EFFECT OF SORGHUM PLANTING DATE ON SUGARCANE APHID POPULATIONS AND ASSOCIATED NATURAL ENEMIES

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Abstract

The sugarcane aphid *Melanaphis sacchari* (Hemiptera: Aphididae) has recently become a major pest of grain sorghum in southeastern Arkansas and elsewhere in the southern U.S. There are currently few effective insecticides labeled for sugarcane aphid control on grain sorghum [*Sorghum bicolor* (L.) Moench], and although field research on the sugarcane aphid is limited, primary literature suggests potential control mechanisms using natural enemies. An experiment was set up with four replicate blocks and eight treatments to investigate the population dynamics of sugarcane aphids and their associated natural enemies in sorghum planted on different dates. Treatments were arranged using a full factorial structure, including four planting dates (14-Apr, 10-May, 1-Jun, 21-Jun) that were either sprayed with flupyradifurone (Sivanto) for sugarcane aphid control or left unsprayed. Sugarcane aphids were monitored each week for twelve weeks. Sugarcane aphid populations in the untreated plots showed a decrease in density shortly after flowering in all planting dates; in the first two planting dates, this initial peak was followed by a second, larger surge at the beginning of August. Sudden declines in aphid populations that then occurred could be explained by dispersal behavior as well as the buildup of natural enemies, including several species of Coccinellidae which were observed in abundance on the respective planting dates at the times of these peaks.

Introduction

The sugarcane aphid [*Melanaphis sacchari* (Zehntner 1897)] is an invasive pest of grain sorghum [*Sorghum bicolor* (L.) Moench] in Arkansas that has been found in the state since 2014. Economic damage can occur from vegetative stages through harvest due to the aphids' feeding and production of honeydew. The current recommended threshold is 50 or more aphids per leaf on at least 25% of the plants in the field (Studebaker 2016). In 2015 and 2016, two insecticides were available for use against the sugarcane aphid on grain sorghum, Sivanto Prime (flupyradifurone) and Transform WG (sulfoxaflor). Limitations in chemical availability and efficacy for sugarcane aphid infestations necessitate the development of IPM programs; potential strategies include neonicotinoid seed treatments that provide early suppression of aphid infestations, early planting so that plants are at a less susceptible stage of development when infestations exceed the threshold, and protection of natural enemies that are recruited by sugarcane aphids and aid in population regulation in mid- to late-season.

The objective of this study was to evaluate the effect of sorghum planting date on sugarcane aphid population densities and their natural enemies.

Materials and Methods

A split plot experiment with four replicates and eight treatments was set up to examine the effects of grain sorghum planting date on sugarcane aphid infestations and their effects on yield. Treatments were arranged in a 4 × 2 full-factorial structure, with 4 planting dates (the whole-plot factor) and 2 insecticide regimes (the split-plot factor). In

2015, the planting dates were April 30th, June 5th, June 17th, and July 13th; in 2016, the planting dates were April 14th, May 10th, June 1st, and June 21st. Each planting date was replicated four times as randomized strips within the field; each strip was divided in half, with one half treated with Sivanto Prime (flupyradifurone) at four ounces per acre to control sugarcane aphids, and one half left untreated. Split-plots were 40 feet by four rows spaced 38 inches apart. Plant stages were recorded and sugarcane aphids were counted on one upper leaf and one lower leaf of ten random plants in each plot weekly, beginning with their initial discovery in the field and continuing until harvest and/or population collapse. There were a total of 13 collection dates in both 2015 and 2016. Natural enemies of sugarcane aphids were also identified using the Natural Enemies Handbook (Flint et al. 1999) and other online resources and counted weekly on five random plants in each plot in 2016.

Mean aphid population density per leaf was calculated for each treatment on each collection date. At harvest, grain weight (in pounds) and percent moisture were measured and converted into bushels per acre at 14% moisture. A two-way ANOVA was performed on yield data, with replicate and the interaction between replicate and planting date as random effects, and planting date, insecticide, and their interaction as fixed effects at a significance level of 0.05. Post-hoc mean separations were performed using the Fisher method of least significant difference ($\alpha = 0.05$).

Results

Sugarcane aphid population densities peaked post-flowering in the untreated plots of the first two planting dates and during flowering on the third and fourth planting dates in 2015 (Fig. 1). Planting date ($F = 181.67$, $P < 0.001$) and insecticide treatment ($F = 27.10$, $P < 0.001$) were found to be statistically significant factors in yield analysis in 2015 (Table 1). The interaction between planting date and insecticide regime was also significant across treatments ($F = 6.38$, $P = 0.008$).

Sugarcane aphid population densities peaked twice post-flowering in the untreated plots of the first planting date in 2016 (Fig. 2). Population densities began peaking around flowering on the second, third, and fourth planting dates. In 2016, planting date was the only statistically significant factor ($F = 104.03$, $P < 0.001$) (Table 2); insecticide regime was not found to affect yield ($F = 0.239$, $P = 0.6335$). The interaction between planting date and insecticide treatment was not significant ($F = 0.681$, $P = 0.580$).

Natural enemies observed included the following: *Diomus terminatus* adults and larvae (Coleoptera: Coccinellidae), green lacewing larvae (Neuroptera: Chrysoperla), brown lacewing larvae (Neuroptera: Hemerobiidae), multicolored Asian ladybeetle adults and larvae (Coleoptera: Coccinellidae), pink-spotted ladybeetle adults and larvae (Coleoptera: Coccinellidae), convergent ladybeetle adults and larvae (Coleoptera: Coccinellidae), hoverfly larvae (Diptera: Syrphidae), and an *Aphelinus* parasitoid species (Hymenoptera: Aphelinidae).

Discussion

Although sugarcane aphid infestations occurred at different times in the season both years, it is evident that densities were highest on flowering sorghum, which suggests that flowering sorghum is more favorable to aphid population development than vegetative-stage or dough-stage sorghum. Furthermore, sorghum that was past the flowering stage when infestations reached their peak was less vulnerable to yield loss; based on this, earlier planted sorghum may be more likely to reach less sensitive stages prior to the rise of economically damaging infestations of sugarcane aphid. Moreover, sugarcane aphid populations appeared to collapse in late season when early planted sorghum had likely already been harvested. However, it is important to note that the period of peak aphid activity was different between years (late August in 2015 and late July/early August in 2016); therefore, thorough scouting of both early and later-planted sorghum will be recommended to producers. These data are consistent with the current threshold recommendation of 50 or more aphids per leaf on 25% or more of the plants in the field. Future research will focus on natural enemy population densities, their responses to aphid population densities, and their abilities to regulate aphid populations at sub-economic levels.

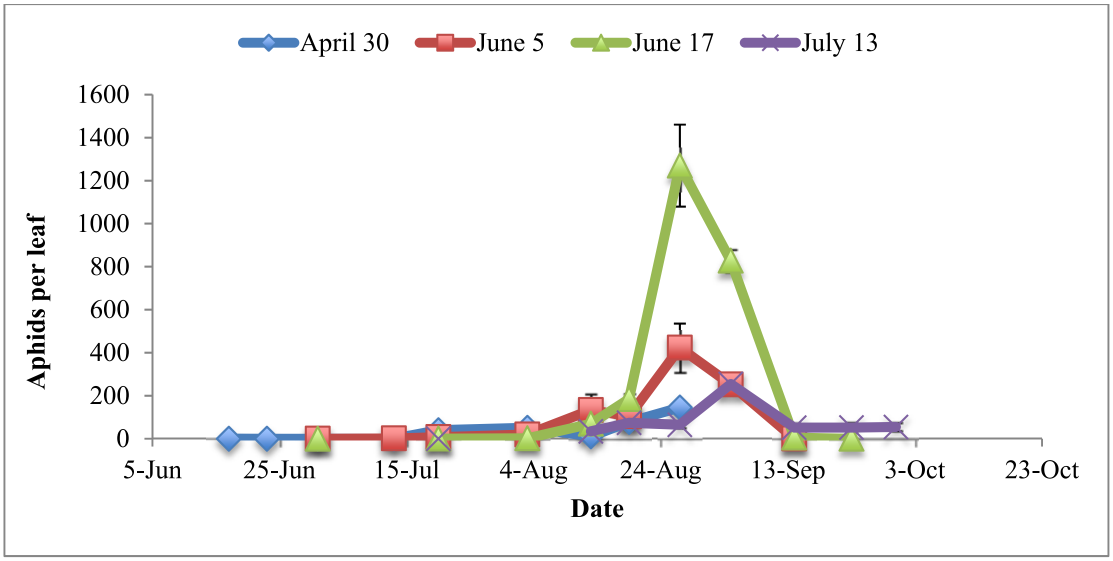

Figure 1. Mean sugarcane aphid population density per leaf in untreated plots during the 2015 sorghum growing season.

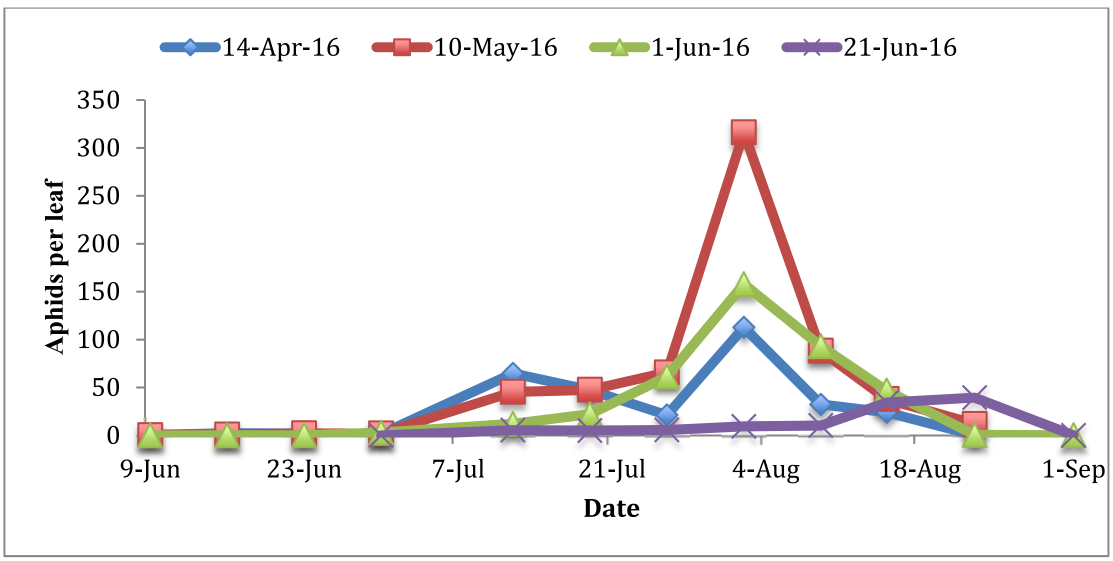

Figure 2. Mean sugarcane aphid population density per leaf in untreated plots during the 2016 sorghum growing season.

Table 1. Mean (± SE) yields from 2015 grain sorghum.

Planting date, treated or untreated	Mean yield (bu/A)
1st planting date untreated	65.5 ± 0.9 b[a]
1st planting date protected	68.1 ± 5.7 b
2nd planting date untreated	71.4 ± 2.0 b
2nd planting date protected	81.3 ± 5.4 a
3rd planting date untreated	9.4 ± 1.6 d
3rd planting date protected	37.7 ± 3.4 c
4th planting date untreated	11.1 ± 3.6 d
4th planting date protected	17.4 ± 1.9 d

[a] Means followed by the same letter are not different based on the Fisher method of least significant difference (α = 0.05)

Table 2. Mean (± SE) yields from 2016 grain sorghum.

Planting date, treated or untreated	Mean yield (bu/A)
1st planting date untreated	116.8 ± 6.9 a[a]
1st planting date protected	111.5 ± 5.4 a
2nd planting date untreated	19.1 ± 2.1 b
2nd planting date protected	24.7 ± 3.5 b
3rd planting date untreated	29.2 ± 6.6 b
3rd planting date protected	33.1 ± 6.7 b
4th planting date untreated	18.8 ± 2.7 b
4th planting date protected	20.2 ± 3.5 b

[a] Means followed by the same letter are not different based on the Fisher method of least significant difference (α = 0.05)

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