INFLUENCE OF BOLL WEEVIL ERADICATION ON APHID POPULATIONS IN MISSISSIPPI COTTON: YEAR 3

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Abstract

A survey of cotton aphid populations in three different regions of boll weevil eradication (BWEP) in Mississippi was conducted in the summer of 2000. Because eradication efforts were begun at different times, each region was in a different phase of BWEP. Region 1 was involved in the first full season of BWEP, while Regions 2 and 3/4 were in the third and fourth years, respectively. By July 1, survey fields in Regions 1, 2, and 3/4 had received an average of 1.83, 0.83 and 2.16 ULV malathion sprays respectively, which were applied as part of BWEP. Counting early season treatments that growers applied to control pests other than boll weevils or aphids, fields in Regions 1, 2 and 3/4 received a total of 3.50, 1.83, and 2.83 non-aphicide sprays, respectively, by July 1. Region 1 received significantly more aphid sprays (average of 1.0 sprays per field) than either Region 2 (0.5 aphid sprays per field) or Region 3/4 (0.17 aphid sprays per field). Highest aphid populations were observed in Region 3/4, peaking at an average of 81.48 aphids per leaf. However, aphid populations in Regions 1 and 2 were suppressed by the higher number of aphid treatments applied in these regions.

Introduction

Cotton aphids, *Aphis gossypii*, have long been considered an important secondary pest of cotton. This is because insecticides applied to control other cotton pests may kill predators and parasites that suppress aphid populations. This suppression of natural enemies may allow cotton aphid populations to rapidly increase in number. Such flaring of cotton aphids was first observed during the 1940's when calcium arsenate was used to control boll weevils (Isley 1946). Since this time there have been numerous other examples of cotton aphid populations being flared by applications of organophosphate and pyrethroid insecticides (King et. al. 1987, Edelson 1989). Because the primary insecticide used in Boll Weevil Eradication Programs (BWEP), malathion ULV, is an organophosphate insecticide which has little or no activity against cotton aphids, there is a potential for cotton aphids to be flared during the early years of BWEP when the number of malathion sprays is normally greatest.

Mississippi is divided into four regions for purposes of boll weevil eradication (Figure 1). However, for the purpose of this study, Regions 3 and 4 were combined because these two regions began boll weevil eradication efforts in the same year. For this reason Regions 3 and 4 will be collectively known as Region 3/4. Region 3/4 is located in the Hill region of the state and began eradication efforts in fall of 1997. Region 2, which is located in the South Delta, began boll weevil eradication in fall of 1998, followed by Region 1 or the North Delta, which began boll weevil eradication in fall of 1999. In the summer of 2000 all regions of the state were involved in full boll weevil eradication efforts. However, because some regions had been involved for longer than others, the intensity of ULV malathion use would presumably differ among regions.

The first full year of boll weevil eradication, or the year after the fall startup, is historically when flaring of secondary pests such as the cotton aphid is most common. This is due to the frequent applications of ULV malathion needed to kill the initial population of boll weevils during the early portion of the season.

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Although low numbers of aphids are commonly present in most Mississippi cotton fields, the cotton aphid is usually considered a secondary pest. In recent years, this insect has gained status as a pest due to escape from parasitism and predation (King et al. 1987, Slosser et al. 1989). Predators and parasites that occur naturally in the field are directly affected by the insecticides that producers use to control other cotton pests. Fortunately for mid-south cotton producers, cotton aphid is subject to epizootics of the entomopathgenic fungus *Neozygities fresnii* (Steinkraus et al., 1991; 1992). Once an outbreak of *N. fresnii* occurs, the aphid population usually is reduced to extremely low levels for the remainder of the growing season.

The primary objective of this survey was to observe the effects that ULV malathion treatments used in BWEP have on cotton aphid population development, as well as on the incidence of *Neozygites fresnii*.

Methods

A survey line was established to monitor aphid populations within the three regions of BWEP (Figure 1). Each of these regions had six survey fields. These fields were selected with the cooperation of extension personnel as well as private consultants within the counties that the survey line transected. Starting on May 25th, fields were visited on a weekly basis and scouted for the presence of cotton aphid. One leaf from the fifth node below the terminal was pulled from each of twenty plants and the total number of aphids was counted. This number was then divided by twenty to get an average number of aphids per leaf. When aphid populations were sufficiently high, a sample of at least 50 aphids was collected and placed in ethanol. These aphids were then mailed to the University of Arkansas where they were examined for the presence of the entomopathogenic fungus, *Neozygites fresnii*. Additional information on whitefly populations was also collected by counting the number of whiteflies on twenty leaf turns in each field. Maturity of the crop was determined each week by counting the number of true leaves or, as the plants matured, the number of nodes above white bloom or cracked boll. A complete insecticide treatment history from planting to end of season was obtained from the producer. The number of ULV malathion sprays, along with the date that these sprays were applied to each of the fields, was collected from BWEP personnel.

Results and Discussion

Insecticide treatment histories for all three regions involved in the survey are summarized in Table 1. There were considerable differences among the three BWEP regions in early season insecticide use, as well as the mean number of aphicide treatments.

Table 1 shows that by July 1 fields in Region 1 had received an average of 1.83 ULV malathion sprays, while an average of 0.83 and 2.16 malathion sprays had been applied in Regions 2 and 3/4 by this time. It was somewhat surprising that fields in Region 3/4, which was in its 4th year of BWEP, received more malathion treatments than Region 1. However, growers in Region 1 also applied an average of 1.67 foliar sprays for pests other than boll weevils or aphids by July 1. Consequently, the total number of early season insecticide sprays applied to fields in Region 1 was higher than either of the other two regions (Table 1). Fields in Region 1 also received the highest number of aphid sprays , with five out of the six survey fields being treated for aphids and an average of 1.0 aphid treatments per field, compared to only 0.50 and 0.17 aphid treatments per field in Region 2 and Region 3/4, respectively. However this higher number of aphicide sprays that was applied to fields in Region 1 is not necessarily an indication that aphid populations were higher in Region 1.

Examination of the data for average seasonal cotton aphid populations (Figure 2) shows that aphid populations were never excessively high in Region 1. Populations in Region 1 peaked at 30.13 aphids per leaf on June

28, which is similar to the aphid population curve observed in Region 2. Populations in Region 3/4 also peaked on June 28, but at a much higher level of 81.48 aphids per leaf. However in considering the higher aphid populations in Region 3/4 one must note that only one of the fields in Region 3/4 was treated for aphids, while half of the fields in Region 2, and five of six fields in Region 1 were treated for aphids. These aphicide treatments would be expected to have a strong negative effect on aphid populations. It is noteworthy that aphid populations did not exceed 100 aphids per leaf in any field during 2000.

Collectively these results show that, although fields in Region 1 received the highest number of early season insecticide sprays, there was no observable increase of early season cotton aphid populations. Still, fields in Region 1 recieved significantly more treatments for aphids than fields in either of the other regions. This is likely a response to grower's concern over the potential for increased aphid problems due to the unusually heavy early season insecticide use and a resulting tendency to treat promptly when building aphid populations were first observed. Conversely, growers in the Hill region, Region 3/4 are generally more tolerant of low to moderate aphid populations and have a tendency to wait for aphid populations to be controlled by outbreaks of the *N. fresnii* fungal disease, unless aphid populations reach excessively high levels.

Aphid population numbers dramatically decreased after July 1 due to an epizootic of the entomopathogenic fungus *Neozygites fresnii* (Steinkraus et al., 1991; 1992). This fungus typically is observed in early to mid-July, and once this outbreak occurs, aphid populations rarely reach damaging levels for the remainder of the growing season (Layton, 2000). Figure 3 shows the incidence of *N. fresnii* in each region of the state. Lower levels of this disease were observed in Regions 1 and 2 with the highest incidence occurring in Region 3/4. This was to be expected because Region 3/4 had the highest aphid populations. The sharp decrease in disease incidence that is observed in all three regions is due to the reduced aphid numbers and the inability to collect aphid samples. A slight resurgence in the aphid populations in Regions 1 and 2 can be seen in Figure 2. This re-occurrence of a measurable population of cotton aphids often occurs late in the growing season, but is usually suppressed by continued presence of *N. fresnii* in the field.

In 2000, bandedwinged whitefly populations were relatively low throughout the growing season (Figure 4). Whitefly populations peaked earliest and highest in Region 2. These populations never exceeded more than 10 whiteflies per leaf turn. Consequently it does not appear that bandedwinged whitefly populations were flared by BWEP efforts in Region 1. None of the fields along our survey line were treated for whiteflies during the 2000 growing season.

In summary, although 2000 aphid populations were highest in Region 3/4 and similar in Regions 1 and 2, fields in Region 1 averaged 1.0 aphid sprays per field, while only half of the fields in Region 2 and one of six fields in Region 3/4 was treated with an aphicide. Thus it appears that Region 1 did not experience increased cotton aphid populations during its first full season of BWEP, but fields in Region 1 did receive a significantly higher number of aphid sprays. It is note worthy that highest aphid populations were observed in Region 3/4, which was also the Region that received the highest number of ULV malathion treatments. However, because few fields in Region 3/4 received treatment for aphids, it is difficult to conclude that aphid populations in Region 3/4 were flared significantly by these early malathion sprays. Still, it appears that ULV malathion sprays had some influence on aphid populations in 2000. Highest aphid populations were observed in Region 3/4, which also received the highest number of early season malathion treatments, and the highest number of aphid treatments occurred in Region 1, which received an average of 1.83 early season malathion sprays and had the highest total number of early season insecticide treatments (3.50).

During the 1999, growing season, when Region 2 was in its first full year of BWEP, we did not observe flaring of aphids due to BWEP efforts (Long et. al., 2000). Although aphid populations initially increased sharply, an average of 1.33 aphicide applications were made in Region 2 which kept the aphid populations suppressed. Region 3/4, which was in its second full year of eradication, had slightly higher aphid population levels, but averaged only 0.20 aphicide applications per field.

In 1998 we were presented with a unique opportunity to observe the effects that BWEP has on aphid populations in Mississippi. The Hill region of the state was the only region involved in eradication efforts while the Delta was considered a non-eradication zone. During this time we saw definite flaring of aphid populations in the Hill region due to BWEP treatments. Seven out of nine fields in our Hill survey region exceeded 100 aphids per leaf before July 1 of that year while the highest aphid population recorded in any of the seven survey fields in the Delta region was 18.3 aphids per leaf (Layton et. al., 1999).

In summary, short-term flaring of aphid populations due to the frequent use of ULV malathion may occur in some instances, but the long term benefits of the BWEP far outweigh the short term effects that secondary pests such as the cotton aphid have on production of the crop. With the eradication of the boll weevil producers, can look forward to lower costs, due to fewer sprays for boll weevils and secondary pests, and higher yields, due to the elimination of yield losses from boll weevil.

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Table 1. Average number of ULV malathion treatments, other non-aphicide treatments applied before July 1 and average season-long number of aphid treatments applied to survey fields in Region 1 (n=6), Region 2 (n=6), and Region 3/4 (n=6) in 2000.

	# Mal sprays before 7/1	# Other sprays before 7/1	Total # non-aphid sprays before 7/1	Avg. # aphid sprays	Seasonal avg. # mal sprays
Region 1	1.83a	1.67a	3.50a	1.00a	4.83a
Region 2	0.83a	1.00a	1.83a	0.50b	3.16a
Region 3	2.16a	0.66a	2.83a	0.17b	4.50a

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

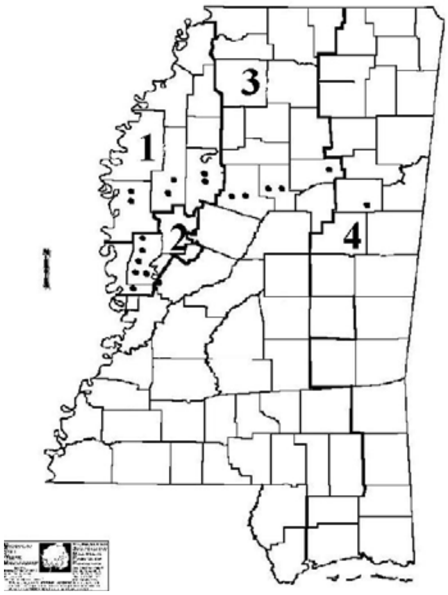

Figure 1. Distribution of aphid population survey fields. Fields in the North Delta (Region 1) were in the second year, or first full year of BWEP. The South Delta (Region 2) was in the third year of eradication, and the Hills (Regions 3 & 4) were in the fourth year of BWEP.

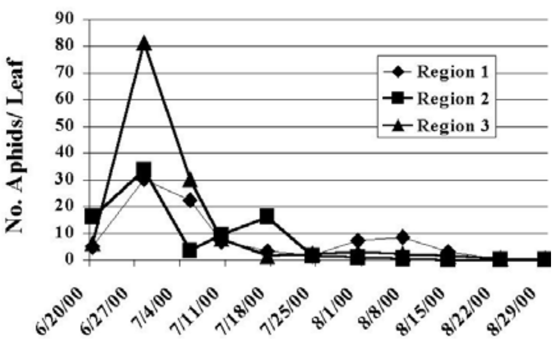

Figure 2. Average seasonal cotton aphid populations in Region 1 (n=6), Region 2 (n=6), and Region 3/4 (n=6), 2000.

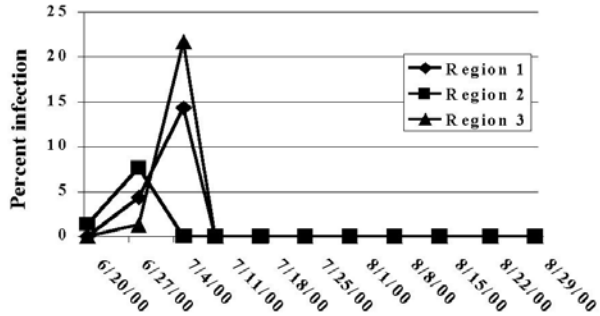

Figure 3. Average percent of cotton aphids with the fungal disease, *Neozygites fresnii* in Region 1 (n=6), Region 2 (n=6) and Region 3/4 (n=6) in 2000.

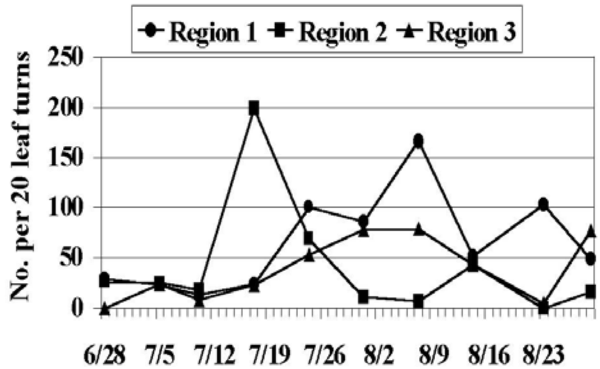

Figure 4. Average seasonal bandedwinged whitefly populations for Region 1 (n=6), Region 2 (n=6), and Region 3/4 (n=6) in 2000.