INSECTICIDES FOR EARLY SEASON TARNISHED PLANT BUG CONTROL

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Abstract

Field trials were conducted in 1998 and 1999 to examine the efficacy of selected insecticides against early season tarnished plant bug populations in addition to the side effect of such insecticides on the beneficial arthropods complex. The influence of insecticide sprays on lint yield was also investigated. We found that new compounds such as Actara, Regent, Strategy, Steward, and Provado to be highly effective against plant bugs. Bidrin and Vydate tended to be less effective while Orthene tended to show a trend toward weaker performance. Steward, Strategy, Provado, Denim, and Vydate were soft on beneficials while Regent, Actara, and Orthene were harsh. Bidrin and Provado showed a tendency toward intermediate toxicity against beneficial arthropods. Increased lint yield compared to the check treatment was obtained with Strategy, Actara, and Provado.

Introduction

The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois) is a major concern of Arkansas and other Mid-South cotton growers. The feeding activities of *L. lineolaris* cause square shed, aborted plant terminals and damaged anthers and bolls which result in delayed crop maturity and reduced yield (Tugwell et al. 1976, Smith 1985, and Johnson et al. 1996). It was estimated that in 1998 a total of about 3.0 million acres were treated for *Lygus* in the U. S. and the total loss in production to these pests was about 230,057 bales (Williams 1999). Cotton farmers in Arkansas lost over 21,000 bales in 1998 due to *Lygus* damage (Williams 1999). Chemical sprays are the primary method used to control plant bugs and prevent feeding damages from occurring. However, population resistance to the major classes of insecticides in the Mid-South has been reported (Snodgrass and Scott 1988, Snodgrass and Elzen 1995). Also, the decision to spray early in the cotton production season is not without risks. Insecticides used to control plant bugs cause varied degrees of damage to the beneficial arthropods complex in the cotton fields. Thus, information on the effects of the available insecticides on plant bugs and the beneficial arthropod complex is needed so that a resistance/beneficial insect management program can be developed. Also needed are data correlating plant bug densities to seed cotton yield. One study (Phelps et al. 1996) examined the correlation between tarnished plant bug abundance on one hand and square retention and yield on the other. We initiated this study to examine the efficacy of several chemicals on early season plant bug populations. We also examined how chemical treatments influenced lint yield and the side effects of such treatments on the natural enemies complex.

Materials and Methods

Three separate tests were conducted in 1998 and 1999 on the Southeast Branch Experiment Station near Rohwer, AR to examine the efficacy of insecticides on pre-bloom plant bug populations. Standard production practices were used to produce the crop in both years. In 1998, one test was run in which Paymaster 1220 BGxRR was planted on 5-22-98. Two tests were carried out in 1999 (hereafter referred to as Test I and Test II) and in both tests DPL NuCotn 33B was planted on 5-13-99. Plots were 4 rows wide and 40 feet long in all three tests and were arranged in a Randomized Complete Block Design with 4 replications. We used a planting pattern of 4 x 2 skip row in 1998 so that each plot was bordered on each side by a 2 row fallow strip. Mustard was planted between plots in 1999 to ensure strong plant bug populations in the cotton plots. Insecticides were applied in all three tests using a John Deere high clearance sprayer in 10 gallons of total spray solution/acre. Appropriate rates of surfactants were used in both years.

Treatments were made on 7-6-98. In 1999, treatments in Test I were made on 6-18, 6-27, 7-6, and 7-12-99. Treatments in Test II were made on 6-21, 6-28, 7-5, and 7-13, 99.

Posttreatment arthropod counts were taken 3 days after treatment in both years. A 3-foot beat sheet (6 row feet per plot) was the sampling method used in 1998. In 1999, three sampling methods were used: a 3-foot beat sheet (6 row feet per plot), a sweep net (10 sweeps per plot), and KISS (a modified leaf blower, 40 row feet per plot). However, only beat sheet data will be presented in this report. Posttreatment plant mapping and fruiting counts were recorded in both years and processed using COTMAN.

Lint yield in 1998 and 1999 were determined by machine harvesting the middle 2 rows of the plots. Cotton was harvested on 9-30-1998. In 1999, cotton in Tests I and II was harvested on 10-04-99.

Data were processed using the Pesticide Research Manager 5 (PRM) / Agriculture Research Manager (ARM) (Gylling Data Management) and CoStat (CoStat Statistical Software). Analysis of Variance was run and Least Significant Difference (LSD) was used to separate the means.

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Results and Discussion

Insecticide Efficacy

All treatments in 1998 significantly reduced plant bug numbers compared to the untreated check (Table 1). However, although all chemicals provided similar degrees of control, a strong trend was seen for Strategy, Steward, and Provado to be especially effective against plant bugs in the 1998 test while Orthene and Bidrin seemed to be less effective. Provado, which represents a new class of insecticides (Chlornicotinyls) for the control of sucking insects, has performed consistently well against plant bugs in our previous tests (Kharboutli et al. 1998). In addition to the lethal effect of Provado on plant bugs, its efficacy is enhanced by the reported sublethal antifeeding effects (Teague and Tugwell 1996). In 1999, all treatments in Test I provided significant reduction in plant bug counts compared with the untreated check (Table 2). However, Actara, Leverage, Regent, and Provado gave the best control of plant bugs. These are new insecticides and represent new chemistries with novel modes of action. The development of insecticide resistance in populations of *Lygus lineolaris* in the Mid-South makes it vital for new and novel chemistries to be available in order to successfully manage these pests. Steward, also a new insecticide with a novel mode of action, was intermediate in efficacy especially at the low (0.09 lb ai/ac) rate, while Vydate and YCR 2894 seemed to be the weakest of all treatments. In Test II (1999), only Karate Z, Leverage, and Decis significantly reduced plant bug counts compared with the untreated check. However, Provado, Bidrin, and Baythroid tended also to provide high levels of plant bug control. Orthene and Vydate were the least effective treatments in this test.

Effect of Insecticides on Beneficial Arthropods

The effects of the various treatments on beneficial arthropods are shown in Tables 1, 2, and 3. No significant differences in beneficials abundance were found among treatments in 1998. However, trends in the 1998 data indicated that Strategy, Steward, and Provado were somewhat gentler on beneficials than Orthene or Bidrin. Steward has been reported by Tillman et al. (1998) to have no significant adverse effects on survival of beneficial insects. In Test I (1999), all insecticides except Denim significantly reduced beneficial arthropods counts compared to the check treatment (Table 2) with Actara and Leverage being the harshest among all chemicals. Regent, Provado, and Steward showed a tendency toward intermediate toxicity against beneficial arthropods. In an earlier study (Kharboutli et al. 1998), we found Regent to be particularly harsh on beneficials. Regent has been reported to reduce beneficial arthropods by up to 86% compared to the untreated cotton (Parker and Huffman, 1997). Stark et al. (1995) discussed the selectivity of Provado to beneficial insects while McNally and Mullins (1996) and Duffie et al. (1997) reported no direct harmful effects of Provado on minute pirate bugs and big-eyed bugs in cotton. In Test II (1999), beneficial counts in all treatments were similar to those in the untreated check (Table 3). However, beneficial arthropods tended to be more abundant in plots treated with Karate and Vydate than plots treated with Leverage, Bidrin, and Baythroid. Karate and Vydate were gentler on beneficials than compounds such as Leverage, Bidrin or Baythroid. Adverse effects of insecticides on beneficials in all tests may have been diluted by their continued movement into the test plots from adjacent fields. It is also conceivable that chemicals with high potency against plant bugs will also exert a negative effect on the beneficial populations by reducing their food resources. However, because the time between spraying and counting was relatively short (3-10 days) we can then conclude that some of the chemicals used in this study probably accounted for a good portion of the observed mortality of beneficial arthropods. Farmers need to take that into consideration since preservation and augmentation of natural enemies is an important element in pest control programs.

Lint Yield

All treatments produced similar lint yields to that of the untreated check in 1998 (Table 1). Strategy, which numerically topped all treatments in lint yield, produced significantly more lint than Orthene which ranked as the poorest among all chemicals in terms of lint yield. Plots treated with Orthene produced 126 lb less cotton lint than the check plots (although the difference was not significant). Steward's performance in this test was relatively modest with no dose response in lint yield observed. This may be partly due to the low plant bug pressure during the current test. Increased lint yield was obtained with Steward in our earlier tests (Kharboutli et al. 1999). In Test I (1999), Actara (0.0623 lb ai/ac) and Provado (0.047 lb ai/ac) were the only treatments to significantly increase lint yield compared with the check treatment (Table 2). Each of the two compounds produced about 300 lb more cotton lint than the check treatment. Plots treated with Steward (0.11 lb ai/ac) or Regent (0.05 lb ai/ac) produced about 200 lb more cotton lint than the check plots, though the difference was not significant. Neither of the two compounds caused a dose response effect on lint yield. In Test II (1999), all treatments including the untreated check produced statistically similar lint yields (Table 3). However, Bidrin (0.50 lb ai/ac) and Orthene (0.4 lb ai/ac) increased lint yield numerically by 274 and 264 lb, respectively, compared with the check treatment. Although treatment rankings for yield data did not completely match those of plant bug count, there was a general trend for treatments that killed more plant bugs to produce more cotton. This clearly demonstrates the economic importance of these bugs to cotton growers and the need to keep them under control. However, early season square shed may not always translate into a dramatic decrease in cotton yield as the case with some of the compounds tested in this study.

This is principally due to the cotton plant's ability to tolerate and compensate for early-season bug damage and square shed if growing conditions late in the season were favorable.

Summary

The tarnished plant bug is a key pre-bloom cotton pest responsible for most of the early-season square shed and the subsequent yield loss. Chemical control of the bug is attainable, however, judicious use of the available insecticides to control the tarnished plant bug is needed in order to slow down the development of resistance and preserve the natural enemy complex. Some chemicals that could be very effective against plant bugs may also be very harmful to the natural enemies in the cotton agroecosysytem. Understanding the full measure of the insecticides killing power in crops is an important prerequisite for implementing a sound and a successful IPM programs to control the tarnished plant bug in cotton. The tarnished plant bug will more than likely continue to be a serious pest of cotton in the U.S. and the need is high for more work to put together an effective control strategy against this pest.

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Table 1 . Plant bug control, beneficial arthropods counts, and lint yield following a single insecticide application against plant bugs[1]. Rohwer, AR. 1998.

Treatment	Rate lb (ai/ac)	Plant Bugs per 6 Row Ft[2]	Beneficials per 6 Row ft[2]	Lint Yield lb/ac
Check	-	2.3 a	6.0 a	511 ab
Orthene 90S	0.5	1.0 b	1.8 a	385 b
Orthene 90S +	0.5 +	1.0 b	2.3 a	517 ab
Provado 1.6F	0.0375			
Bidrin 8 +	0.25 +	0.8 b	2.0 a	494 ab
Provado 1.6F	0.125			
Provado 1.6F	0.0375	0.5 b	5.0 a	436 ab
Steward 1.25SC	0.09	0.5 b	6.5 a	514 ab
Steward 1.25SC	0.11	0.5 b	6.0 a	503 ab
Strategy 0.16EC	0.01	0 b	6.3 a	558 a

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Beat sheet samples were taken on 7-9-1998; 3 DAT.

Table 2 . Plant bug control, beneficial arthropods counts, and lint yield following repeated insecticide applications against plant bugs[1]. Rohwer, AR. 1999. (Test I)

Treatment	Rate lb (ai/ac)	Plant Bugs per 6 Row Ft[2]	Beneficials per 6 Row ft[2]	Lint Yield lb/ac
Check	-	2.9 a	12.7 a	1252 b
YCR 2894 4SC	0.047	1.3 b	6.0 bc	1440 ab
Vydate C-LV 3.77	0.33	1.1 b	6.9 bc	1359 ab
Steward 1.25SC +	0.09 +	1.1 b	4.7 bc	1311 ab
Dyne-amic	64[3]			
Denim 0.16EC +	0.01 +	0.9 b	9.6 ab	1411 ab
Kinetic HV	32[3]			
Steward 1.25SC +	0.11 +	0.7 b	5.4 bc	1428 ab
Dyne-amic	64[3]			
Provado 1.6F	0.047	0.6 b	6.2 bc	1541 a
Regent 2.5EC	0.038	0.4 b	7.3 bc	1381 ab
Regent 2.5EC	0.05	0.4 b	7.8 bc	1457 ab
Actara 25WG	0.0623	0.4 b	4.2 bc	1556 a
Leverage 2.7SC	0.079	0.3 b	2.8 c	1423 ab
Actara 25WG	0.047	0.2 b	3.4 c	1520 ab

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Beat sheet samples taken on 6-21, 7-1, 7-9, and 7-15-99; 3 DAT.
[3]Dyne-amic and Kinetic HV rates are in fluid ounces per 100 gallon.

Table 3 . Plant bug control, beneficial arthropods counts, and lint yield following repeated insecticide applications against plant bugs[1]. Rohwer, AR. 1999. (Test II)

Treatment	Rate lb (ai/ac)	Plant Bugs per 6 Row Ft[2]	Beneficials Per 6 Row Ft[2]	Lint Yield lb/ac
Check	-	1.94 a	7.94 ab	1125 a
Orthene 90S	0.4	1.44 ab	7.50 ab	1389 a
Vydate C-LV 3.77	0.25	0.63 ab	10.38 a	1237 a
Vydate C-LV 3.77 +	0.25 +	0.63 ab	6.38 ab	1241 a
Provado 1.6F	0.025			
Baythroid 2EC	0.032	0.56 ab	4.50 b	1270 a
Bidrin 8	0.5	0.50 ab	4.75 b	1399 a
Provado 1.6F	0.047	0.44 ab	5.44 ab	1289 a
Decis 1.5EC	0.022	0.38 b	5.38 ab	1283 a
Leverage 2.7SC	0.079	0.31 b	2.44 b	1339 a
Karate Z 2EC	0.028	0.13 b	10.44 a	1277 a

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Beat sheet samples taken on 6-24, 7-1, 7-8, and 7-16-99; 3 DAT.