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CONTROL OF COTTON APHIDS IN MISSISSIPPI COTTON

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Abstract

A series of small plot insecticide efficacy trials were conducted during the growing seasons of 2000, 2001, and 2002 to evaluate control of cotton aphids on cotton. Once they reach treatable levels cotton aphid populations usually decline quickly, whether or not they are treated. However, treatment with an effective aphicide can provide control several days sooner than relying on natural control. Treatments that provided effective aphid control in these trials included: Furadan (carbofuran), Bidrin (dicrotophos), Centric (thiamethoxam), Assail/Intruder (acetamiprid), Trimax/Provado (imidacloprid), and Fulfil (pymetrozine).

Introduction

Cotton aphids, *Aphis gossypii* Glover, are occasional pests of Mississippi cotton. Although low numbers of aphids are usually present in every field, it is relatively uncommon for them to reach treatable levels. This is because epizootics of the entomopathogenic fungus, *Neozygites fresenii*, usually occur in cotton aphid populations during early July (Hollingsworth et. al. , 1995; Layton, 2002), and in most cases these epizootics occur in time to prevent aphids from reaching levels that cause economic damage.

Because they do not damage fruit directly, but rather cause indirect damage by removing sap from the plant, the overall damage potential of the cotton aphid is considerably less than that of pests such as the tobacco budworm and bollworm, which feed directly on developing fruit. While some studies have found no adverse effects on yield, even when aphid populations reached fairly high populations, exceeding 100 aphids per leaf (Weathersbee and Hardee, 1995), other studies have shown that aphids can adversely affect yield (Andrews and Kitten, 1989 ; Harris et. al., 1992), and in one case a yield loss of 220 lbs was documented (Layton, et. al., 1996).

When aphid populations do reach damaging levels before *N. fresenii* becomes active, it is usually because their naturally occurring predators and parasitoids have been destroyed by early season sprays that were applied to control other pests. In 1998 and 1999 cotton aphids were ranked, respectively, as the second and third most damaging insect pest of the year in Mississippi (Williams 1999; 2000). But, this was due to the disruption of natural enemies associated with early season applications of ULV malathion applied as part of the boll weevil eradication program (Layton et.al., 2001).

When aphid populations build to damaging levels before the *Neozygites* fungus becomes active, foliar insecticide treatments are required to prevent yield loss. Although aphid populations can rebound quickly following insecticide treatments, even treatments that are highly effective, insecticide treatments play an important role in suppressing aphid populations until the *Neozygites* fungus becomes active in the population. However, cotton aphids have a history of developing resistance to foliar applied insecticides (Grafton- Cardwell, 1991; Rosenheim et. al., 1995), and, because of their high reproductive potential, can rebound quickly following ineffective, or marginally effective, treatments. Therefore, it is important to continually evaluate the efficacy of current aphicides and to evaluate the potential of newly developed insecticides.

Materials and Methods

During the 2000, 2001, and 2002 growing seasons, a total of five, replicated trials were conducted to evaluate efficacy of various aphicides on cotton aphid populations in the state. Three of these trials were conducted in the Hill portion of the state with the remaining two being conducted in the Delta. All trials, with the exception of one of the Hill trials, were conducted on commercially planted cotton. Of the five trials, two were planted to transgenic Bt-cotton varieties while the other three were planted to conventional varieties.

All trials were replicated four times in a randomized complete block design. All plots were 8 rows wide with plot length varying from twenty-five to fifty feet. All treatments were applied with a CO_2 backpack sprayer calibrated to deliver 10 gallons of finished spray per acre through 8001E spray tips at 40 psi.

Plots were rated by examining ten to twenty leaves per plot (5^{th} leaf below terminal) and counting the number of aphids present on the underside of the leaf. Results are reported as average number of aphids per leaf. Ratings for these trials were made from two to seven days after treatment. Because the entomopathogenic fungus *Neozygites fresnii* occurs when aphid populations reach high numbers, aphid populations often begin to decline, due to the fungal disease, in untreated plots shortly after most efficacy trials are initiated.

Results and Discussion

Trial 1 of 2000

The first trial of 2000 was conducted in the south Delta region of Mississippi (Table 1). Aphids developed to heavy numbers relatively early here and treatments were applied on June 15, when plants were in the 7-leaf stage. At 3DAT aphid populations averaged approximately 140 per leaf in the untreated plots and all treatments tested provided acceptable control.

Trial 2 of 2000

The second trial of 2000 was conducted in Noxubee County MS, which is located on the eastern side of the state in the Black Belt Prarie (Table 2). Treatments were applied on June 30, and plants were in the 8 to 9-leaf stage. Populations in the untreated plots peaked at 5DAT. Although the 2 fl.Oz./acre rate of Leverage (imidacloprid + cyfluthrin) provided some control of aphids, it was significantly less effective than the other treatments. Fulfil (pymetrozine) provided good control of aphids, but its full efficacy was not manifested until 5DAT. Although aphid populations had begun to decline by 7DAT, it appeared that the residual control provided by Assail (acetamiprid) was slightly better than that provided by Furadan (carbofuran).

Trial 1 of 2001

Table 3 presents the results of the first 2001 trial, which was again conducted in Noxubee County. Treatments were applied on July 5 when plants were in the early bloom stage. Highest aphid populations were observed at 2DAT. All treatments provided significant reductions in aphids populations, with Furadan (carbofuran) providing the best control at both 2 and 4DAT.

Trial 2 of 2001

The second trial of 2001 was conducted on the Plant Sciences Research Farm at Mississippi State University (Table 4). It was applied on July 12 to a late-planted field of Stoneville 747, that was in the 9-leaf stage. Pre-treatment counts were relatively low, averaging only 27.3 aphids per leaf, and populations dropped further at 2 and 4DAT. All treatments provided effective control. As in some of the previous trials, it was evident that Fulfil (pymetrozine) is a very effective aphicide, but the full efficacy of this product did not become evident until after 2DAT.

2002 Aphid Trial

The 2002 aphid trial was conducted in Grenada County, MS, which is located in the Hill region of the state, and was applied on June 21, when plants averaged 6.2 leaves. This trial was designed to compare the low and high rates of Centric (thiamethoxam), Intruder (acetamiprid), Trimax (imidacloprid), and Bidrin (dicrotophos) to the 0.25 lbs. Ai/acre rate of Furadan (carbofuran). Populations in the untreated plots were highest at 3DAT, averaging 203 aphids per leaf, and gradually declined, due to the *Neozygites* fungus, on subsequent sample dates. All treatments provided effective control of this aphid population, and there was little difference between the rates of the various insecticides tested.

Summary

Considered collectively the results of these five trials illustrate several key points about cotton aphid control in Mississippi. 1) Once they reach treatable levels aphid populations usually decline quickly, due to the *Neozygites* fungus, whether or not they are treated. 2) Treatment with an effective aphicide will usually provide control several days earlier than relying on the *Neozygites* fungus. 3) The carbamate Furadan (carbofuran) is a highly effective aphicide, providing fast acting control. 4) The older organophosphate material, Bidrin (dicrotophos) provided effective aphid control in all five trials. 5) The two new neonicotinoid products, Centric (thiamethoxam) and Assail/Intruder (acetamiprid), are highly effective aphicides. 6) Fulfil (pymetrozine), which belongs to the pyridine azomethine class and acts by inhibiting the salivary pump also provides effective aphid control, but full efficacy of this product is not evident until after 3DAT.

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Table 1. Cotton Aphid Trial 1, 2000 Sharkey County, MS.

	lbs ai	**Avg. No. Aphids per Leaf**	
Treatment	**per acre**	**3 DAT**	**6 DAT**
Untreated	--	139.9 a	5.3 abc
Furadan 4F	0.25	0.6 d	5.9 ab
Bidrin 8 E	0.5	4.0 bc	4.1 c
Provado 1.6 EC	0.047	4.0 bc	5.3 abc
Centric 40 WG	0.047	2.6 cd	4.1 bc
Centric 40 WG	0.062	1.9 cd	4.2 bc
Fulfil 50 WG +	0.125 +		
Latron CS-7	0.25% v/v	13.7 b	4.2 bc
Assail 70 WP	0.05	1.5 cd	2.0 d
Assail 70 WP	0.0375	2.7 cd	1.9 d
Lannate 2.4 LV	0.45	17.5 b	6.9 a

Means within a column that are not followed by a common letter differ significantly (Fishers Protected LSD, $P = 0.1$). Data were transformed {Log (x + 1)} before analysis.

Table 2. Cotton Aphid Trial 2, 2002, Noxubee Co, MS.

Treatment	**lbs ai**	**Avg. No. Aphids per Leaf**		
	per acre	**3 DAT**	**5 DAT**	**7 DAT**
Untreated	--	65.0 a	111.2 a	35.6 a
Furadan 4F	0.25	1.2 e	1.8 cde	6.9 bc
Bidrin 8 E	0.5	2.7 d	1.6 cde	3.2 de
Assail 70 WP	0.05	0.9 e	0.6 de	1.8 e
Assail 70 WP	0.0375	0.6 e	0.4 e	1.4 e
Centric 40 WG	0.047	1.2 e	0.5 de	2.5 de
Provado 1.6 EC	0.047	7.8 c	3.7 c	5.3 cd
Leverage 2.7	2.0 fl. oz*	22.1 b	11.2 b	14.9 ab
Fulfil 50 WG +	0.125 +			
Latron CS-7	0.25% v/v	19.8 b	2.0 cd	5.7 cd

Means within a column that are not followed by a common letter differ significantly (Fishers Protected LSD, $P = 0.1$). Data were transformed {Log (x + 1)} before analysis.
* Leverage 2.7 is a premix containing 1.6 Lb imidacloprid and 1.1 Lb. Cyfluthrin per gallon. Two fl. oz./A of Leverage 2.7 provides 0.025 Lbs Ai/A of imidicloprid and 0.017 Lbs. Ai/A of cyfluthrin.

Table 3. Cotton Aphid Trial 1, 2001, Noxubee Co., MS.

Treatment	lbs ai Per acre	Avg. No. Aphids per Leaf 2 DAT	4 DAT	6 DAT
Untreated	--	54.6 a	38.9 a	15.3 a
Centric 25 WG	0.047	9.6 d	7.0 d	1.8 c
Centric 25 WG	0.035	12.8 cd	7.4 d	1.1 c
Provado 1.6	0.047	20.1 bc	16.1 c	5.9 b
Furadan 4F	0.25	0.8 e	0.8 e	0.6 c
Bidrin 8E +	0.33 +			
Provado 1.6	0.0125	21.2 b	23.6 bc	6.2 b
Bidrin 8E	0.5	20.5 bc	16.5 c	8.4 b
Bidrin 8E	0.33	18.8 bc	27.6 b	5.3 b

Means within a column that are not followed by a common letter differ significantly (Fishers Protected LSD, *P* = 0.1). Data were transformed {square root x)} before analysis, but actual means are presented above.

Table 4. Cotton Aphid Trial 2, 2001, Oktibbeha Co. MS.

Treatment	lbs ai Per acre	Avg. No. Aphids per Leaf 2 DAT	4 DAT
Untreated	--	17.1 a	3.0 a
Centric 25WG	0.047	0.6 e	0.2 e
Assail 70 WP	0.0375	1.9 de	0.3 de
Assail 70 WP	0.05	1.9 de	0.7 bcde
Calypso 4F	0.047	4.6 bc	1.6 b
Fulfill 50WG	0.0625	4.3 bcd	1.1 bc
Fulfill 50WG	0.125	6.5 b	1.1 bcd
Bidrin 8E	0.5	2.6 cde	0.5 cde

Means within a column that are not followed by a common letter differ significantly (Fishers Protected LSD, *P* = 0.1). Data were transformed {square root x)} before analysis, but actual means are presented above.

Table 5. Cotton Aphid Trial,2002, Grenada Co. MS.

Insecticide and Formulation	Lbs. Ai Per acre	Avg. No. Aphids/Leaf 3 DAT	7 DAT	10 DAT	17DAT	24DAT
Untreated	--	203.0 a	133.1 a	74.5 a	22.2 a	9.3 a
Centric 40 WG	0.05	3.0 b	12.1 b	32.4 a	17.9 a	6.7 a
Centric 40 WG	0.031	2.5 b	21.9 b	38.1 a	25.0 a	10.1 a
Trimax 4SC	0.047	4.5 b	25.1 b	36.9 a	26.3 a	9.9 a
Trimax 4SC	0.031	10.6 b	22.6 b	28.2 a	30.7 a	10.0 a
Intruder 70WP	0.05	0.8 b	7.7 b	30.3 a	19.1 a	9.9 a
Intruder 70WP	0.031	1.2 b	11.9 b	36.0 a	23.0 a	10.0 a
Bidrin 8 E	0.5	2.4 b	15.6 b	33.6 a	19.0 a	11.3 a
Bidrin 8 E	0.33	9.3 b	17.8 b	38.3 a	25.5 a	9.2 a
Furadan 4F	0.25	1.3 b	19.8 b	31.6 a	27.0 a	10.6 a

Means within a column that are not followed by a common letter differ significantly. (Fisher's Protected LSD, *P*=*0*.1).