EFFICACY OF SELECTED INSECTICIDES FOR CONTROL OF COTTON APHID IN LOUISIANA

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Abstract

Cotton aphid, *Aphis gossypii* Glover, is an occasional cotton pest in the United States, but may cause significant problems in some years. In 2009, the cotton aphid ranked fifth among cotton pests in the Mid-South, infesting ≈22% of the region's acreage and was responsible for a loss of ≈4,000 bales. Neonicotinoids are heavily utilized in cotton against this pest, and additional classes of insecticides are needed. Cotton aphid exposure to neonicotinoids frequently occurs because of the widespread use as seed treatments on seedling cotton and use in early-season applications targeting tarnished plant bugs. The objective of these experiments was to evaluate selected insecticides for control of cotton aphids in Louisiana cotton. The efficacies of selected insecticides ranged from 49% to >90% at 2-4 days after treatment (DAT). Only two products, Transform (0.022 and 0.033 lb AI/acre) and Intruder (0.044 lb AI/acre), provided acceptable levels of control (>75%) for cotton aphid at 2-4 DAT. At 7-8 DAT, all insecticide treatments accept Trimax Pro (0.047 and 0.063) provided acceptable levels of control (>75%) for cotton aphid. The neonicotinoid insecticides, with the exception of Trimax Pro, can still provide acceptable levels of cotton aphid control. However, performance is inconsistent in some trials. In the early 2000's, control (>90%) of cotton aphid was routinely achieved with low-mid rates of neonicotinoid insecticides including Intruder, Centric, and Trimax in Louisiana. Field control issues against Mid-South cotton aphid suggest that neonicotinoid susceptibility is declining, but there is tremendous variability within populations. Currently, only one insecticide with an alternative mode of action, Carbine (flonicamid), is registered to control cotton aphids. Sulfoxaflor (GF-2372) is an experimental compound from Dow AgroSciences with a unique mode of action. It has demonstrated excellent control of Louisiana cotton aphids in field trials. Sulfoxaflor would provide an alternative mode of action to neonicotinoid insecticides for cotton aphid control.

Introduction

Cotton, *Gossypium hirsutum* (L.), is one of the major agronomic crops grown in the Mid-Southern U.S. The states of Arkansas, Louisiana, Mississippi, and Tennessee harvested 1.4 million acres of cotton that yielded >2.4 million bales during 2009 (Williams 2010). Producers spent >$126 million for management of numerous arthropod pests in Mid-South cotton fields. The most important pests in this region include tobacco budworm, *Heliothis virescens* (F.); bollworm, *Helicoverpa zea* Boddie; cotton aphid, *Aphis gossypii* Glover; tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois); and spider mites (*Tetranychus* spp.). Several species of aphids may be found on cotton plants, but the cotton aphid is the primary species across the U.S. cotton belt. This insect is generally considered to be an occasional or secondary pest, but infestations can reach levels that influence normal plant development, especially during periods of excessive environmental stress. In 2009, cotton aphids were the fifth-most costly cotton pest, infesting ≈22% of the region's acreage and causing a loss of ≈4000 bales (Williams 2010).

Cotton aphids in Louisiana are a common problem during the pre-flowering to early-flowering stages of plant development. Heavy cotton aphid infestations are usually induced with agronomic and pest management practices applied to cotton fields (Slosser et al. 1989, Leonard and Lorenz 2007). These factors interact concurrently with local environmental conditions, and no single event is usually responsible for inducing cotton aphid outbreaks. During flowering stages, the entomopathogenic fungus, *Neozygites fresenii,* regulates cotton aphid populations across Louisiana (Steinkraus et al. 1995). Epizootics normally develop during late June to mid-July and effectively

eliminate any subsequent problems with this pest for the remainder of the season. Chemical control is the primary means of managing cotton aphid, but the use of non-selective insecticides disrupt natural biocontrol agents and create problematic infestations in cotton.

Reports of inconsistent cotton aphid control have persisted for as long as insecticides have been used against this pest. The significance of cotton aphid as a cotton pest during the previous two decades was associated with the development of insecticide resistance in populations across numerous states (Grafton-Cardwell 1991, Kerns and Gaylor 1992, O'Brien and Graves 1992, Gore et al. 2010). In the late 1990's, there were no registered insecticides capable of providing satisfactory control of this pest. Fortunately, the neonicotinoids (Centric, Intruder, and Trimax) were registered for cotton shortly thereafter, and are currently still recommended. During 2006-2007, many cotton fields in Louisiana and Mississippi experienced less than satisfactory control of cotton aphids with these products (Leonard and Lorenz 2007). Neonicotinoids are being over-used in cotton, and additional insecticide classes are needed to ensure effective management of cotton aphid (Gore et al. 2010). Wang et al. (2002) showed that cotton aphid could develop an 8-fold resistance to imidacloprid (Trimax) after selection for 12 consecutive generations. The objective of this report is to briefly summarize the results of insecticide screening trials for control of cotton aphid in Louisiana during 2006-2010.

Materials and Methods

The performance of six insecticides in selected formulations and rates were evaluated for efficacy against cotton aphid in ten field trials during 2006-2010 (Table 1). A non-treated control was included in all trials to confirm cotton aphid infestation levels during the sample periods. All studies were conducted at the Macon Ridge Research Station near Winnsboro, LA (Franklin Parish). The general methods and experimental protocols for measuring insecticide efficacy against cotton aphids were similar among all trials. Cotton seed in each trial was planted during LSU AgCenter-recommended planting dates and managed according to best agronomic practices. Bollgard or Bollgard II varieties were planted in plots that consisted of two to four rows (centered on 40 inches) and 45-50 ft in length. Treatments were placed in a RCB design with four to five replications. All cultural practices and IPM strategies recommended by the Louisiana Cooperative Extension Service were used to optimize plant development and manage non-target insects across the test sites. Insecticides were applied when cotton aphid populations exceeded 50-100 aphids/plant terminal. All treatments were applied with a CO_2-charged backpack spray system calibrated to deliver 10 gpa through TeeJet® TX-9 hollow cone nozzles (2/row) at 45 psi. Thirty plant terminals infested with cotton aphids were tagged prior to insecticide applications in all tests. Insecticide efficacy against cotton aphids was measured by selecting 10 tagged plant terminals per plot at 2-4 and 7-8 days after treatment (DAT), depending on the trial. Plant samples were processed using whole-plant washing procedures to remove aphids. Adults and nymphs were counted using a dissecting microscope. Data were analyzed with ANOVA, and means were separated according to DMRT. The results for each insecticide treatment in a specific trial were converted to percent control relative to the non-treated control. Means across all trials, as well as the lowest and highest relative control levels are reported for each insecticide treatment.

Table 1. Insecticides evaluated in Louisiana field trials against cotton aphid during 2006-2010.

Trade Name	Common Name	Formulation	Manufacturer
Belay	clothianidin	2.13SC	Valent
Carbine	flonicamid	50WG	FMC
Centric	thiamethoxam	40WG	Syngenta
Transform (GF-2372)*	sulfoxaflor	50WG	Dow
Intruder	acetamiprid	70WP	DuPont/Gowan
Trimax Pro	imidacloprid	4.44F	Bayer

*Currently not labeled for use in cotton to control cotton aphids.

Results and Discussion

The efficacies of selected insecticide treatments against cotton aphids are reported in Table 2. Results are not directly compared across all trials because of variability in a specific product's frequency across all tests. The

sample sizes (replicates by trials) for these products ranged from four to forty-four. The efficacies of selected insecticides ranged from 49% to 89% and 55% to 97% at 2-4 and 7-8 DAT, respectively. Only two products, Transform (0.022 and 0.033 lb AI/acre) and Intruder (0.044 lb AI/acre), provided acceptable levels of control (>75%) for cotton aphid at 2-4 DAT. At 7-8 DAT, all insecticide treatments accept Trimax Pro (0.047 and 0.063 lb AI/acre) provided acceptable levels of control (>75%) for cotton aphid. The neonicotinoid insecticides, with the exception of Trimax Pro, can still provide acceptable levels of cotton aphid control. However, performance was inconsistent during the period these trials were conducted.

In the early 2000's, excellent control (85-100%) of cotton aphids was routinely achieved with neonicotinoid insecticides (Intruder, Centric, and Trimax) in Louisiana (Gable et al. 2002, Temple et al. 2004, Bommireddy et al. 2006). Field control issues in Louisiana suggest that cotton aphid susceptibility to neonicotinoid insecticides is declining, but there is variability in susceptibility among populations. Laboratory studies during 2008 and 2009, showed cotton aphid susceptibility was highly variable (1-5X) among Mississippi populations (Gore et al. 2010). Fortunately, one insecticide with an alternative mode of action, Carbine (flonicamid), is currently registered for use to control cotton aphids. Transform (Sulfoxaflor, GF-2372), an experimental compound from Dow AgroSciences, has demonstrated satisfactory control of cotton aphid in Louisiana in limited small-plot trials. Sulfoxaflor would provide an alternative to current insecticides used for cotton aphid control.

Table 2. Performance (percent control) of insecticides for control of cotton aphid in Louisiana during 2006-2010 across all DAT.

Trade Name	Formulation	Rate (lb AI/A)	N	Mean 2-4 DAT (Low-High)	Mean 7-8 DAT (Low-High)
Belay	2.13SC	0.067	8	54 (38-69)	93 (91-95)
Carbine	50WG	0.088	20	60 (51-72)	84 (73-94)
Centric	40WG	0.050	28	67 (36-98)	84 (71-99)
Transform (GF-2372)	50WG	0.022	8	86 (82-90)	96 (95-97)
		0.033	4	89	97
Intruder	70WP	0.026	8	55 (54-56)	79 (77-80)
		0.035	12	70 (55-98)	92 (87-99)
		0.044	44	77 (39-98)	88 (74-99)
Trimax Pro	4.44F	0.047	8	49 (43-55)	60 (54-66)
		0.063	8	51 (50-52)	55 (51-58)

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