INVESTIGATIONS INTO TIMING AND FREQUENCY OF INSECTICIDE APPLICATIONS FOR COTTON FLEAHOPPER

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Abstract

Studies initiated in 2005 were continued in 2008 to reassess action thresholds for the cotton fleahopper, *Pseudatomoscelis seriatus* (Reuter). Trials in 2008 were conducted in east (Burleson Co.) and central Texas (Tom Green Co.). Treatments included one, two or three automatic insecticide applications applied one week apart, current economic threshold and an untreated check. As in previous years of the study, insecticide treatments showed no significant yield advantages. However, the trial in Burleson County indicated that yields in the insecticide treatments were numerically higher than the untreated. These findings suggest insecticide application may be provide some benefit when moderate fleahopper population levels are present throughout the fruiting season. However, currently established thresholds appear to be adequate to maintain yields. After four years, it appears that thresholds in the Southern Blacklands are adequate but questions remain about the frequency.

Introduction

Both adults and nymphs of the cotton fleahopper feed on new growth, including small squares. Squares up to pinhead size are susceptible to damage and the plant is most susceptible to feeding injury during the first three weeks of fruiting. Cotton fleahopper losses in Texas ranged from 13,113 bales in 2006 to 108,057 bales in 2007 for a total loss of $42,896,707 (Williams 2006, 2007 and 2008). However, cotton fleahoppers are managed differently in Texas depending on the production area.

In the eastern region of the state, cotton fleahoppers are considered a key pest and thresholds range from 10-15 cotton fleahoppers per 100 plants. Parker et al. (2000) combined data from five experiments conducted in the Texas Coastal Bend in 1993, 1995 and 1998-1999. They showed that yields significantly increased in insecticide treated cotton by 77.3 lbs. lint per acre. In contrast, Minzenmayer et al. (1988) compared four trials in West Texas. Three of the trials had no statistical differences in yields and one trial showed significant differences only in late planted cotton.

Interest in cotton fleahopper management has increased with the increased adoption of transgenic cotton and the success of boll weevil eradication. Producers will often include an insecticide for cotton fleahoppers while making glyphosate applications early in the season. However, numerous studies have indicated that cotton can compensate for early season square losses. Sterling and Hartstack (1988) used field data and computer models to indicate that no loss in profits would occur for cotton where squares were removed for 30 days, although a significant delay in harvest was observed. More recently, studies conducted in the High Plains indicate that yields are not adversely affected when squares are removed manually from the first position of the first nine fruiting nodes (Baugh et al. 2003). Similar studies in other areas of Texas also indicate an impact on earliness but overall yields are not significantly different (Parker et al. 1986).

With the development of new transgenic varieties that have higher yield potential than the varieties tested in previous trials, studies initiated in 2005 were continued in 2008 to reassess action thresholds for the cotton fleahopper.. Presented herein are results in 2008 and a brief summary of our findings during the previous three years of the study.

Materials and Methods

The varieties used in the trial were D&PL 434 RR planted on April 15, 2008 in the Southern Blacklands and FM 1740 B2F planted on May 20, 2008 in the Southern Rolling Plains. Cotton was managed conventionally in each trial except for cotton fleahoppers. The experiment was conducted in the eastern part of the state in Burleson County, Texas at the Texas A&M Research Farm and in the central part of the state in Tom Green County, Texas east of Wall. Plots were 4 rows X 50 ft with four replications arranged in a randomized complete block design. Treatments included one, two or three automatic insecticide applications, an economic threshold and an untreated. Automatic treatments were made beginning at pinhead square stage, (May 28) in Burleson County and July 2 in Tom Green County, with treatments following approximately every seven days. The economic threshold used was 10 cotton fleahoppers per 100 plants in Burleson County and 25 cotton fleahoppers per 100 plants in Tom Green County. Applications were made with a self-propelled CO_2 sprayer equipped with two TX-6 hollow cone nozzles per row calibrated to deliver 5 GPA total volume at 30 psi. Intruder® (1.0 oz/ac or 0.044 lbs. ai/ac of acetamiprid) was used to manage cotton fleahoppers. The trial in Burleson County was also treated on July 1, 2008 with Centric® (2.0 oz/ac or 0.05 lbs ai/ac of thiamethoxam) and Tracer® (2.0 oz/ac or 0.0625 lbs ai/ac of spinosad) and on July 22, 2008 with Oberon® (16.0 oz/ac or 0.25 lbs ai/ac of spiromesifen).

Cotton fleahoppers sampling was initiated when plants had 5-6 true leaves. Plots were sampled one day before and after each insecticide application for a total of five sample dates in Tom Green County. In Burleson County, samples were taken before the three applications and again a day later as well as six days after the third application for a total of six sample dates. On each sample date, 10 plants (Tom Green County) or 20 plants (Burleson County) were randomly selected and the terminal area of each plant was visually inspected for cotton fleahopper adults and nymphs. Number of adults and nymphs per plant were recorded.

Percent square sets were taken one day after the second application and six days after the third application in Burleson County. Percent square sets were taken one day after the first application, one day after the second application and one day after the third application in Tom Green County. The first week of squaring begins when the majority of the plants first have at least one visible square (pin head-match head) on the branch below the terminal. The first branch below the terminal was determined to be the branch which has a fully expanded leaf (at least as large as a quarter). Fruiting positions were mapped on 10 randomly selected plants. Fruit sites on the first two branch positions were mapped. Plants in the center two rows were sampled. Percent square sets were transformed (arcsine transformation) before being analyzed.

Treatment yield was measured by hand harvesting one row length of 1/1000th acre. Data were analyzed with ANOVA and Fisher's LSD.

Results and Discussion

The number of cotton fleahoppers (combination of nymphs and adults) for the Burleson County trial is in Table 1. Cotton fleahopper numbers were at threshold at the start of the trial and maintained numbers above the current economic threshold in the untreated plots throughout the trial. Numbers declined one day after the first treatment but numbers rebounded as expected. In light of these findings it appears that small plots are not a detriment when cotton fleahopper numbers are high. The threshold plot was sprayed twice during the trial (May 28 and June 11). Cotton fleahopper numbers in the treated plots were significantly different than the untreated until the end of the treatment period except for June 12.

Table 1. Comparison of cotton fleahopper numbers (average per 20 plants) following insecticide treatments, Texas A&M Research Farm, Burleson County, Texas 2008.

	Mean Number of Cotton Fleahoppers/20 Plants						
Treatment[1]	May 27	May 29	June 3	June 5	June 10	June 12	June 17
1 Automatic	4.00a	0.00b	0.00b	0.25b	0.75c	0.75a	1.50b
2 Automatic	4.25a	0.50b	0.00b	0.00b	0.25c	0.25a	1.50b
3 Automatic	3.25a	0.25b	0.30b	0.00b	0.25c	0.25a	0.50b
Threshold	3.25a	0.25b	0.00b	0.00b	2.50b	0.00a	0.25b
Untreated	4.25a	3.00a	2.80a	2.00a	5.50a	2.25a	4.00a
LSD (P=0.05)	2.52	1.062	1.75	1.448	1.202	1.688	1.664
P>F	0.8110	0.0003	0.0187	0.0425	.0001	0.0781	0.0028

1. Treatments occurred May 28, June 4 and June 11
Means in a column followed by the same letter are not significantly different by ANOVA (P=0.05; LSD).

The number of cotton fleahoppers (combination of nymphs and adults) for the Tom Green County trial is in Table 2. Cotton fleahopper numbers never exceeded threshold levels during the trial. This was the fourth year that numbers stayed below economic thresholds for the trial. Nonetheless, these population levels are reflective of cotton fleahopper population levels in West Texas.

Table 2. Comparison of cotton fleahopper numbers (average per 10 plants) following insecticide treatments, Ripple Farm, Tom Green County, Texas 2008.

	Mean Number of Cotton Fleahoppers/20 Plants					
Treatment[1]	July 1	July 3	July 8	July 10	July 15	July 17
1 Automatic	0.00a	0.00a	0.25a	0.25a	0.00a	0.25a
2 Automatic	0.00a	0.00a	0.00a	0.00a	0.75a	0.00a
3 Automatic	0.00a	0.00a	0.00a	0.00a	0.00a	0.25a
Threshold	0.00a	0.00a	1.00a	0.00a	1.25a	0.75a
Untreated	0.00a	0.25a	1.25a	0.50a	0.50a	1.75a
LSD (P=0.05)	0.000	0.507	1.740	0.487	1.312	1.364
P>F	1.0000	0.6114	0.4097	0.4449	0.2496	0.0991

1. Treatments occurred July 2, July 9 and July 16
Means in a column followed by the same letter are not significantly different by ANOVA (P=0.05; LSD).

Square set data was taken for first and second position squares twice early in the season. All treatments were similar and none of the treatments had significantly more squares than the untreated control (Tables 3 and 4). The Williamson County trial (Table 3) showed the most differences. Rainfall prevented taking square sets during the first two weeks of squaring; however numerical differences were evident at the third week of squaring. The square set at the start of the third week in the untreated plot (67.5%) would be considered unacceptable (Table 3). Yields in the Williamson County trial were not statistically different but the sprayed treatments were numerically higher than the untreated trial. The total number of squares in the threshold treatment was significantly lower than any of the chemically treated plots at the end of the third week of squaring (Table 4). However, yields were not significantly different and the yield was actually numerically higher in the untreated treatment (Table 4).

Table 3. Comparison of average number of squares per 10 plants, percent square set and yield following insecticide treatments, Texas A&M Research Farm, Burleson County, Texas 2008.

Treatment[1]	June 5		June 18		Yield (lbs lint/acre)
	Total squares per 10 plants	% square set	Total squares per 10 plants	% square set	
1 Automatic	59.00a	90.00a	113.00a	92.00a	1076.00a
2 Automatic	51.50a	81.00a	104.00a	88.00a	1153.00a
3 Automatic	56.50a	82.50a	105.00a	87.00a	1113.75a
Threshold	56.50a	85.60a	101.50a	89.00a	1087.00a
Untreated	41.00a	86.40a	82.50a	70.00a	973.75a
LSD (P=0.05)	14.484		22.638		252.975
P>F	0.1096		0.1089		0.6308

1. Treatments occurred May 28, June 4 and June 11
Means in a column followed by the same letter are not significantly different by ANOVA (P=0.05; LSD).
Percent Square Sets were transformed before analysis. Data are non-transformed for write up purposes

Table 4. Comparison of average number of squares per 10 plants, percent square set and yield following insecticide treatments, Ripple Farm, Tom Green County, Texas 2008.

Treatment[1]	July 10		July 17		Yield (lbs lint/acre)
	Total squares per 10 plants	%square set	Total squares per 10 plants	% square set	
1 Automatic	140.50a	97.00a	212.50a	96a	1324.25a
2 Automatic	168.00a	98.00a	236.00a	98a	1218.00a
3 Automatic	155.50a	97.00a	209.50a	98a	1248.75a
Threshold	157.00a	97.00a	196.50a	97a	1243.25a
Untreated	143.50a	97.00a	219.00a	98a	1340.50a
LSD (P=0.05)	33.892		11.966		171.796
P>F	0.4378		0.0442		0.4748

1. Treatments occurred July 2, July 9 and July 16
Means in a column followed by the same letter are not significantly different by ANOVA (P=0.05; LSD).
Percent Square Sets were transformed before analysis. Data are non-transformed for write up purposes

Tables 5 and 6 provide a summary of the yields for the four years of the trial. Even with the wide variability between the years (above average rainfall in 2005 and 2007 compared to below average in 2006 and 2008), no significant differences are evident in the data. Numerical yield trends in the Blacklands (Burleson/Williamson Counties) indicate that thresholds appear to be adequate and that there is no need for automatic applications. The difference between the two areas may be due to the population dynamics of cotton fleahoppers. The Blacklands tend to have more chronic infestations that are present throughout the first three weeks of squaring whereas Tom Green County populations are more sporadic.

Table 5. Comparison of yield following insecticide treatments in Burleson and Williamson County, Texas 2005-2008.

Blacklands					
Treatment[1]	Yield (lbs lint/acre) 2005	Yield (lbs lint/acre) 2006	Yield (lbs lint/acre) 2007	Yield (lbs lint/acre) 2008	Avg. Yield (lbs lint/acre)
1 Automatic	724.50a	536.33a	578.20a	1076.00a	728.75
2 Automatic	769.50a	544.33a	575.43a	1153.00a	760.56
3 Automatic	769.50a	525.85a	616.72a	1113.75a	756.45
Threshold	783.00a	516.78a	589.20a	1087.00a	743.99
Untreated	775.75a	534.93a	486.80a	973.75a	692.80

1. Blacklands yield in 2008 are irrigated

Table 6. Comparison of yield following insecticide treatments in Tom Green County, Texas 2005-2008.

Tom Green County					
Treat[1]	Yield (lbs lint/acre) 2005	Yield (lbs lint/acre) 2006	Yield (lbs lint/acre) 2007	Yield (lbs lint/acre) 2008	Avg. Yield (lbs lint/acre)
1 Automatic	649.71a	1815.8a	2061.73a	1324.25a	1462.87
2 Automatic	619.32a	2069.3a	2015.86a	1218.00a	1480.62
3 Automatic	679.16a	1966.0a	2040.49a	1248.75a	1483.60
Threshold	617.42a	1996.5a	2051.54a	1243.25a	1477.17
Untreated	627.87a	1962.3a	2111.50a	1340.50a	1510.54

1. Tom Green County yields in 2006 - 2008 are irrigated

Summary

Results in 2008 are similar to those observed during the previous three years. Although yields are not significantly different in the Blacklands location, a trend exists for treated plots to yield higher than the untreated. The Blacklands trial also indicates that there is no yield advantage to three automatic applications. The Tom Green trial indicates that under low cotton fleahopper populations, no advantage to treating is gained. The four years of the Tom Green trial also indicate that no advantage exists to treating marginal cotton fleahopper populations. The trial has been conducted on different varieties in the past four years (FM 960 B2R, D&PL 488 BGRR, D&PL 444 BGRR, D&PL 434 RR, FM 1740 B2F) and different characteristics in cotton varieties can impact how a plant responds to insect damage and can dramatically impact response to cotton fleahoppers (Ring et al. 1993). However, all the varieties have many characteristics (trichome density, etc.) that are available in many of the common varieties currently planted by producers and the response has been fairly consistent over the past four years.

The trend for higher yields in the Blacklands with the two, three and threshold treatments indicates that insecticide treatments are probably necessary when moderate fleahopper population levels are present throughout the fruiting season. However, the threshold treatments appear to be adequate to maintain yields. Over the four years of the trial, the threshold treatments in Williamson County have been sprayed a total of six times while the three automatic treatments have received twelve applications.

The trial indicates that producers and crop managers need to consider multiple factors when using current economic thresholds. Although numerous tests have shown the utility of the current thresholds, the thresholds do not consider all the dynamics of crop production such as weather, disease, continuous insect infestations, simultaneous infestations of more than one arthropod or the role of natural enemies (Ring et al. 1993). The introduction of transgenic cotton that is tolerant of herbicides has resulted in producers treating their weeds early in the growing season when cotton fleahoppers are also present. Many producers are now adding an insecticide with the herbicide to save a trip across the field. This trial shows that such insecticide use is not always needed. With increasing production costs, growers may be able to reduce input costs by better management of early season insects.

Cotton has the ability to compensate for early square loss without much delay in the harvest season. Producers should be able to take advantage of this in managing cotton fleahoppers and other plant bugs. These same tests need to occur over multiple years to determine how the plant responds to higher cotton fleahopper numbers and in more favorable moisture conditions.

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