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PLANTING PATTERNS AFFECTING THE ABUNDANCE OF COTTON APHIDS AND BANDEDWINGED WHITEFLIES IN DRYLAND COTTON

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Abstract

A 3-yr study was conducted at the Texas Agricultural Experiment Station farm in the Texas Rolling Plains during the 1998-2000 growing seasons to quantify the effect of planting pattern on population abundance of the cotton aphid, *Aphis gossypii* Glover, and bandedwinged whitefly, *Trialeurodes abutilonea* (Haldeman). 'Sphinx' cotton was planted in late April, mid-May, and early June, representing early, normal, and late planting dates in the Texas Rolling Plains. Within each planting date, planting pattern treatments included 1) solid-row stand, 2) two rows planted, one row skipped (*Skip 2x1*), and 3) two rows planted, two rows skipped (*Skip 2x2*). For this article, data are averaged over planting dates; thus, only the influence of planting pattern is reported. Abundance of cotton aphids and whitefly nymphs were estimated by inspecting 10 leaves from the upper half and 10 leaves from the lower half of plants from each plot. Insects were surveyed every week, beginning early August and continuing until populations declined. Analysis of variance showed that average cotton aphid abundance varied significantly with planting pattern. *Solid-row* pattern attracted fewest numbers of cotton aphids, followed by *Skip 2x1* and *Skip 2x2*. Planting pattern also had a significant effect on whitefly abundance, but the influence of planting pattern on whitefly abundance was opposite to that for cotton aphids. Soil moisture was marginally higher on skip-row plots compared to the solid-row plots, but the leaf moisture content was significantly higher in skip-row plots compared to the solid-row plots. Plants were significantly taller in skip-row plots compared to the solid-row plots. Plant vigor and higher leaf moisture content likely contributed to higher aphid abundance and lower whitefly abundance in skip-row plots compared to the solid-row plots.

Introduction

Cotton aphids have been a yearly secondary pest in cotton in the Rolling Plains of Texas for the past 20 years, with moderate to high densities during 1990, 1991, 1993, and 1995 (Slosser et al. 1997, Slosser et al. 1998). Naturally occurring biological control agents have contributed to the maintenance of aphid populations to a secondary pest status in the Rolling Plains region, and projects are underway to investigate methods to enhance the efficacy of natural enemies of cotton aphids through modifications in cultural practices (Parajulee et al. 1997, Parajulee and Slosser 1999, Slosser et al. 2000). The bandedwinged whitefly has been a periodic economic pest of cotton in Louisiana (Clower and Watve 1973), but it has historically been a non-pest in Texas cotton. However, during the past few years, bandedwinged whiteflies have become increasingly more prevalent in Texas. Little is known about the ecology and behavior of bandedwinged whiteflies in Texas cotton.

Cotton production is primarily dryland in the Rolling Plains, with only 6-8% of the cotton acreage under irrigated production system. Thus, cultural practices such as adjustment in planting date and plant density (spacing and row patterns) play a significant role in cotton production in the Rolling Plains. The objective of our study was to quantify the population abundance patterns of cotton aphids and bandedwinged whiteflies as affected by planting date and planting pattern.

Materials and Methods

The study was conducted at Texas Agricultural Experiment Station farms at Munday (1998 and 1999) and Chillicothe (2000), Texas. The cotton variety 'Sphinx' was planted in 40" rows, with plots 20 rows wide by 75 ft. long. The test consisted of two treatments (planting date and planting pattern) with three levels each, and the entire test was replicated three times, with a total of 27 experimental plots. The three planting dates included the commonly recommended optimum planting date of May 16-19 and three weeks before (April 26-29) and three weeks after (June 6-9) the optimum planting date, representing normal, early, and late planting dates for the Rolling Plains region. The three planting patterns included 1) solid-row stand of 4.2 plants/ft (55,000 plants/acre), 2) two rows planted, one row skipped (36,660 plants/acre), hereafter referred to as *Skip 2x1*, and 3) two rows planted, two rows skipped (27,500 plants/acre), hereafter referred to as *Skip 2x2*. The entire test was deployed in a split-plot design, with the planting date as a whole plot and planting pattern treatments as subplots. Crop and land management followed a standard practice recommended for dryland cotton production for the region. All plots received fertilizer @ 30-0-0-12 (N-P-K-S) lbs/acre.

Abundance patterns of cotton aphids and bandedwinged whiteflies were monitored weekly starting August 24 (1998), August 3 (1999) and August 21 (2000) and continuing until populations declined. Cotton aphids and whitefly nymphs were estimated by inspecting 10 leaves from the top half and 10 leaves from the lower half of plants from each plot. Soil moisture was monitored in all treatment plots, once per month, using a combination of gravimetric and neutron scattering techniques. Plant height was measured only in 1999 after plant cut-out. Leaf moisture was measured only in 2000 by drying leaves in an oven. For the purpose of this article, all data were averaged across planting dates to discuss only the influence of skip-row patterns on cotton aphid and whitefly abundance. Insect abundance data were subjected to a repeated measures analysis of variance, with planting pattern as a source of varibility and sample week as repeated measures (Abacus Concept 1989). Other parameters were analyzed using a one-way ANOVA.

Results and Discussion

Cotton Aphid Abundance

Aphid abundance was far below economic threshold of 50 aphids per leaf throughout the season in all three years (Table 1). The low aphid abundance during the three growing seasons can be attributed to extremely hot and dry weather in the Rolling Plains. The daily minimum temperatures and maximum temperatures during July-August were higher in all three years of the study compared with the 16-year average temperature profile for the Rolling Plains (Table 2). Also, the total precipitation during July-August was much lower during the study period compared with the long-term average for the region (Table 2). Abundance of cotton aphids varied significantly with planting pattern in all three years (1998: $F = 4.53$; df = 2, 18; $P = 0.02$; 1999: $F = 6.70$; df = 2, 18; $P = 0.006$; 2000: $F = 7.76$; df = 2, 18; $P = 0.007$). *Solid-row* planting pattern was associated with the lowest aphid abundance, followed by *Skip 2x1* and *Skip 2x2*, consistently for all three years of the study (Table 1). *Skip 2x1* treatment marginally increased the aphid numbers compared with the *Solid-row* planting while *Skip 2x2* had significantly higher aphid numbers compared with the *Solid-row* treatment in all years.

Bandedwinged Whitefly Abundance

Average abundance of bandedwinged whitefly nymphs was significantly influenced by planting pattern in 1999 ($F = 5.20$; df = 2, 18; $P = 0.01$), but the abundance was marginally influenced by planting pattern in 2000 ($F = 1.66$; df = 2, 18; $P = 0.21$) (Table 3). Overall, *Solid-row* planting pattern was associated with the highest whitefly abundance, followed by *Skip 2x1* and *Skip 2x2* (Table 3). *Skip 2x1* treatment marginally suppressed the whitefly numbers compared with the *Solid-row* planting while *Skip 2x2* had significantly lower whitefly numbers compared with the *Solid-row* treatment.

Soil Moisture Conservation and Plant Parameters

Skip-row planting patterns maintained marginally higher soil moisture compared with the solid planted cotton in 1998 and 2000, while the effect was statistically significant in 1999. Averaged over three years, *Skip 2x2* maintained significantly higher moisture in the soil profile compared with the *Solid-row* treatment; *Skip 2x1* treatment had marginally higher soil moisture compared with the *Solid-row* treatment (Table 4). Even though soil moisture was not significantly enhanced by skip-row planting patterns with year-to-year consistency, it appeared that marginally higher moisture in the soil profile in the skip-row plots could increase leaf moisture content significantly compared with the solid-planted cotton. In 2000, soil moisture was not significant among treatment plots, but the leaf moisture was significantly increased as the number of rows skipped increased (Table 5). Our results of higher aphid numbers and lower whitefly numbers in skip-row plots compared with the solid-planted cotton most likely resulted due to the differential leaf moisture content among treatments. These results are in agreement with Slosser et al. (1992) who have shown a significant positive correlation between leaf moisture content and aphid numbers and negative correlation between leaf moisture and bandedwinged whitefly abundance. Skip-row planting also increased the plant height by 2 inches compared with the solid planting; indicating a higher level of leaf nitrogen and more available moisture to those plants. The increased leaf nitrogen has also been shown to positively correlate with the aphid numbers (Slosser et al. 2002). Therefore, aphid increase in skip-row plots compared with solid-planted cotton in this study should have been the result of multiple factors, including leaf moisture, leaf nitrogen, and overall vegetative growth of the plant (Slosser et al. 1992, 1997, 1998).

References

Abacus Concept. 1989. SuperANOVA, accessible general linear modeling. Abacus Concepts, Berkeley, CA.

Clower, D. F., and C. M. Watve. 1973. The bandedwinged whitefly as a pest of cotton, pp. 90-91. Proceedings, Beltwide Cotton Production and Research Conference. National Cotton Council, Memphis, TN.

Parajulee, M. N., R. Montandon, and J. E. Slosser. 1997. Relay intercropping to enhance abundance of insect predators of cotton aphid (*Aphis gossypii* Glover) in Texas cotton. International Journal of Pest Management 43: 227-232.

Parajulee, M. N, and J. E. Slosser. 1999. Evaluation of potential relay strip crops for predator enhancement in Texas cotton. International Journal of Pest Management 45: 275-286.

Slosser, J. E., R. Montandon, W. E. Pinchak, and D. R. Rummel. 1997. Cotton aphid response to nitrogen fertility in dryland cotton. Southwestern Entomologist 22: 1-10.

Slosser, J. E., M. N. Parajulee, and D. G. Bordovsky. 2000. Evaluation of food sprays and relay strip crops for enhancing biological control of bollworms and cotton aphids in cotton. International Journal of Pest Management 46: 267-275.

Slosser, J. E., M. N. Parajulee, D. L. Hendrix, T. J. Henneberry, and D. R. Rummel. 2002. Relationship between *Aphis gossypii* (Homoptera: Aphididae) and sticky lint. Journal of Economic Entomology (*in press*).

Slosser, J. E., W. E. Pinchak, and W. A. Frank. 1992. Effect of planting date on cotton aphid and bandedwinged whitefly populations in dryland cotton. Southwestern Entomologist 17: 89-100.

Slosser, J. E., W. E. Pinchak, and D. R. Rummel. 1998. Biotic and abiotic regulation of *Aphis gossypii* Glover in west Texas dryland cotton. Southwestern Entomologist 23: 31-65.

Table 1. Average number of cotton aphids per leaf in dryland cotton, as affected by planting pattern.

Planting Pattern	1998	1999	2000	Average
Solid-row	1.815 b	3.271 b	0.283 c	1.789 b
Skip 2x1	2.717 ab	5.644 b	0.539 b	2.800 ab
Skip 2x2	4.709 a	7.248 a	0.761 a	4.239 a

Means followed by same letter within a column are not significantly different (P>0.05).

Table 2. Average climatic parameters for the Rolling Plains during July-August, 1982-2000.

Parameter	1998	1999	2000	Average (1982-1997)
Daily Minimum Temperature (^{o}F)	72.6	72.5	72.6	71.2
Daily Maximum Temperature (^{o}F)	101.6	99.5	100.0	96.1
Total Precipitation (inch)	0.4	1.2	1.1	5.5

Table 3. Average number of whitefly nymphs per leaf in dryland cotton, as affected by planting pattern.

Planting Pattern	1999	2000	Average
Solid-row	10.483 a	2.540 ab	6.510 a
Skip 2x1	8.442 ab	2.870 a	5.656 ab
Skip 2x2	6.394 b	2.130 b	4.260 b

Means followed by same letter within a column are not significantly different (P>0.05).

Table 4. Average soil moisture (inch per 5-ft column) in dryland cotton, as affected by planting pattern.

Planting Pattern	1998	1999	2000	Average
Solid-row	10.999 a	11.374 ab	11.233 a	11.202 b
Skip 2x1	11.269 a	11.256 b	11.452 a	11.326 ab
Skip 2x2	11.220 a	11.901 a	11.901 a	11.663 a

Means followed by same letter within a column are not significantly different (P>0.05).

Table 5. Average plant height (1999) and average percentage leaf moisture (2000) in dryland cotton, as affected by planting pattern.

Planting Pattern	Plant Height (in.)	% Leaf Moisture
Solid-row	22.111 b	69.056 c
Skip 2x1	23.800 a	69.944 b
Skip 2x2	24.090 a	70.942 a

Means followed by same letter within a column are not significantly different (P>0.05).