NEW INSECTICIDE CHEMISTRY FOR CONTROL OF THE TARNISHED PLANT BUG IN COTTON

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Abstract

Control of the tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), with experimental insecticides, Regent® (class phenylpyrazole) applied at 0.038 - 0.05 lb AI/acre, Actara® (class thiamethaoxam) applied at 0.046 - 0.09 lb AI/acre, and Steward® (class indoxacarb) applied at 0.09 and 0.11 lb AI/acre was as good as or better than control obtained with the standard treatments Karate®, Monitor®, Vydate®, Orthene®, and Baythroid® applied at 0.028, 0.30, 0.25 to 0.33, 0.25 to 0.33, 0.03 lb AI/acre in various trials during 1998 and 1999. Regent, Actara, and Steward represent new classes of insecticide chemistry and will be useful in controlling tarnished plant bugs and in reducing resistance.

Introduction

The tarnished plant bug, (TPB), *Lygus lineolaris* (Palisot de Beauvois) is a serious pest of cotton in the Mid-South. Adults and nymphs damage the plant by feeding on terminals, squares, blooms, and small bolls causing yield loss. Williams (1999) reported that *Lygus spp.* ranked third behind the boll weevil, *Anthonomus grandis* Boheman, bollworm/budworm, *Helicoverpa zea* (Boddie) and *Heliothis virescens* (F.), in yield loss in the Mid-south. TPB highly resistant to pyrethroid insecticides with multiple resistance to organophosphate and cyclodiene insecticides were found in cotton in the Mississippi Delta in 1993 (Snodgrass 1994). Difficulty in controlling TPB in cotton with non pyrethroid insecticides in 1994 was reported by Snodgrass and Elzen (1995). Pyrethroid resistance in TPB populations is presently widespread in the Delta of AR, LA, and MS (Snodgrass and Scott 1996). Because insecticide resistence is widespread in the mid-south and control of TPB on cotton is mainly with insecticides, research on how to use existing and new insecticides is needed.

Fipronil (Regent®, Rhone Poulenc AG Company) belongs to the phenyl pyrazole class of insecticides and has been in development as a cotton insecticide since 1989. Regent was shown to have significant activity on thrips, TPB, and boll weevils (Burris et al.1994, Shaw and Yang 1996, and Hamon et al. 1996). Scott et al. (1996) demonstrated in a laboratory spray chamber bioassay that Regent at 0.05 lb AI/acre provided excellent control of pyrethroid resistant TPB. Pankey et al. (1996) reported that 2 DAT, only Regent (0.025 and 0.038 lb AI/acre) had significantly higher mortality of TPB when compared to the untreated check. Snodgrass and Scott (1999) reported that Regent (0.05 lb AI/acre) and Monitor® (0.33 lb AI/acre) provided mortalities of 97% and 100% respectively on highly resistant TPB at 24 hours.

Thiamethaoxam (Actara®, Novartis Ag) belongs in the neonicotinoid class of insecticides and has shown good activity on the TPB. Scott et al. (1999) evaluated Actara at 0.046 and 0.093 lbs AI/acre during 1997 in small plot tests. Results showed that TPB populations were reduced at the high rate equal to that obtained with Regent at 0.038 lb AI/acre and Karate® at 0.028 lbs AI/acre. Treatments were all significantly lower than the untreated check.

Indoxacarb (Steward®, Dupont Ag) belongs to the oxadiazine group of insecticides. Steward has been extensively evaluated and has shown a high degree of activity on certain cotton pests that includes possible suppression of TPB populations. Teague and Tugwell (1998) evaluated Steward against late season TPB. At 4 DAT Orthene® at 0.50 lb AI/acre significantly lowered the number of TPB as compared to treatments of Curacron at 0.50 lb AI/acre and Steward applied at 0.065 and 0.11 lb AI/acre. Reductions in TPB numbers also were noted with the other treatments compared to the untreated check: however, control was below acceptable levels. Allen et al. (1999) maintained that Steward®was effective in controlling TPB populations. Control of the TPB was monitored in three different tests where Steward was applied at 0.09 and 0.11 lbs AI/acre. The efficacy of Steward on TPB was consistent throughout the various tests when compared to other treatments. Teague et al. (1998) indicated that Orthene applied at 0.50 lb AI/acre was more effective than Curacron applied at 0.50 lb AI/acre and Steward at 0.06 and 0.1 lb AI/acre. Although not significant, numbers of TPB in Steward were lower than those found in the Curacron treatment or the untreated check. Hammes et al. (1999) indicated that Steward provided TPB control at 5-7 days post treatment similar to the standards, Orthene and Vydate®.

The object of this manuscript was to bring together information from different researchers on their results with Regent, Actara, and Steward as compared with standard insecticides in tests for TPB control.

Materials and Methods

Small Plot Test - Mississippi

Tests were conducted in 1998 and 1999 to evaluate various insecticides for TPB control in NuCOTN 33B cotton at Stoneville, MS. Plot size were 16 rows X 60 feet with treatments replicated three times. Plots were sprayed with a John Deere high clearance sprayer calibrated to deliver a total volume of 6 gallons per acre. Treatments in 1998 were:

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Regent® (0.038 and 0.05 lb AI/acre); Vydate® (0.25 lb AI/acre); Monitor® (0.30 lb AI/acre); Karate® 1EC, Karate Z (0.028 lb AI/acre); Actara® (0.067 and 0.09 lb AI/acre); and an untreated check. Treatments in 1999 included Regent (0.038 and 0.05 AI/acre), Steward® (.09 and 0.11 lb AI/acre), Vydate (0.33 lb AI/acre), Actara (0.047 and 0.062 lb AI/acre), Orthene® (0.33 lb AI/acre), Acetamiprid (0.05 lb AI/acre) and an untreated check. Data from replicated plots were analyzed by ANOV (SAS Institute 1989), and means were separated by LSD.

Small Plot Test - Arkansas

Small plot tests to evaluate TPB control were conducted during 1999 in cotton in Arkansas. Treatments included Regent (0.038 and 0.05 AI/acre), Steward (0.11 lb AI/acre, Provado® (0.047 lb AI/acre), Orthene (0.50 lb AI/acre), Actara (0.047 lb AI/acre), Leverage® (0.079 lb AI/acre), and an untreated check. Treatments were replicated four times. Data were analyzed by ANOV, and means were separated by LSD. Treatments were applied with a CO_2 charged high clearance sprayer calibrated to deliver a total volume of 17.7 gallons per acre.

Cage Studies - Arkansas

Several cage studies were conducted to evaluate various insecticides for control of TPB in cotton. Treatments were replicated three times. Mortality data were analyzed with ANOV, and means separated by LSD. Treatments included in the first study were: Steward (0.11 lb AI/acre), Provado (0.047 lb AI/acre), Orthene (0.50 lb AI/acre), Actara (0.047 lb AI/acre), and an untreated check. In the second study treatments were: Actara (0.047 and 0.062 lb AI/acre), Orthene (0.50 lb AI/acre), and an untreated check. Treatments included in the third study were: Steward (0.065, 0.09, 0.11 lb AI/acre), Regent (0.038 lb AI/acre), and an untreated check. TPB were caged in each study using three nylon organdy sleeve cages placed in the center two rows of each plot of each treatment. Five TPB nymphs (3 to 5th instar) were placed into each cage. Treatments were applied with a CO_2 charged back pack sprayer that was calibrated to deliver a total volume of 11 gallons per acre.

Large Plot EUP Test - Mississippi

Control of TPB in large plots of 'NuCOTN 33B' were evaluated in 1998 and 1999 on a farm near Stoneville. Treatments in 1998 were Regent (0.05 lb AI/acre), Vydate (0.25 lb AI/acre), Baythroid (0.03 lb AI/acre), and an untreated check. Treatments in 1999 were: Regent (0.05 lb AI/acre), Actara (0.067 lb AI/acre), Vydate (0.33 lb AI/acre), Orthene (0.33 lb AI/acre), Leverage (0.079 lb AI/acre), and an untreated check. Treatments were replicated four times. Plot size was three to four acres and replicated four times. Data were analyzed by ANOV and means separated by LSD. Treatments both years were applied with a John Deere 6000 high clearance sprayer calibrated to deliver a total volume of 6 gallons of spray per acre.

Aerially Applied EPU Test - Mississippi

Control of TPB with insecticides applied by air were evaluated in 1998 and 1999 on a farm located near Leland, MS. In 1998, Regent (0.05 lb AI/acre) and Vydate (0.25 lb AI/acre) were each applied to fifteen acre plots of NuCOTN 33B cotton (non-replicated). In 1999 Regent, Orthene, and Actara were applied at 0.05, 0.33, and 0.067 lb AI/acre respectively. There was an untreated check both years. In the aerial EUP, averages are shown for the treatment and check; cost prohibited a replicated test. Treatments were applied with an Air Tractor (402) at 3 gallons total volume pressure.

Results and Discussion

Small Plot Test - Mississippi

Average numbers of TPB per acre for the small plot test in 1998 are shown in Figure 1. The untreated check had significantly higher numbers of TPB for the season than any treatment. Vydate (0.25 lb AI/acre) had significantly higher numbers of TPB for the season than Actara (0.067 lb AI/acre). All other treatments were not statistically different.

Average numbers of TPB per acre for the small plot test in 1999 are shown in Figure 2. The untreated check had significantly higher numbers of TPB for the season than any treatment. There were no significant differences among treatments.

Small Plot Test - Arkansas

Table 1 shows the number of TPB per plot in 25 sweeps 5 DAT. The untreated check had a significantly higher total population than any treatment. Leverage had significantly lower numbers of adults than all other treatments except Orthene. It also had significantly lower total numbers of TPB than Provado treatment.

Cage Studies - Arkansas

Table 2 shows the percent mortality after 96 hours in the 1st cage study. Mortality in the untreated check was significantly lower than the treatments. There was no difference in mortality between the other treatments at 4 DAT. Table 3 shows the results of the 2nd cage study. At 4 DAT mortality in the untreated check was zero. Mortality in treatments ranged from 90-95%, all of which were significantly higher than check. In the 3rd cage study, all treatments had significantly higher mortality than the untreated check at 3 DAT. Regent numerically had the highest mortality but did not differ significantly from Steward at 0.65 and 0.11 lb AI/acre (Table 4).

Large Plot EUP Test -Mississippi

The untreated check had significantly higher seasonal averages of TPB than the insecticide treatments in 1998 (Figure 3). Although mean numbers of TPB did not differ significantly among the three insecticide treatments, lower mean numbers were found in the Vydate and Regent treatments as compared to the Baythroid treatment. In 1999, (Figure 4) the untreated check had significantly higher mean numbers of TPB than the other treatments. No significant differences occurred among treatments.

Aerially Applied EUP Test - Mississippi

In 1998 in the aerial applied EUP (Figure 5), there were no differences in the seasonal averages of TPB in the treatments of Regent (0.05 lb AI/acre) and Vydate (0.25 lb AI/acre). Populations in both treatments were lower than the untreated check. In 1999, the Orthene (0.33 lb AI/acre) treatment had lower seasonal means of TPB (Figure 6) than the untreated check. Mean numbers did not differ between Orthene and Actara® (0.067 lb AI/acre).

Summary

TPB control with Regent, Actara, and Steward in 1998 and 1999 was as good as or better than the control obtained with different standard insecticides in cage studies and small plot trials. In large plot EUP trials, Regent and Actara performed as well as Baythroid, Vydate, Orthene, and Leverage. The new chemistries were found to be effective in controlling TPB in cotton. Because of the possibility of widespread resistance that occurs in TPB populations in the Mid-South, registration of the new insecticides would greatly help in the control and management of resistance in this pest.

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Table 1. TPB mortality rate 5 DAT in small plot, Teague & Tugwell 1999.

		Rate	Tarnished Plant Bugs 5 DAT		
		Lb ai/ac	adults	nymphs	Total
Regent	2.5 EC	0.038	2.25a	1.67	4.00bc
Regent	2.5 EC	0.050	1.75b	2.25	4.00bc
Steward	1.3 SC	0.110	1.25b	1.50	2.75c
Provado	1.6 F	0.047	2.00b	3.25	5.25b
Orthene	90 S	0.500	2.75abc	0.00	2.75c
Actara	25 WG	0.047	3.25ab	0.50	3.75bc
Leverage	2.7 EC	0.079	1.00c	1.50	2.50c
Untreated			4.25a	3.75	8.00a
	LSD (0.05)		2.00	NS	2.47

Table 2. TPB mortality rate 4 DAT in 1st cage study, Teague & Tugwell 1999.

Treatment & Formulation		Rate lb ai/ac	4 DAT % dead
Steward	1.25 SC	0.11	97.80
Provado	1.6 F	0.047	100.00
Orthene	90 S	0.5	97.77
Actara	25 WG	0.047	100.00
Untreated			15.56
	LSD (0.05)		9.20

Table 3. TPB mortality rate 4 DAT in 2nd cage study, Teague & Tugwell 1999.

Treatment & Formulation		Rate lb ai/ac	4 DAT % dead
Actara	25 WG	0.047	90.00
Actara	25 WG	0.062	93.33
Orthene	90 S	0.5	95.53
Untreated			0.00
	LSD (0.05)		20.09

Table 4. TPB mortality rate in 3rd cage study, Teague & Tugwell 1999.

Treatment & Rate lb ai/ac	% TPB Dead 3 DAT
Steward 0.065 lb ai/ac	86.26
Steward 0.09 lb ai/ac	71.23
Steward 0.11 lb ai/ac	84.28
Regent 0.038 lb ai/ac	95.69
UTC	3.94
LSD (0.05)	24.71

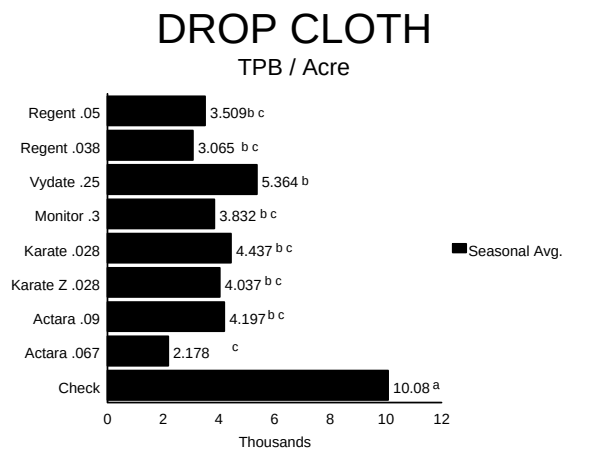

Figure 1. Seasonal averages of TPB in small plot insecticide trial, 1998.

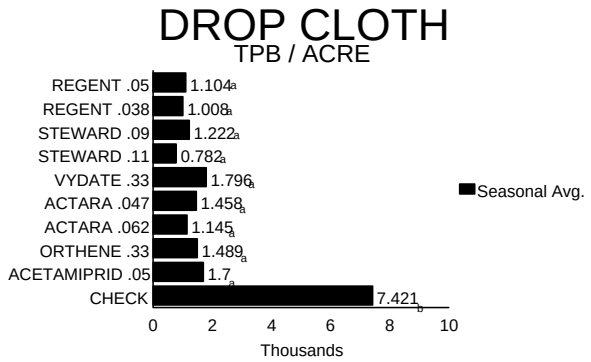

Figure 2. Seasonal averages of TPB in small plot insecticide trials, 1999.

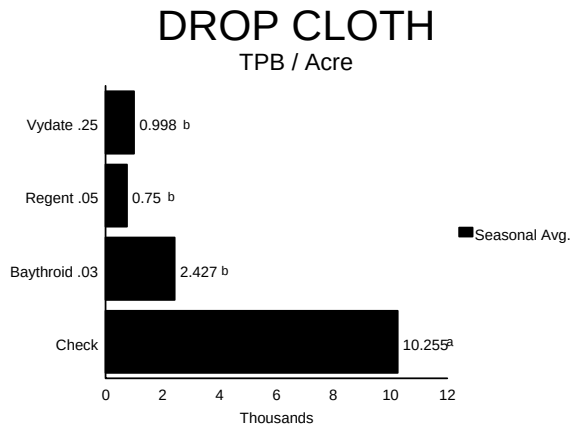

Figure 3. Seasonal averages of TPB in an EUP trial, 1998.

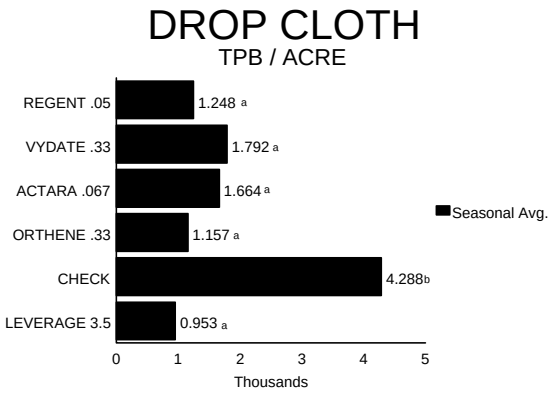

Figure 4. Seasonal averages of TPB in an EUP trial, 1999.

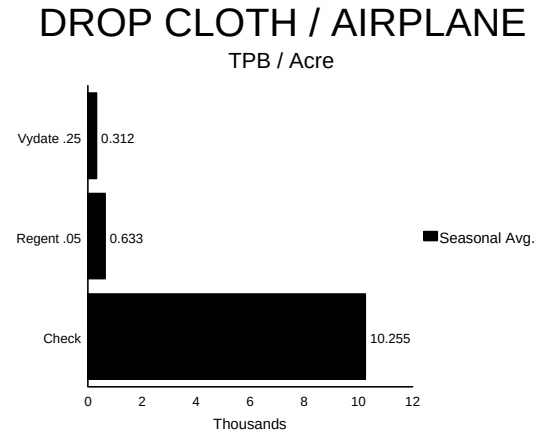

Figure 5. Seasonal averages of TPB in an EUP airplane trial, 1998.

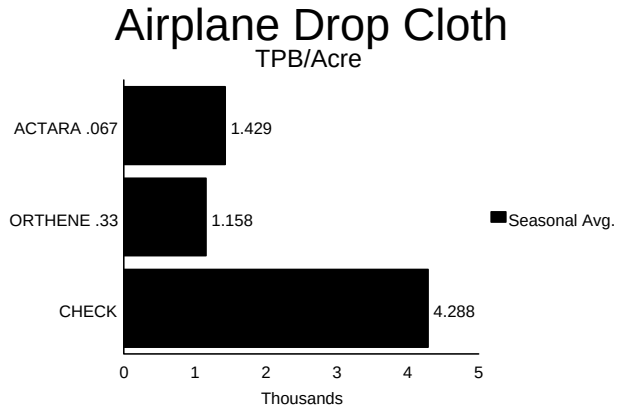

Figure 6. Seasonal averages of TPB in an EUP airplane trial, 1999.