments. Eight pots were grown in each chamber and represented a replicate of each main treatment. The four treatments were: A) Control-no thrips, no Temik, B) Temik-no thrips, C) Control-no Temik with thrips, and D) Temik-with thrips. The Temik was applied at the equivalent to 4.6 lb. a.i. per acre. The Temik was applied into the treated pots to simulate an at-planting application.

After seedling emergence thrips were introduced into the 2 "+ thrip" chambers. Thrips were collected from surrounding alfalfa fields as needed to maintain a constant thrip presence. Thrips were added to maintain a constant thrip level of 2 to 4 thrips per plant. No additional thrips were added when either an adult or immature was observed on each plant.

Plant measurements were made after 8 weeks of growth. This time period allowed the maximum amount of growth that could be contained in the growth chambers and prevented the plants from becoming excessively root-

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bound. Leaf areas were measured with a Li-Cor Leaf Area Meter. Photosynthesis measurements were made with a Li-Cor Model 6200, Photosynthesis meter (data not presented). Plant roots were separated by a soil eluriator and partitioned into tap and fine roots then oven dried. All weight measurements are reported on a dry weight basis. Tensiometers were used to monitor soil moisture. Water was applied as indicated by the tensiometer to avoid water stress.

The growth chamber study was repeated twice. An analysis of variance was run on the four main treatments with eight replications. There were no differences attributed to the separate repetitions of this study so unless otherwise noted, the main treatment means are pooled for this summary.

A field trial was also conducted to validate the growth chamber results. The trial was planted on April 18, 1991. The trial had other systemic treatment comparisons but for this report only the treatments similar to the growth chamber study will be discussed. The field site did encounter early season insects. Thrips were present and produced server foliar symptoms from thrip feeding. Spider mites and aphids were also present and may have contri-buted to the observer results produced from this trial. The mite and aphid densities were below the UC IPM threshold guidelines for treatment. However, the present of this early season complex of thrips, mites and aphids adds to the difficulty of making a direct comparison to the controlled condi-tions of the growth chamber. Following a cleanup miticide application there were no other insect problems at this location. Field measurements of top growth and root density were made 27 and 53 days after planting. Soil cores were collected and washed to separate roots for dry weight estimates. Final lint yields were determined at harvest.

Results and Discussion

The thrip feeding on plants in the growth chambers produced similar foliar symptoms as observed in the field. In the unprotected treatment (no Temik plus thrips) the major damage from thrip feeding was confined to the first three true leaves. The cotyledons of this most severely affected treatment were not as noticeably damaged as the upper main stem leafs. The Temik protected treatment, in the presence of thrips also showed some foliar damage from thrip feeding but was much less than the unprotected treatment.

Final plant height was significantly influenced by the presence of thrips. The thrip free plants were taller than the thrip affected plants. The Temik treatments were not significantly taller than the no Temik treatment when thrips were present. Final node count follows a similar pattern although, not as distinct as the plant height data (Table 1).

The final leaf area and leaf dry weight from the 1991 trial is presented in Table 2. The 1990 results were similar. Final leaf areas and dry weights were greatly influenced by the early presence of thrips. The thrip free treatments produced significantly greater leaf areas and dry weights than the thrip affected plants. Within the no-thrip treatments, the Temik at planting did not affect the final leaf areas or leaf dry weights. With thrips present the Temik protected treatment produced significantly greater final leaf areas and leaf dry weights than the unprotected control but significantly less than the thrip free treatments.

There were no significant difference in final main stem, tap root and fine root dry weights of the two treatments that did not have thrips present (Table 3). In the thrip-present chambers the Temik treatment produced significantly higher dry weights for all three parameters measured. Even with the Temik protection the damaged caused by the thrips resulted in a 38 % reduction in main stem dry weight, a 26 % reduction in tap root dry weight and a 33 % reduction in fine root dry weight compared to the thrip free controls. Without the systemic protection, the dry weight reductions from thrip damage for final stem, tap root and fine root measurements were 67, 80, and 82 %, respectively , compared to the thrip free control.

The field trial experienced heavy thrip damage but this was in addition to the presence of mites and aphids. On June 10 (53 days after planting) the difference between the insect damaged plants and the protected (Temik treatment) plants was very evident. The protection provided from the Temik represented a 63 % increase in the dry weight of the above ground plant, a 100% increase in tap root and a 190 % increase in fine root dry weights over the untreated controls. Lint yield at harvest showed a 195 lb. increase from the Temik treatment that experienced less early insect damage.

Conclusions

The results of this growth chamber study do not support a plant growth response from Temik applied at planting. The observed differences in the plant parameters monitored in this study were caused by thrip damage. Thrip pressure early in the cycle (planting through 4 weeks of growth) significantly reduced all of the plant based measurements. The largest differences were in final leaf area, stem and root (tap and fine roots) dry weights. The results support a direct relationship between the plants ability to produce and maintain a functioning leaf area during this early growth phase to establish above and below ground structures. In the presence of early thrips, Temik allowed the treated plants to approach a more optimum growth potential. The field results, although confounded by the complex of early season insects also support this conclusion. The results also suggest that early season plant height and node development are poor indicators of restrictions to root development caused by thrip feeding and/or reduced leaf areas.

References

1. Integrated Pest Management for Cotton. 1984. University of California Division of Agriculture and Natural Resources Publication No. 3305. p. 87.

2. Kerby, T. A. and M. Keeley. 1987. Cotton seedlings can withstand some early leaf loss. Calif. Agric.41(1-2): 18-19.

3. Longer, D. E., D. M. Oosterhuis and M. Withrow. 1993. Cotton seedling recovery from partial and complete defoliation. Arkansas Farm Research, 42(6): 10-11.

4. Reed, J. T. and J. Reinecke. 1990. Western Flower Thrips on Cotton: Plant Damage and Mite Predation - Preliminary Observations. Proc. Beltwide Cotton Prod. Res. Conf. p. 309-310.

5. Roberts, B.A., R.L. Dunlap, B.L. Weir and R. Vargas. 1990. Early season pest management in the San Joaquin Valley. CA. Proc. Beltwide Cotton Prod. Res. Conf. p. 181-182.

Table 1. Mean plant height (cm) and total nodes from 1990-91 Growth Chamber Study.

Treatment	**Plant Height**	Total Node
A - Control (No Thrips)	27.9a	8.4
B - Temik (No Thrips)	26.8a	8.4
C - Control (+ Thrips)	19.2b	8.2
D - Temik (+ Thrips)	20.2b	7.4

Table 2. Leaf areas (cm2) and leaf dry wt. (g) from 1991 Growth Chamber Study.

Treatment	**Leaf Area**	**Leaf Wt**
A-Control (No Thrips)	1143a	6.2a
B-Temik (No Thrips)	1138a	6.1a
C-Control (+ Thrips)	516c	2.8c
D-Temik (+ Thrips)	671b	4.0b

Table 3. Mean stem, tap root and fine root dry weights (g) from the 1990 and 1991 Growth Chamber Study.

Treatment	**Main Stem**	**Tap Root**	**Fine Roots**
A-Control (No Thrips)	3.3a	0.84a	2.27a
B-Temik (No Thrips)	3.2a	0.73a	2.29ab
C-Control (+ Thrips)	1.1c	0.19c	0.49c
D-Temik (+ Thrips)	1.9b	0.54b	1.53b