INSECTICIDES FOR TARNISHED PLANT BUG CONTROL IN SOUTHEAST ARKANSAS

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Abstract

Field trials were conducted in 1996 and 1997 to select the most effective products that would reduce plant bug numbers, protect beneficial arthropod populations, and minimize square shed. We found Regent and Provado to be consistently effective against plant bugs. Bidrin performed well in 1997 but tended to be less effective at the 4.8 oz/acre rate in 1996 while Orthene seemed to exhibit a trend toward weaker performance. Among the tank mix treatments, Provado 70WG + Baythroid in 1996, and Vydate + Bidrin in 1997 provided good plant bug suppression. Vydate and Dimethoate were consistently soft on beneficials while Regent and Orthene were consistently harsher. Bidrin and Provado showed a consistent tendency toward intermediate toxicity against beneficial insects. YCR at the high rate (.056 lb/a) seems to offer an excellent square protection compared with the rest of the compounds tested in this study. Provado performed very well in this study and showed similar square retention values at the two rates tested (3.75 oz/A, 2 oz/A).

Introduction

The tarnished plant bug, Lygus lineolaris (Palisot de Beauvois) and other plant bug species are 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, subsequently, results in delayed crop maturity and reduced yield (Tugwell et al. 1976, Smith 1985, and Johnson et al. 1996). It was estimated that in 1995 a total of about 4.5 million acres were treated for plant bugs in the U. S. and the total loss in production to these pests was 240,134 bales (Shaw et al. 1997). Control of the tarnished plant bug is obtained almost exclusively by insecticides (Snodgrass and Scott 1996, Teague and Tugwell 1996). However, population resistance to the major classes of insecticides in the Mid-South has been reported (Cleveland and Furr 1979, Snodgrass and Scott 1988, Hollingsworth et al.1995). 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 insufficient are the data available in the literature concerning the problem of square shed in relation to plant bug densities and 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 plant bug populations and, consequently, on percentage square shed and cotton yield. We used the plant mapping techniques outlined in Bourland et al. (1994) to track square shed by nodal position and thus obtain an accumulative figure of square shed as the growing season progressed.

Materials and Methods

Pre-bloom plant bug studies were conducted on the Southeast Branch Experiment Station near Rohwer, AR in 1996 and 1997. Standard production practices were used to produce the crop in both years. In 1996, Suregrow 125 was planted on 5-2-96 and harvested on 9-18-96. Deltapine Nucotn 33b was planted on 5-16-97 and harvested on 10-17-1997. Mustard was planted on every fifth row in both years to ensure strong plant bug populations in the cotton plots. Plots were 4 rows wide by 35 feet long in 1996, and 4 rows by 40 feet long in 1997. Plots were arranged in a Randomized Complete Block Design with 4 replications. Pretreatment stand counts, beat sheet samples (6 row feet/plot), and node counts were taken in both years.

In 1996 and 1997, insecticides were applied using a high clearance sprayer in 10 gallons of total spray solution/acre. Treatment dates in 1996 were 5-30, 6-7, and 6-13. Treatments were made on 6-23,7-3, and 7-11 in 1997. Appropriate rates of surfactants were used in both years.

Posttreatment arthropod counts were taken using a 3 foot beat sheet. Two samples were taken per plot on each sampling date. Plots were sampled on 6-3, 6-6, 6-10, 6-13, 6-17 and 6-20-96. In 1997, plots were sampled on 6-26, 6-30, 7-7, 7-10, 7-14, and 7-21. Posttreatment plant mapping and fruiting counts were taken on 6-6, 6-11, 6-17, and 6-25, in 1996. In 1997, plant mapping and fruiting counts were taken on 6-25, 7-2, 7-8, and 7-15. Fruiting counts were processed using COTMAN.

When the test application and insect-fruiting data collection phase of the project was completed the test was treated on 6-21 and 6-24 with Orthene 90S at .5 lbs/acre in 1996. In 1997, the test was treated with Orthene 90S at .50 lbs/acre plus methyl parathion 4EC at 1 pt/acre on 7-24. These treatments were made to limit further plant bug damage to the field. The mustard plants were shredded in 1996 on 6-21, and 7-9 in 1997.

Lint cotton yields in 1996 and 1997 were determined by machine harvesting the middle 2 rows of the plots on 9-18-96 and 10-17-97. Seed cotton weights were obtained by weighing the cotton harvested from each plot.

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The data were statistically analyzed using Costat Statistical Software in both years.

Results and Discussion

Insecticide Efficacy

The ranking of chemicals used in this study as to their efficacies was very similar between the two years of study. Plant bug control results for the 1996 and 1997 tests are shown in Table 1 and Table 2, respectively. Regent, a currently unregistered insecticide, was consistently effective against plant bugs at all the rates used in this study. As a new class of chemistry, Regent could play an important role in plant bug control and resistance management programs. Provado1.6F performed well at the 3.6 and 3.75 oz/acre rates in 1996 and 1997, respectively, with a trend toward a weaker performance at the 2 oz/acre rate was observed in 1997. Provado represents a new class of insecticides (Chlornicotinyls) for the control of sucking insects such as plant bugs. Previous studies have reported a high efficacy of Provado on the tarnished plant bug (Scott et al. 1996) and showed an increased and a longer control of the tarnished plant bug by Provado over Vydate C-LV (Ruscoe et al. 1996). In addition to the lethal effect of Provado on plant bugs, its efficacy is much enhanced by the reported sublethal antifeeding effects (Teague and Tugwell 1996, Brown et al. 1997). Nauen (1995) found that such antifeeding effects on aphids may not be noticed until yields are taken. Therefore, plant bug counts in fields treated with Provado may not accurately reflect the effect of their densities on cotton yield since they are not feeding and damaging squares. Furthermore, new research has shown that Provado enhances the pathogenicity of some fungal pathogens, including Beauveria bassiana (Quintela and McCoy 1997) against the tarnished plant bug (Brown et al. 1997). Bidrin was effective at both the 8 and 4 oz/acre rates in 1997, but tended to be less effective at the 4.8 oz/acre rate in 1996. Orthene, at .28 and .56 lbs was affective in 1996 and 1997, but a trend toward weaker performance may be present. Among the tank mix treatments, Provado 70WG + Baythroid in 1996, and Vydate + Bidrin in 1997 provided good plant bug suppression.

Effect of Insecticides on Beneficial Arthropods

The effects of the various treatments on beneficial arthropods are shown in Table 1 and Table 2. No significant differences were found in 1996 among all treatments with regard to effects on beneficial arthropods. However, after examining the 1997 data, we see that both Vydate and Dimethoate were consistently soft on beneficials while Regent and Orthene were consistently harsher. Regent has been reported to reduce beneficial arthropods by up to 86% compared to the untreated cotton (Parker and Huffman, 1997). Bidrin and Provado showed a consistent tendency toward intermediate toxicity against beneficial insects. 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. It is conceivable that chemicals with high potency against plant bug 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.

Square Shed and Yield

Percentage square retention and yield data after repeated applications of the various insecticides are shown in Table 3 and Table 4. No significant differences in square retention were found among treatments in 1996, but in 1997 four compounds/tank mixes gave significantly greater square retention values than that of the check. YCR at the high rate (.056 lb/a) seems to offer an excellent square protection compared with the rest of the compounds tested in this study, however, at the low rate (.022 lb/A) square set was similar to that of the check. Provado performed very well in this study and gave similar square retention figures at the two rates tested (3.75 oz/A, 2 oz/A). Similar results were obtained by Phelps et al. (1996) who reported a significantly higher percent square retention with Provado treatment than Vydate C-LV. Regent and a tank mix of Phaser+Provado showed good promises and gave significantly more square retention than compounds such as Dimethoate and Vydate (Table 3 and Table 4). The findings obtained in this study are in agreement with a previously stated notation by Johnson et al. (1996) that the primary cause of pre-bloom shed is generally considered due to plant bug feeding. Our data show that, in general, treatments that afforded good plant bug control (e.g. Regent and Provado) also gave high square retention rates and the vice versa. Since square shed is a measure of plant response to a stressful condition (e.g., pest infestation), we conclude that plant bugs contributed largely to the square shed rates observed in this study. This becomes more obvious if we look at the data from the untreated check plots especially that population levels of other insects that could also cause square shed (worms, aphids, thrips, boll weevil) were negligible in both years.

All treatments produced similar yields to that of the check in 1996, but in 1997 only Provado and Regent produced significantly more cotton than the check. In a study conducted by Parker and Huffman (1997), Regent significantly increased lint yield compared to the check but the increase was only numerical compared to Vydate CLV and Baythroid 2E. Although treatment rankings for yield data did not completely match those of plant bug count, there was a strong negative correlation between yield data and plant bug counts in the 1997 study ($P = 0.0095$). Treatments that killed more plant bugs produced 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. Late-season temperatures in 1997 were above average in southern Arkansas and so more degree-days were accumulated than usual which resulted in maturing more bolls than it would have been under less favorable conditions.

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, judicoius 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 tarnsihed 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 and beneficial counts following repeated insecticide applications for plant bug control[1]. Rohwer, AR 1996.

Insecticide	Rate / Acre	Plant bugs / 6 row ft[2]	Benenficialarthropods/ 6 row ft[3]
Regent 2.5EC	2.56 oz	0.9 d	2.2 a
Regent 2.5EC	1.28 oz	1.0 cd	1.3 a
Provado 70WG + Baythroid 2EC	29 g + 1.92 oz	1.0 cd	1.7 a
Regent 2.5 EC	1.95 oz	1.1 cd	3.3 a
Orthene 90S	0.28 lbs	1.1 cd	2.7 a
Provado 1.6F	3.6 oz	1.2 cd	2.3 a
Orthene 90S	0.56 lbs	1.2 cd	1.7 a
Dimethoate 4E	8 oz	1.3 bcd	3.2 a
Provado 70WG + Baythroid 2 EC	20.9 g + 1.28 oz	1.6 abcd	3.0 a
Baythroid 2EC	1.92 oz	1.8 abcd	2.5 a
Lorsban 4EC	8 oz	1.8 abcd	2.3 a
Bidrin 8E	4.8 oz	1.9 abcd	1.7 a
Vydate C-LV	8.5 oz	2.0 abc	2.8 a
Provado 70WG	29 g	2.3 ab	2.8 a
Check		2.4 a	4.0 a

[1]Averages followed by the same letter are not statistically different at the 5% level of significance.
[2]All plant bugs including both adults and immatures.
[3]Immature stages only.

Table 2. Plant bug and beneficial counts following repeated insecticide applications for plant bug control[1]. Rohwer, AR 1997.

Insecticide	Rate / Acre	Plant bugs / 6 row ft[2]	Beneficial artthropods / 6 row ft[3]
Regent 2.5EC	1.95 oz	1.1 c	2 c
Bidrin 8EC	8 oz	1.1 c	2.3 c
Provado 1.6F	3.75 oz	1.3 bc	2.3 c
Vydate C-LV + Bidrin 8EC	8.5 oz + 4 oz	1.4 bc	2.5 bc
Vydate C-LV	8.5 oz	1.4 bc	3.0 ab
Bidrin 8EC	4 oz	1.4 bc	3.0 abc
Vydate C-LV	11.9 oz	1.5 bc	4.0 abc
Monitor 4EC	16 oz	1.8 abc	2.3 c
Ovasyn 1.5E + Provado 1.6F	10.6 oz + 2 oz	1.8 abc	2.4 c
Provado 1.6F	2 oz	1.8 abc	2.0 c
YCR 2894	.056 lbs	1.9 abc	2.0 c
Orthene 90S	.33lbs	2.0 abc	2.3 c
Phaser 3EC + Provado 1.6F	21 oz + 2 oz	2.0 abc	2.8 abc
YCR 2894	.022 lbs	2.0 abc	3.5 abc
Dimethoate 4E	10 oz	2.0 abc	3.0 abc
EXP61096A	.05 lbs	2.1 ab	4.0 ab
Check		2.5 a	4.3 a

[1]Averages followed by the same letter are not statistically different at the 5% level of significance.
[2]All plant bugs including both adults and immatures.
[3]Immature stages only.

Table 3. Percent square retention and yield following repeated insecticide treatment for plant bug control[1]. Rohwer, AR 1996.

Insecticide	Rate / Acre	% Square Retention	Yield Lb / Acre
Provado 70 WG	29 g	86.4 a	1116.8 b
Baythroid 2EC	1.92 oz	85.4 a	1138.5 ab
Orthene 90S	0.56 lbs	85.0 a	1157.0 ab
Provado 1.6F	3.6 oz	81.5 a	1206.8 ab
Regent 2.5EC	2.56 oz	80.9 a	1183.3 ab
Provado 70WG + Baythroid 2EC	20.9 g + 1.28	80.0 a	1242.0 ab
Provado 70WG + Baythroid 2EC	29 g + 1.92 oz	78.8 a	1122.0 b
Orthene 90S	0.28 lbs	78.8 a	1250.0 ab
Check		77.4 a	1211.3 ab
Bidrin 8EC	4.8 oz	77.3 a	1236.0 ab
Regent 2.5 EC	1.95 oz	76.9 a	1166.5 ab
Vydate C-LV	8.5 oz	76.6 a	1314.3 a
Lorsban 4EC	8 oz	75.3 a	1246.0 ab
Dimethoate 4E	8 oz	74.6 a	1160.8 ab
Regent 2.5EC	1.28 oz	74.2 a	1186.5 ab

[1]Averages followed by the same letter are not statistically different at the 5% level of significance.

Table 4. Percent square retention and yield following repeated insecticide treatment for plant bug control[1]. Rohwer, AR 1997.

Insecticide	Rate / Acre	% Square Retention	Yield Lb / Acre
YCR 2894	.056 lbs	82.8 a	1195 abc
Provado 1.6F	3.75 oz	78.0 ab	1304 a
Phaser 3EC + Provado1.6F	21 oz + 2 oz	77.8 abc	1194 abc
Regent 2.5EC	1.95 oz	77.0 a-d	1293 ab
Ovasyn 1.5E + Provado 1.6F	10.6 oz + 2 oz	75.8 a-e	1131 a-d
Vydate CLV	8.5 oz	74.0 a-f	1241 abc
Provado 1.6F	2 oz	73.8 a-f	1171 a-d
Bidrin 8EC	8 oz	72.0 a-f	1181 a-d
Monitor 4EC	16 oz	71.5 b-f	1219 abc
Bidrin 8EC	4 oz	71.3 b-f	1106 bcd
EXP 61096A	0.05 lbs	67.6 b-f	1008 d
YCR	.022 lb	66.8 b-f	1176 a-d
Orthene 90S	.33 lb	66.5 c-f	1178 a-d
Dimethoate 4E	10 oz	66.3 def	1203 abc
Vydate CLV	11.9 oz	65.5 e-f	1191 a-d
Check		64.8 e-f	1067 cd
Vydate CLV + Bidrin 8EC	8.5 oz + 4 oz	63.5 f	1184 a-d

[1]Averages followed by the same letter are not statistically different at the 5% level of significance.