FACTORS CONTRIBUTING TO LATE-SEASON COTTON APHID INFESTATIONS

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Abstract

The development of cotton aphid, *Aphis gossypii* Glover, populations in relation to irrigation management and application of insecticides was investigated in 1998 and 1999. Three water management treatments included no irrigation (dryland), irrigation termination by mid-August, and irrigation termination in late August. Three chemical treatments, within each of the three water management treatments, were the untreated check, application of cyhalothrin which is known to stimulate aphid population increase, and cyhalothrin followed by the aphicide pymetrozine. There was only one population peak in early September, 1998 and one in late September, 1999. An application of cyhalothrin combined with late irrigation in August resulted in very high aphid population levels during September in both years. Pymetrozine effectively reduced aphid numbers following the cyhalothrin treatment in dryland and irrigated, early termination treatments, but pymetrozine was less effective in irrigated, late termination treatments.

Introduction

The cotton aphid, *Aphis gossypii* Glover, became a significant problem in west Texas beginning in the mid-1980's (Leser et al. 1992). In addition to its ability to reduce lint yield (Fuchs and Minzenmeyer 1995), the cotton aphid secretes honeydew on open lint, and the resulting sticky lint causes severe problems during the spinning process at textile mills (Ellsworth et al. 1999). Sticky lint caused by cotton aphids was a particularly severe problem in cotton grown in the Texas High Plains in 1995 (Lloyd 1997). Yield reductions appear to be associated with high infestation levels during the period when cotton is actively producing blooms, while sticky lint is a problem associated with late-season infestations that occur near crop harvest. Persistent insecticides (Bartlett 1968), pyrethroids (Kidd et al. 1996), and plant nutrition including elevated levels of leaf nitrogen and moisture (Slosser et al. 1998) are associated with rapid development of cotton aphid infestations.

Objectives of this study were to (1) define the interaction between water management and pyrethroid applications on cotton aphid population development prior to and at the time of initial boll opening during September, and (2) determine if pymetrozine could effectively control late-season aphid outbreaks following a cyhalothrin application.

Materials and Methods

Studies were conducted at the Texas Agricultural Experiment Station at Chillicothe. The cotton cultivar "TAMCOT Sphinx" was planted 30 April 1998 and 28 April 1999. Seeding rate was 5.7 seeds per row foot in 40" row spacings, and row direction was E-W. Fertilizer was applied immediately prior to planting at 30 lb N/acre in dryland plots and 60 lb N/acre in irrigated plots. Plot size both years was 10 rows wide by 70' long. Irrigated and dryland plots were maintained in the same location, but chemical treatment subplots were randomly assigned each year.

A split-plot experimental design, arranged as randomized complete blocks with three replications, was used. Whole plots were three irrigation treatments: (1) dryland - no supplemental irrigation during the growing season, (2) early termination of irrigation with last application in early to mid-August, and (3) late termination of irrigation with last application in late August; the latter two treatments are subsequently referenced as irrigated-early termination and irrigated-late termination, respectively. About 2.5 - 3.0" water were applied at each irrigation. Irrigations were terminated 13 August and 27 August 1998 in Treatments 2 and 3, respectively, and on 12 August and 27 August 1999, respectively.

Subplots were three chemical treatments: (1) an untreated check, (2) an application of cyhalothrin [Karate® at 0.04 lb AI/acre, Zeneca Ag Products, Wilmington, DE] during periods of increased bollworm, *Helicoverpa zea* (Boddie) activity, and (3) an application of cyhalothrin, as in Treatment 2, followed by an application of pymetrozine [Fulfill™ at 1.5 oz AI/acre, Novartis Crop Protection, Inc., Greensboro, NC] when cotton aphids began to increase. Stylgard 309, a spreader-sticker, was added to the pymetrozine solutions at 0.25% of total spray. Cyhalothrin was applied 8 July and 12 August and pymetrozine was applied 26 August in 1998, and in 1999 cyhalothrin was applied 2 and 25 August and pymetrozine on 8 September in dryland plots and on 17 September in irrigated plots. Pymetrozine is a new aphicide (Allemann et al. 1997) that was selected to determine if it could counteract the influence of cyhalothrin on aphid population increase. Chemicals were applied with a John Deere Hi-Cycle sprayer with drops to provide three nozzles per row. Total solution applied was 10.8 GPA in both years. The middle 6 rows within the 10 row plots were treated to minimize drift onto adjacent plots.

Aphids were sampled once-a-week, in the middle six rows of a plot, beginning the first week in July. Aphid numbers were counted visually on ten leaves picked from the top-half of the plant and on ten leaves picked from the bottom-half of the plant. A leaf was picked every 2-3 steps along a row and visually examined. Top-half and bottom-half leaves were taken from different rows within a plot. All aphids were counted individually until numbers reached about 100/leaf, after which numbers were estimated by counting groups containing five or ten individuals.

Data were analyzed using analysis of variance for a split-plot experiment, arranged as randomized complete blocks with three replications. The FACTOR and RANGE programs of MSTAT-C (MSTAT Development Team 1988) were used, and means were separated with protected least significant difference (LSD, $\propto = 0.05$).

Results and Discussion

A single population peak occurred on 8 September 1998 and on 28 September 1999 (Figure 1). Cotton aphid populations typically reach peak densities during August in the Texas Rolling Plains, but harsh environmental conditions delayed development of aphid populations in both years. When cotton is planted in late April, as in this study, plant regrowth during September can occur, and early planting is one factor that contributes to the occurrence of cotton aphid population peaks during September. Because rapid boll opening begins by early September in early planting dates, the prospects for contamination of lint by aphid honeydew are enhanced. The focus of this report relates to the influence of late season irrigation and insecticide applications on development of cotton aphid populations during September.

1998 Study

Aphid numbers were similar in dryland and irrigated treatments in late August. However, in early September aphid numbers were significantly higher in irrigated-late termination plots as compared to numbers in dryland and irrigated-early termination plots, which were statistically similar. In relation to the untreated check, aphid numbers were significantly higher in cyhalothrin treated plots on 25 August and 1 September in all three water management treatments, and this relationship was extended by a week to 8 September in the irrigated-late termination plots. The cyhalothrin treatment delayed the attainment of maximum aphid numbers by one week

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in dryland and irrigated-early termination plots in relation to the timing in the untreated plots. Pymetrozine suppressed aphid numbers to levels similar to those in the untreated plots in both dryland and irrigated-early termination plots throughout September. Although pymetrozine suppressed aphid numbers following the application of cyhalothrin in irrigated-late termination plots, this aphicide was not as effective as in the dryland and irrigated-early termination plots.

1999 Study

During September, aphid numbers were significantly higher in plots that received a late irrigation as compared to numbers in plots grown dryland or that had early termination of irrigation. During October, aphid numbers were similar in all three water management treatments. Highest numbers of aphids were recorded on 28 September in irrigated- late termination plots, while highest numbers in dryland and irrigated-early termination plots occurred on 6 October.

In relation to the untreated plots, the cyhalothrin treatment stimulated development of higher levels of aphids in all three water management treatments. In dryland and irrigated-early termination plots, aphid numbers in pymetrozine-treated and untreated plots were similar from mid-September to mid-October. In irrigated-early termination plots, aphid numbers in the pymetrozine treated plots were statistically similar to numbers in untreated plots until 20 October. In the irrigated-late termination plots, aphid numbers were significantly higher in cyhalothrin and pymetrozine-treated plots than numbers in the untreated plots. Pymetrozine did not reduce aphid numbers in irrigated-late termination plots in 1999.

Summary

When cotton aphid population increases occur between mid-August and mid-September, a cyhalothrin treatment can stimulate development of high numbers. However, cyhalothrin did not always stimulate population increase because the first application in early July 1998 or in late July 1999 did not result in rapid development of high aphid numbers. Most irrigation applications did not result in development of high populations. When aphid numbers began to increase, populations were highest in plots with the most recent irrigation (Figure 1).

High population levels extended over a two-week period in 1998 and over a four-week period in 1999. During these periods of natural population increase, an application of cyhalothrin stimulated development of populations levels that were higher than those in the untreated checks in all three irrigation treatments. An application of pymetrozine following cyhalothrin reduced aphid numbers to levels similar to those in untreated plots in dryland and irrigated-early termination plots in both years. However, pymetrozine was less effective in the irrigated-late termination plots in 1998, and pymetrozine did not reduce aphid numbers in 1999 (Figure 2). Leaf moisture regulates reproductive potential of cotton aphids, and when reproduction is enhanced during boll opening by a late irrigation, an aphicide as pymetrozine is less effective for reducing aphid numbers.

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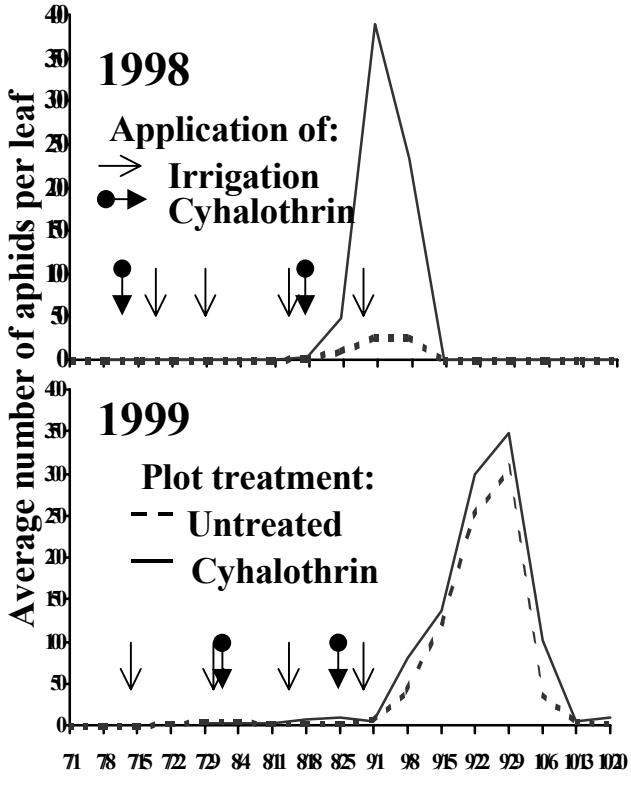

Figure 1. Cotton aphid populations in relation to irrigation and cyhalothrin applications. Chillicothe, Texas.

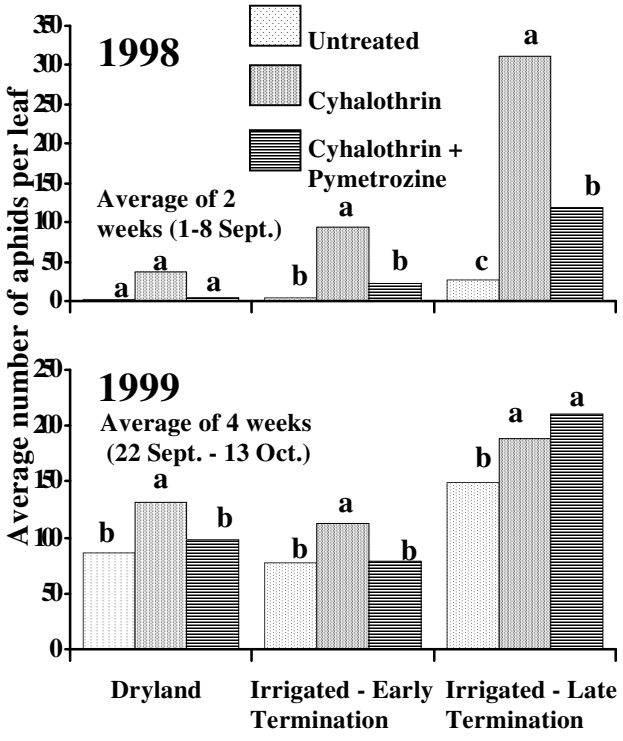

Figure 2. Effect of three irrigation treatments and three chemical treatments on cotton aphid numbers. Chillicothe, Texas. [Chemical treatments are compared within irrigation treatments; bars with a common letter are not different (P>0.05, LSD).]