EFFECTS OF INSECTICIDES AT PLANTING ON EARLY DEVELOPING POPULATIONS OF COTTON APHID

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Abstract

Although the cotton aphid, *Aphis gossypii* Glover, is a perennial insect pest of cotton in the southeastern USA, it rarely causes yield loss in the crop. However, because it was recently implicated in transmitting Cotton Leaf Roll Dwarf Virus (CLRDV) to cotton, research efforts have focused on the vector and pathogen and potential for yield-limiting impacts on the crop. Timing of infection with CLRDV could be important, with seedlings potentially more susceptible to the virus than older plants. Because insecticides used at planting for thrips might have differential control of cotton aphid early in the season, counts of aphids exposed to the systemic activity of different in-furrow insecticides provided data on potential suppression of cotton aphid on young cotton plants. Cotton aphids were suppressed or controlled (systemically) by the carbamates aldicarb and thiodicarb and the neonicotinoids imidacloprid and thiamethoxam when used at planting. Cotton aphids were not controlled by the organophosphates acephate and phorate when used at planting. Significantly more cotton aphids were present with the use of acephate.

Introduction

Annually, the cotton aphid, *Aphis gossypii* Glover, infests Upland cotton, *Gossypium hirsutum* (L.), at high levels in the southeastern USA (Cook and Threet 2021), but this rarely results in significant yield loss to the crop. Most often, cotton aphid amounts to a nuisance pest for consultants who regularly visit fields when scouting for problems to address. However, under certain circumstances, such as on stressed and young cotton plants, cotton aphid might be detrimental to the crop. Additionally, because cotton aphid was recently discovered to be a vector of Cotton Leaf Roll Dwarf Virus (CLRDV), much research has focused on the insect pest and potential for yield loss due to feeding and transmission of the virus. Many questions about the vector/disease combination are currently being addressed with research, with the question of timing of infection being an important one to answer. If young cotton plants are potentially more at risk for injury from cotton aphid and early infection with CLRDV, we should learn more about population levels of aphids on the young crop. Because insecticides used at planting for thrips might offer some suppression or facilitate development of populations of aphids on cotton seedlings, we counted aphids in insecticide trials for thrips to document the impact of systemic insecticides on cotton aphid.

Materials and Methods

During 2020 and 2021, replicated (4) plots (8 rows [38" spacing] by 40 ft) of Upland cotton (DP 1646 B2XF – 2020 and PHY 480 W3FE – 2021) were grown at Clemson University's Edisto Research and Education Center near Blackville, SC. All seed were treated with base fungicides, and some included commercial/maximum rates of the insecticide seed treatments (ST) imidacloprid (Gaucho), thiamethoxam (Cruiser), thiodicarb (component of Aeris ST), and acephate (Orthene at 6.4 oz/100 lb. seed). Additional treatments included in-furrow application of the insecticides aldicarb (AgLogic at 3.5 or 5.0 lb./acre), phorate (Thimet at 5.0 lb./acre), imidacloprid (Admire Pro at 9.2 fl oz/acre or Velum Total at 18 fl oz/acre), and acephate (Orthene 97 at 16 oz/acre) at planting.

After seedling emergence and to about six true leaves, ten plants were pulled by hand weekly from rows two and seven in each plot and quickly and repeatedly inverted and submerged into quart jars half filled with 70% isopropyl alcohol to dislodge any arthropods. In the laboratory, contents of jars were filtered through coffee filters and funnels using a vacuum pump and a series of filtration flasks. Cotton aphids were enumerated during concurrent counts of thrips under dissecting microscopes. Data were subjected to a one-way analysis of variance using Agricultural Research Manager (ARM) software (GDM Solutions 2021) and presented as means per ten-plant samples after data transformations, if necessary.

Results and Discussion

During 2020, counts of cotton aphid during mid-May were highest in the untreated control (seed with fungicide only) and in plots treated with an organophosphate insecticide (acephate or phorate) applied as a seed treatment or

an in-furrow (granular or spray [IFS]) treatment (Figures 1-3). Aphid numbers were consistently and statistically higher in plots treated with acephate than in other insecticide treatments. Aphid densities were significantly lowest in plots treated with neonicotinoid or carbamate insecticides (Figures 1-3).

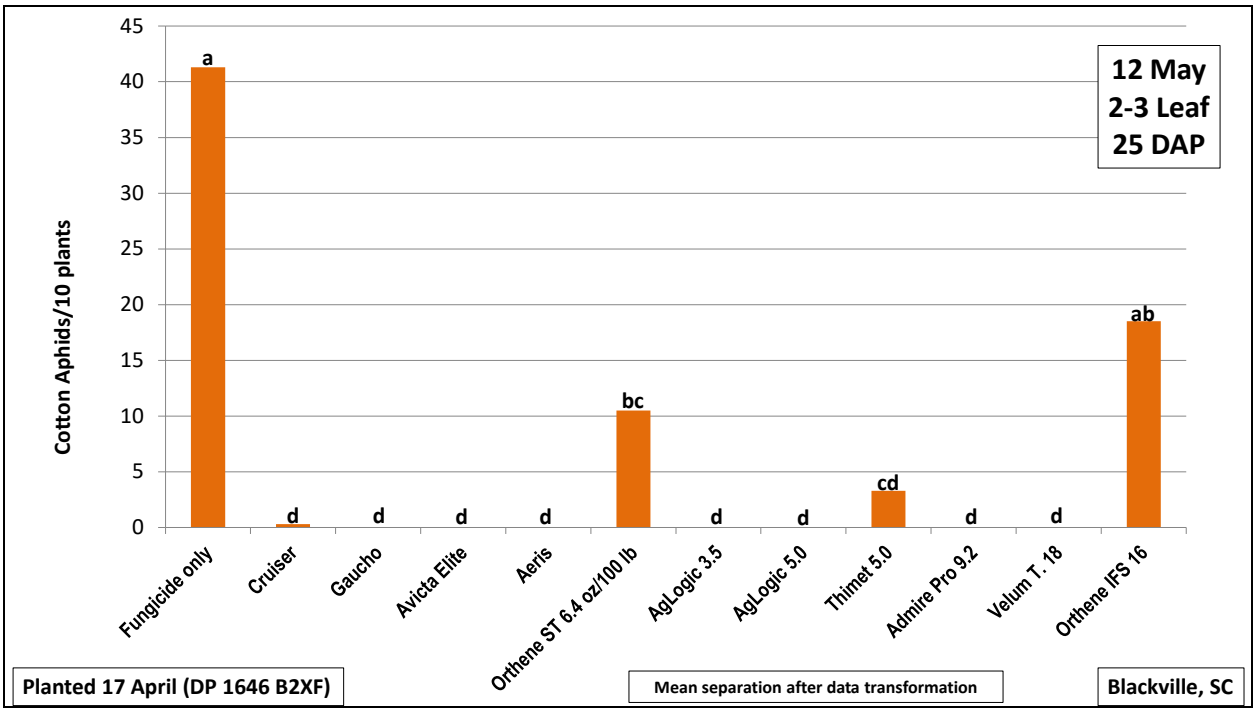

Figure 1. Mean numbers of cotton aphid from cotton seedlings (2-3 leaf stage at 25 days after planting) from various treatments of insecticide used at planting near Blackville, SC, in 2020.

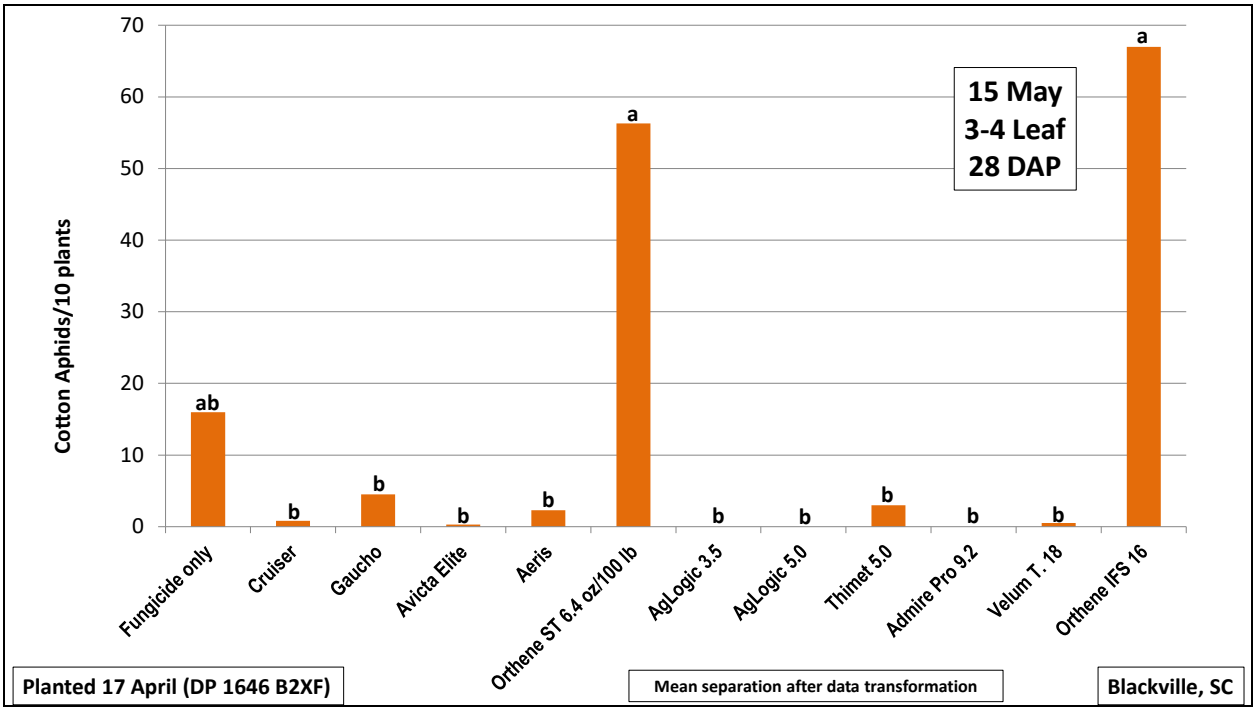

Figure 2. Mean numbers of cotton aphid from cotton seedlings (3-4 leaf stage at 28 days after planting) from various treatments of insecticide used at planting near Blackville, SC, in 2020.

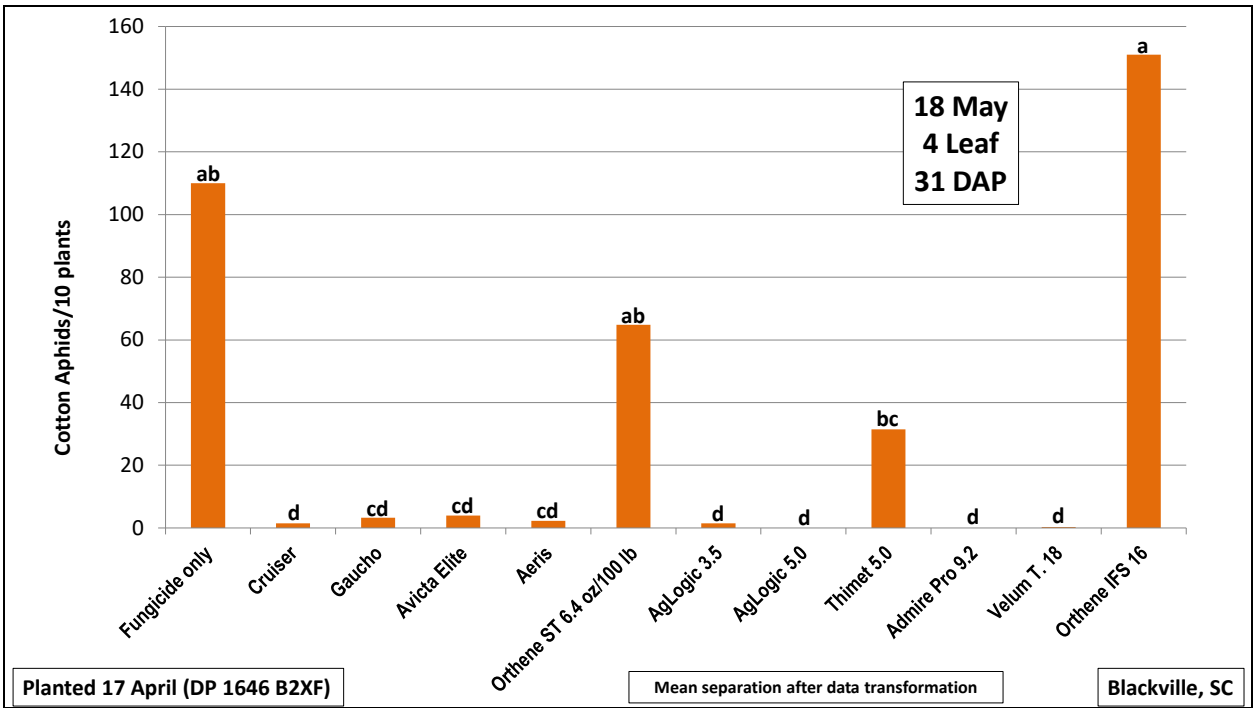

Figure 3. Mean numbers of cotton aphid from cotton seedlings (4 leaf stage at 31 days after planting) from various treatments of insecticide used at planting near Blackville, SC, in 2020.

Near the end of May in 2020 and out to 40 days after planting, densities of cotton aphid remained high in plots treated with organophosphate insecticides or seed treated only with fungicides (Figure 4). Systemic suppression of cotton aphids continued on cotton seedlings with 6-7 true leaves that were treated with carbamate or neonicotinoid insecticides at planting (Figure 4).

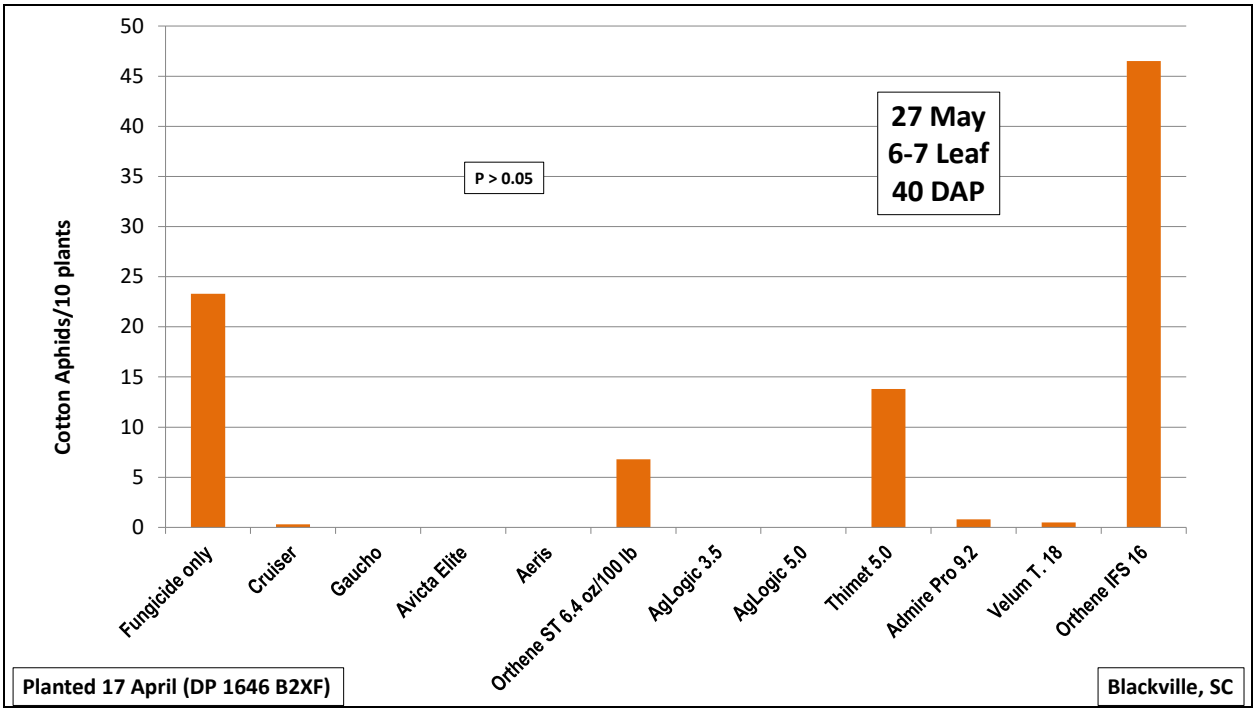

Figure 4. Mean numbers of cotton aphid from cotton seedlings (6-7 leaf stage at 40 days after planting) from various treatments of insecticide used at planting near Blackville, SC, in 2020.

During the fourth week of May in 2021 (23 and 27 DAP), densities of cotton aphid were highest in the fungicide-treated controls and plots treated with acephate as a seed treatment or in-furrow spray (Figures 5 and 6). These results were consistent with those observed in 2020.

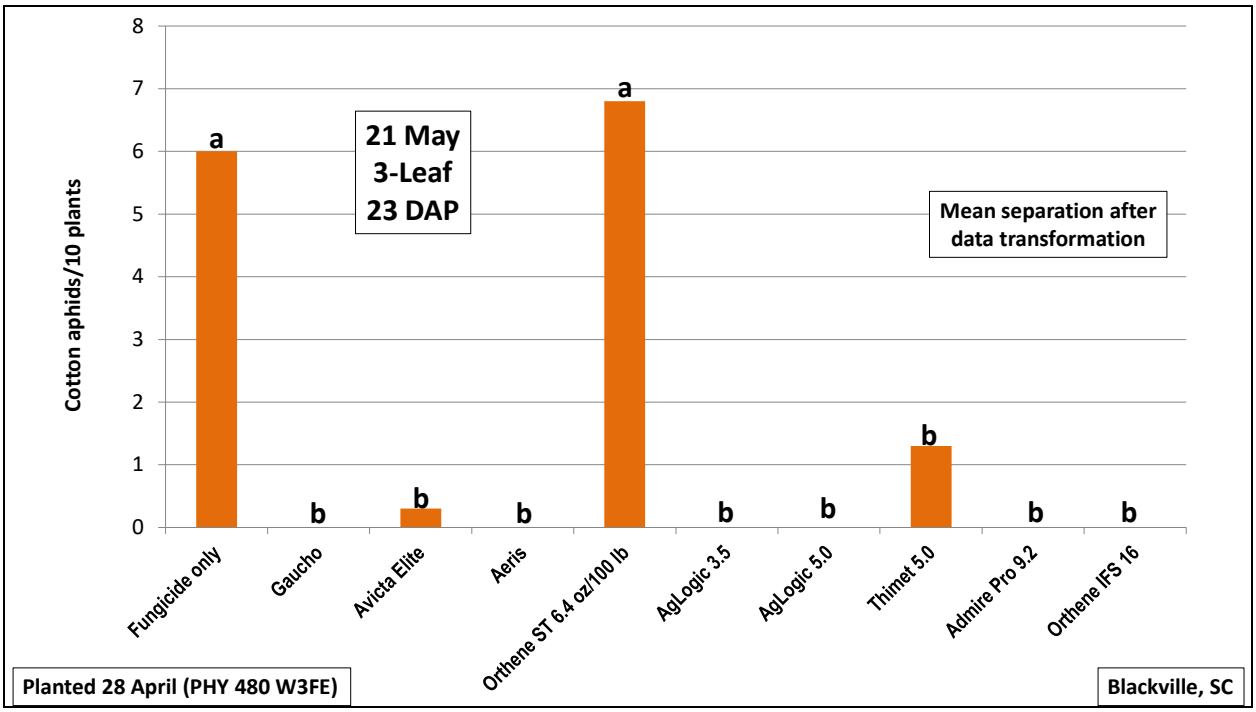

Figure 5. Mean numbers of cotton aphid from cotton seedlings (3 leaf stage at 23 days after planting) from various treatments of insecticide used at planting near Blackville, SC, in 2021.

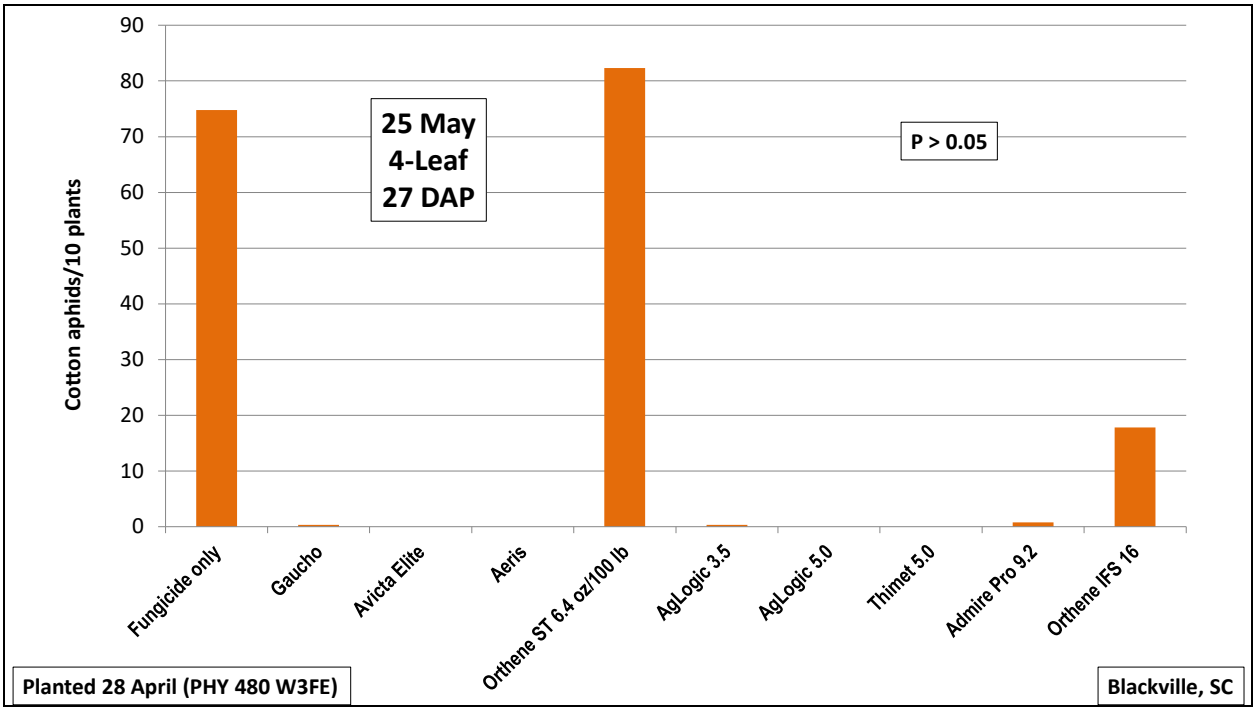

Figure 6. Mean numbers of cotton aphid from cotton seedlings (4 leaf stage at 27 days after planting) from various treatments of insecticide used at planting near Blackville, SC, in 2021.

Summary

Because infestation by cotton aphid and transmission of CLRDV to young cotton plants could be potentially more detrimental to the crop than it has been previously, it is important to note how cotton aphid responds to insecticides used at planting for thrips. This research provided empirical data concerning the impact of at-plant, systemic insecticides on developing populations of cotton aphid in cotton. Populations of cotton aphid established quickly in the absence of neonicotinoid or carbamate insecticides. Specifically, the organophosphate insecticides acephate or phorate or no at-plant treatment with insecticide resulted in early and robustly developing populations of cotton aphid. Producers and crop managers should be aware of the insecticide approach used at planting and the heightened potential for early infestation of cotton aphid, especially if the combination of vector and CLRDV evolves into an important yield-limiting issue in the future.

Acknowledgments

Cotton Incorporated is acknowledged for providing funding to support this research. We thank our industry partners for seed and chemicals. Dan Robinson is acknowledged for his efforts in growing and managing the cotton plots for these research trials. I also thank the temporary summer workers ("bug crew") at the Edisto Research and Education Center that helped collect the data presented here.

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