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INFLUENCE OF BOLL WEEVIL ERADICATION ON APHID POPULATIONS IN MISSISSIPPI COTTON: YEAR 4

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Abstract

A survey of cotton aphid (*Aphis gossypii,* Glover) populations in three different regions of the Boll Weevil Eradication Program (BWEP) in Mississippi was conducted in the summer of 2001. Because eradication efforts were begun at different times, each region was in a different year of BWEP. The North Delta was involved in the third year, while the South Delta and Hills were in the fourth and fifth years, respectively. Boll weevil populations were at an all time low throughout the state in 2001, and no treatments of ULV malathion were required to control boll weevils on any of the survey fields before July 1. Counting early season treatments that growers applied to control pests other than boll weevils or aphids, fields in the Hills, North Delta, and South Delta received a total of 1.5, 2.5, and 0.5 non-aphicide sprays, respectively, by July 1. Aphid populations also were unusually low in 2001. No aphid treatments were applied to any of the survey fields. Highest aphid populations were observed in the Hill region, peaking at an average of 16.8 aphids per leaf, which is well below the economic threshold. Aphid populations in the North and South Delta were lower, with populations peaking at 10.2 and 9.5 aphids per leaf, respectively. This low aphid population is partially attributed to the absence of early season boll weevil sprays. Results of past surveys have illustrated a distinct flaring of aphid populations in BWEP areas receiving a high number of ULV malathion treatments before July 1.

Introduction

Boll weevils have long been a pest to cotton producers in Mississippi. One of the first insecticides used to control boll weevils was calcium arsenate. With the use of this insecticide came the first serious outbreaks of cotton aphids (*Aphis gossypii,* Glover) (Slosser et al., 1989). This insecticide caused the reduction of the natural enemies and allowed the cotton aphids to reproduce unchecked (Weathersbee and Hardee 1994).

Current boll weevil eradication efforts in Mississippi began in 1997 in the eastern portion of the state known as the Hills. The South Delta began eradication efforts the following year, with the North Delta beginning the program in the fall of 1999. This staggered implementation of the program across the state provided a unique opportunity to observe the effects that the Boll Weevil Eradication Program (BWEP) has on the cotton aphid and its population development throughout the growing season.

The primary insecticide used in the BWEP, ULV malathion, is an organophosphate insecticide that is known to flare cotton aphid populations (King et al. 1987, Edelson 1989). The first full year after fall startup of the BWEP is usually the year of the most frequent applications of ULV malathion. This also is typically when secondary pests such as the cotton aphid are most likely to be flared. Cotton aphid populations usually begin to increase rapidly after these applications because of the destruction of natural predators and parasitoids. Because each of the three regions entered the BWEP at different times, it was anticipated that the intensity of ULV malathion use might vary among regions. This varied intensity of spraying would presumably cause the cotton aphid's natural predator and parasitoid populations to vary in intensity also. However, the prevalence of the entomopathogenic fungus, *Neozygites fresnii* (Nowakowski) should not be directly affected by applications of ULV malathion.

N. fresnii is an entomopathogenic fungus that occurs annually in cotton fields during the growing season (Steinkraus and Rosenheim 1995). Cotton aphids become infected with this fungus and rapid die off of the population occurs. After this epizootic, *N. fresnii*, usually continues to keep cotton aphid populations well below economic threshold for the remainder of the season.

The objectives of this survey were to observe the effects of the BWEP on cotton aphid population growth and development in Mississippi, and to monitor the occurrence and level of *N. fresnii* infection during the growing season.

Methods

A survey line was established to monitor cotton aphid populations within three regions of Mississippi's BWEP. Six fields were surveyed within each of the three regions for a total of eighteen fields. Beginning on May 22nd, fields were sampled weekly to determine cotton aphid populations. One leaf from the fifth node below the terminal was pulled from each of twenty plants and the total number of aphids was counted. Results were recorded as average number of aphids per leaf.

When aphid populations were at sufficient levels, a sample of at least 50 aphids were collected and placed in a vial of 70% ethanol. These aphids were mailed to the University of Arkansas where they were examined for the presence of the entomopathogenic fungus *N. fresnii*. Results were recorded as the percent of aphids infected with *N. fresnii.*

A complete insecticide treatment history, as well as variety and planting dates for each field was obtained from the producers or private consultants. The numbers of ULV malathion sprays applied for boll weevil control, along with the dates that these sprays were applied, were obtained from BWEP personnel.

Results and Discussion

The treatment histories for the three regions are shown in Table 1. Historically, aphid populations peak during the first two weeks of July (Long et al., 2001; Long et al., 2000; Layton et al., 1999), therefore insecticide treatments, other than aphicides, applied before July 1 would have the greatest impact on cotton aphid population development. As of July 1, none of the fields in the survey had received an application of ULV malathion as part of the BWEP. However, growers in the Hills, North Delta, and South Delta had applied an average of 0.5, 1.5, and 2.8 foliar sprays for control of pests other than aphids or boll weevil by July 1.

The data for the average seasonal cotton aphid populations are shown in Figure 2. Aphid populations in the 2001 survey were lower in each region than those observed in the previous three years of the aphid survey (Long et al., 2001; Long et al., 2000; Layton et al., 1999). The Hills had the highest population, peaking at an average of 16.8 aphids per leaf on the 10th of July. The highest aphid population observed in any individual field in the Hills was 29 aphids per leaf. Therefore, aphid populations remained well below the economic threshold of 50-100 aphids per leaf (Layton, 2001) for all survey fields. Aphid populations in the South Delta and North Delta peaked one week later, on July 17, at average numbers of 9.5 and 10.2 aphids per leaf, respectively. Because of the lower populations of cotton aphids experienced in 2001, producers on the survey line did not apply any aphicides during the 2001 growing season (Table 1).

Figure 3 shows the incidence of *N. fresnii* for each region for the days that samples were collected. Although aphid populations were low, measurable levels of *N. fresnii* did occur in each of the three regions and aphid populations dropped sharply as a result of these epizootics (Figure 2). The Hill Region of the state had the highest percent of *N. fresnii* followed by the North Delta and then the South Delta. Note that the incidence of *N. fresnii* peaked earliest and at highest levels in the Hill Region, which coincides with the aphid population development for that region (Figure 2). Note that detection of *N. fresnii* was often limited by the inability to collect enough live aphids for a representative sample, therefore incidence of *N. fresnii* was likely underestimated.

These results are dramatically different from those observed in earlier years. In 1998, the Hill region of the state was the only region involved in active eradication efforts. During this time we compared nine fields in the Hill Region (eradication zone) to seven fields in the Delta Region (non-eradication zone). Aphid populations in the Hill Region were distinctly flared due to the applications of ULV malathion. Of the nine fields in the Hill Region, all but two exceeded 100 aphids per leaf by July 1 and one of those fields had received an aphicide by that date, while fields in the Delta Region did not have any aphicides applied throughout the entire growing season and none of the Delta fields reached 100 aphids per field. Aphid populations in the Hill region peaked at an average of 187.9 aphids per leaf, and aphids in the Delta Region peaked at only 60.5 aphids per leaf.

In 1999, the Hill Region was in its second full year of BWEP with the South Delta beginning its first full season of eradication efforts. The North Delta would not begin the BWEP until the fall of 1999. Therefore, the North Delta had no applications of ULV malathion by July 1, but growers in the North Delta did apply an average of 1.5 sprays to control pests other than aphids and boll weevils by July 1. The South Delta had the most applications of ULV malathion at an average of 3.2 sprays by July 1 while there were an average of 2.2 applications for pests other than aphids and boll weevils (5.4 total sprays). The Hill Region had an average of 2.4 sprays by July 1 as well as an average of 0.8 other applications (3.2 total sprays). Cotton aphid populations peaked in the Hill Region at 129.1 aphids per leaf while the North and South Delta's populations peaked at 86.0 and 115.4 aphids per leaf, respectively. Thus, seasonal aphid populations were similar in all three regions. But, both the North and South Delta Regions received an average of 1.3 aphicide applications, respectively while

the Hills received only 0.2 aphicide treatments. Thus in 1999 aphid populations and number of aphid sprays in the North Delta were similar to the South Delta, which was in its first full year of BWEP, even though the South Delta received considerably more early season insecticide treatments (5.4 vs. 1.5) than the North Delta. The South Delta received a total of 5.4 non- aphid sprays by July and the North Delta, which did not begin BWEP until the fall, and received only 1.5 non-aphid sprays by July 1.

By 2000, all three regions of the state were involved in BWEP. The North Delta was in its first full season of eradication while the South Delta was in its second full year, and the Hill Region was in its third full year. By July 1 the Hill Region had received an average of 2.2 ULV malathion sprays and a total of 2.9 non-aphicide sprays (including the malathion sprays), while the North Delta had received 1.8 ULV malathion sprays and 3.5 total non-aphid sprays, and the South Delta had received 0.8 malathion sprays and 1.8 total non-aphicide sprays. The highest cotton aphid populations were observed in the Hills with populations peaking at 81.5 aphids per leaf. The North and South Delta aphid populations were very similar at 30.1 and 33.8 aphids per leaf, respectively. Although aphid populations were highest in the Hills, this region also received the lowest number of aphicide sprays, with an average of 0.2 treatments per field. The North Delta received a significantly higher number of aphid sprays at an average of 1.0 while the South Delta received only half as many at 0.5 aphicide applications.

In summary, aphid populations peaked later and at lower numbers in 2001 than in previous years (Long et al., 2001; Long et al., 2000; Layton et al., 1999). No ULV malathion sprays were applied during the period of time that aphid populations were on the increase. Therefore, flaring of aphid populations due to ULV malathion sprays did not occur during the 2001 growing season. With BWEP is in its final stages, producers can now look to the long term benefits that this program has to offer Mississippi cotton producers as well as cotton producers across the country.

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Table 1. Average number of ULV malathion treatments, and other non-aphicide treatments applied before July 1 and average season-long number of aphid treatments applied to survey fields in North Delta (n=6), South Delta (n=6), and Hills (n=6)in 2001.

	# mal.sprays before 7/1	# other sprays before 7/1	Total #non-aphid sprays before 7/1	Avg. # aphid sprays
North Delta	0	1.5 ab	1.5 ab	0
South Delta	0	2.8 a	2.8 a	0
Hills	0	0.5 b	0.5 b	0

Means not followed by a common letter differ significantly (P = 0.1; Fishers protected LSD).

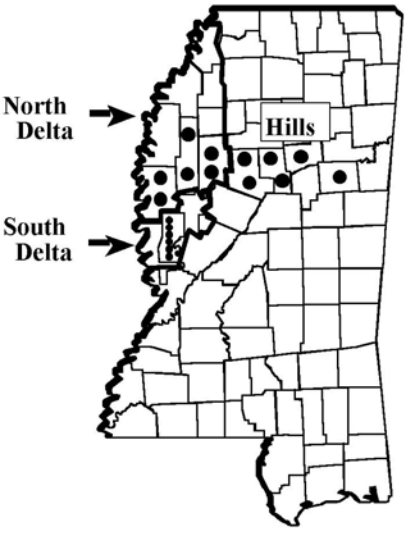

Figure 1. Distribution of aphid population survey fields. Fields in the North Delta were in the third year of BWEP. The South Delta was in the fourth year of eradication, and the Hills were in the fifth year of BWEP, 2001.

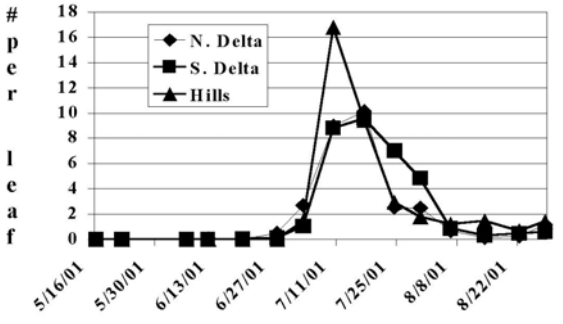

Figure 2. Average seasonal cotton aphid populations in North Delta (n=6), South Delta (n=6), and Hills (n=6), 2001.

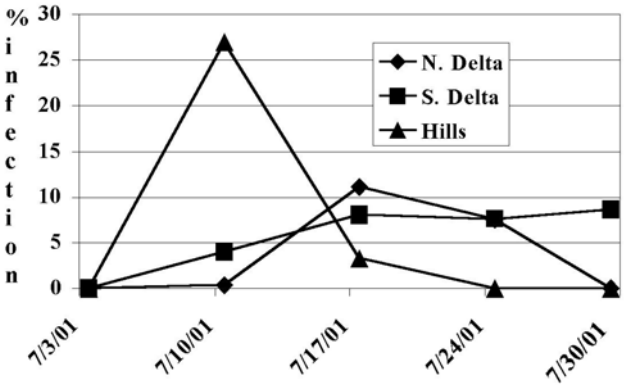

Figure 3. Average percent of cotton aphids with the fungal Disease, *Neozygites fresnii* in North Delta, South Delta, and Hills in 2001.