

**NEW INSECTICIDES FOR CONTROL OF
TARNISHED PLANT BUG - RESULTS FROM
FIELD AND CAGE STUDIES AND LABORATORY
BIOASSAYS**

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Abstract

Field and laboratory studies were conducted in 1998 and 1999 to evaluate efficacy of new and standard insecticides for control of tarnished plant bug (*Lygus lineolaris* (Palisot de Beauvois)) in cotton. Results from tests with Orthene (acephate), Regent (fipronil), Bidrin (dicotophos), Leverage (imidacloprid + cyfluthrin), Actara (thiamethoxam), Provado (imidacloprid) and Steward (indoxacarb) evaluated in small plot trials are presented as well as results from cage studies. It was apparent in cage trials that 3 days was not sufficient time to evaluate some of the newer insecticides such as Steward, and evaluation times for mortality determinations after treatment were lengthened from 3 to 4 days. In the laboratory studies using a waterfoam bioassay method, toxicity of Actara, Provado and Steward was examined, and LC₅₀ values for the formulated insecticides were 0.08 ppm, 0.69 ppm, and 1.46 ppm for Actara, Provado and Steward, respectively. The slow action of these compounds in the laboratory required that the bioassays be extended to 96 hrs. supporting the practice of extending the evaluation interval in field cage studies to 4 days after treatment.

Introduction

Testing new insecticides and re-evaluating standard products for tarnished plant bug (TPB) (*Lygus lineolaris* (Palisot de Beauvois)) control remains a high priority effort in Arkansas cotton research. Summaries of results from field trials from 1998 and 1999 are presented in this paper along with results from laboratory bioassays with 3 insecticides with novel modes of action - Provado (imidacloprid) and 2 new compounds, Actara (thiamethoxam) and Steward (indoxacarb).

Materials and Methods

Small Plot Trial #1- 1998

All field studies were conducted at the Cotton Branch Experiment Station in Marianna, AR. In the first small plot trial, compounds tested were: Regent 2.5EC (fipronil) at 0.038 and 0.050 lb (AI)/acre and Bidrin 8EC (dicotophos) at 0.50 lb (AI)/acre. Plots were planted with 'Sure-Grow 125' on 11 May in 8-row (38 inch centers) wide by 70 ft long plots with 10 ft alleys and separated by a 6.5 ft strips of blooming mustard. The treatments were arranged in a RCBD with 4 replications. The insecticides were applied 11 Aug using a 8-row CO₂ charged hi-boy sprayer calibrated to deliver 9.5 gpa at 30 psi with TX-10 hollow cone nozzles on 19 inch spacing. The number of TPB per plot was estimated at 3 days after treatment (DAT) using 25 sweeps per plot with an 18 inch net. Data were subjected to AOV, and means separated using LSD.

Small Plot Trial #2 – 1998

In this study, Leverage 2.7 EC (imidacloprid + cyfluthrin) at 0.79 lb (AI)/acre, Regent 2.5 EC at 0.038 and 0.05 lb (AI)/acre and Bidrin 8 EC 0.50 lb (AI)/acre were evaluated using procedures identical to those described for Small Plot Trial #1.

Small Plot Trial #3 – 1999

Products evaluated (and rates lb (AI)/acre) were: Regent 2.5 EC (0.038 and 0.05) Leverage 2.7 EC (0.79), Orthene 90 S (acephate) (0.5), Provado 1.6 F (0.047), Steward 1.25 SC (0.110) and Actara 25 WG (0.047). The 'Sure-Grow 125' was planted on 13 May in plots 8-rows wide by 50 ft long with 10 ft alleys and separated by a 6.5 ft strips of blooming mustard. The treatments were arranged in a RCBD with 4 replications. The insecticides were applied 29 July using a 8-row CO₂ charged hi-boy sprayer calibrated to deliver 17.7 gpa at 60 psi with TX-10 hollow cone nozzles on 19 inch spacing. The number of plant bugs per plot was estimated at 5 DAT using 25 sweeps with an 18 inch net.

Cage Trial #1 – 1999

In this small plot cage study, insecticides tested were: Steward 1.25 SC applied at 0.065, 0.09 and 0.11 lb (AI)/acre and Regent 2.5 EC applied at 0.038 lb (AI)/acre. Cotton was planted 13 May on the in 8 row wide plots 50 ft long with 10 ft alleys. The experiment was arranged in a RCBD with 3 replications. Insecticides were applied 2 Jul using a 4-row CO₂ charged backpack sprayer calibrated to deliver 11 gpa at 60 psi with TX 10 hollow cone nozzles on 19 inch spacing. Just prior to application, TPB were collected in blooming mustard plants using sweep nets. The collected TPB were placed in 15 ml plastic vials (5 insects per vial) and immediately put in coolers on ice. In the center 2 rows of each plot, 3 organdy sleeve cages, 6 inches diam by 18 inches long, were secured to randomly selected individual plants.

The lower end of each cage was tied around the plant ca 1 ft from the terminal. The cages were rolled down to the tie and covered with aluminum foil leaving plant terminals exposed. Immediately following, the application while the foliage was still wet, the foil was removed, the cage pulled up, and 5 TPB nymphs (3 to 5th instar) were placed into each cage. Cages were secured with twist ties. After 72 hrs plants were cut below the cage and taken to the laboratory where TPB mortality was determined. Mortality data were analyzed with AOV, and means separated with LSD.

Cage Trial #2

This cage test was conducted to evaluate the efficacy of Actara applied at 0.047 and 0.062 lb (AI)/acre compared to a standard, Orthene applied at 0.50 lb (AI)/acre. Insecticides were applied 15 Jul using a 4-row CO₂ charged back pack sprayer calibrated to deliver 11 gpa at 60 psi with TX 10 hollow cone nozzles on 19 inch spacing. Other experimental procedures were similar to Cage Trial #1 except that insects were caged for 96 hrs on plants.

Cage Trial #3

Insecticides tested (and rate (lb (AI)/acre)) were Steward 1.25 SC (0.11), Provado 1.6F (0.047), Orthene 90S (0.50), and Actara 25WG (0.047). Collection and caging procedures were similar to Cage Trial #2. Insecticides were applied 29 Jul using a 8-row CO₂ charged hi-boy sprayer calibrated to deliver 17.7 gpa at 60 psi with TX 10 hollow cone nozzles on 19 inch spacing. Mortality was determined at 96 hrs.

Laboratory Trials

Laboratory studies to compare toxicity of Provado (imidacloprid), Steward (indoxacarb) and Actara (thiamethoxam) included a waterfoam bioassay method (Teague and Tugwell 1996). This is a quick and inexpensive laboratory method to evaluate insecticides that have both conventional poisoning effects and anti-feeding effects. The formulated insecticides were mixed with 10% sucrose solution and a green or blue marker (McCormick food coloring - 6 drops/50 ml). The marker can be used to detect changes in feeding behavior. Ca. 1.25 ml of the insecticide/dye mixture was pipetted into a 1 cm cube of waterfoam. Individual cubes of water foam were placed in a 2 - sectioned 100 X 4 mm plastic petri dish. In a separate section of the same petri dish a 3 X 3 cm strip of filter paper was inserted to serve as a resting site for the insect. One adult TPB was placed in a each petri dish. All the tested insects were kept at 80° F and at 75 to 85% RH for 96 hr. Tests with imidacloprid were conducted from 1996 to 1998; thiamethoxam and indoxacarb were evaluated in summer 1998. TPB for testing were collected from wild hosts in Craighead, Poinsett, and Lee County, AR, where no insecticide applications had been made. The TPB were kept in a 5 gallon bucket ½ filled with sprouted potatoes or insecticide-free green beans and broccoli. Generally, adults

were 2 to 4 days old at the time of testing. Mortality data were subjected to probit analysis using SAS (ver 7., 1998).

Results

Small Plot Trial # 1

Numbers of TPB 3 days after treatment (DAT) were significantly reduced in all plots sprayed with insecticides compared to the untreated check. No dose response between the 2 rates of Regent was observed. (Table 1).

Small Plot Trial # 2

No significant differences in TPB counts were noted in response to treatments (Table 2). There were problems with the TADS 12253 formulation clogging screens on the spray nozzles, and this likely affected product performance.

Small Plot Trial # 3

Population density of TPB was low in treatment plots at the time of testing; however, statistically significant differences in total numbers of adults and total TPB were observed between treatments at 5 DAT (Table 3). There were no differences in numbers of nymphs between treatments observed. The extended period between application and evaluation was used because some insecticides in the test were believed to be slow acting.

Cage Trial #1

Significant differences between treatments were observed after 3 days of exposure in cages (Table 4). Excellent TPB control was observed in the Regent treated cages. A dosage response with Steward was not apparent. A longer exposure time may be appropriate for evaluating this slower acting insecticide.

Cage Trial #2

All insecticide treatments resulted in greater than 90% control of TPB (Table 5). No mortality was observed in the untreated cages. Differences between treatments in terms of speed of control is masked because of the extended exposure time.

Cage Trial #3

Mortality at 4 DAT was greater than 97% in all insecticide treatments and was significantly higher than the 15.5% observed in the untreated check (Table 6).

Laboratory Trials

Results from laboratory studies indicate the order of toxicity of the insecticides evaluated from least toxic to most toxic was Steward < Provado < Actara. The LC₅₀ values calculated from the laboratory bioassay were 0.69 ppm for Provado, 0.08 ppm for Actara, and 1.46 ppm for Steward (Table 7). The slow action of these compounds required that the bioassays be extended to 96 hrs. Mortality data at 24, 72 and

96 hrs are shown in Figure 1. These data support the use of extended testing interval used in field cage studies.

Concluding Remarks

Insecticide resistant populations of TPB have been reported in Arkansas and Mississippi (Hollingsworth et al 1997, Snodgrass and Elzen 1996, Snodgrass and Scott 1996). In the trials reported here, the fields had not been sprayed with insecticides previously in that season. The relative susceptibility of the TPB populations to synthetic pyrethroids and organophosphate compounds probably was related to a lack of selection pressure in the season.

In cage studies, the level of control may be inflated because TPB were confined only to treated areas for an extended period. Differences between insecticides and rates in terms of speed of control may be masked. The extended exposure time was used because some insecticides in the test were believed to be slow acting. Slower acting compounds require a longer testing period for evaluation. In laboratory bioassays it was apparent, particularly with Steward, that > 48 hr. is needed to assess toxicity of some compounds. For in-field decision making, crop monitoring will be needed to assess immediacy of crop protection provided by the insecticide. Live insects may still be apparent in the field following an insecticide application; however, crop injury may not be occurring.

References

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Table 1. Mean no. TPB per 25 sweeps observed 3 days after insecticide applications in Small Plot Trial #1.

Treatment & Formulation	Rate lb (AI)/acre	No. TPB/25 sweeps 3DAT
Regent 2.5EC	0.038	6.2
Regent 2.5EC	0.05	6.5
Bidrin 8EC	0.50	11.5
Untreated Check		22.0
P>F		0.05
LSD(.05)		9.2

Table 2. Mean no. TPB per 25 sweeps observed 3 days after insecticide applications in Small Plot Trial #2.

Treatment & Formulation	Rate lb (AI)/acre	No. TPB/25 sweeps 3DAT
Leverage 2.7EC	0.79	19.0
Regent 2.5EC	0.038	5.0
Regent 2.5 EC	0.05	6.5
Bidrin 8EC	0.50	10.0
Untreated Check		27.5
P>F		NS

Table 3. Mean no. TPB per 25 sweeps observed 5 days after insecticide applications in Small Plot Trial #3.

Treatment & Formulation	Rate lb(AI)/acre	Mean No. Tarnished Plant Bugs per 25 sweeps (5 DAT)		
		adults	nymphs	total
Regent 2.5 EC	0.038	2.33	1.67	4.00
Regent 2.5 EC	0.050	1.75	2.25	4.00
Steward 1.25 SC	0.110	1.25	1.50	2.75
Provado 1.6 F	0.047	2.00	3.25	5.25
Orthene 90 S	0.500	2.75	0.00	2.75
Actara 25 WG	0.047	3.25	0.50	3.75
Leverage 2.7 EC	0.079	1.00	1.50	2.50
Untreated		4.25	3.75	8.00
P>F (AOV)		0.05	NS	0.05
LSD (0.05)		2.00		2.47

Table 4. Mortality (%) of TPB 3 days after treatment in Cage Trial #1.

Treatment /formulation	Rate lb (AI)/acre	% TPB Dead 3 DAT
Steward 1.25 SC	0.065	86.26
Steward 1.25 SC	0.09	71.23
Steward 1.25 SC	0.11	84.28
Regent 2.5 EC	0.038	95.69
Untreated		3.94
P>F (AOV)		0.05
LSD (.05)		24.71

Table 5. Mortality (%) of TPB 4 days after treatment in Cage Trial #2.

Treatment & formulation	Rate lb (AI)/acre	% Dead (4 DAT)
Actara 25WG	0.047	90.00
Actara 25WG	0.062	93.33
Orthene 90S	0.5	95.53
Untreated	—	0.00
P>5 (AOV)		0.05
LSD (.05)		20.09

Table 6. Mortality (%) of TPB 4 days after treatment in Cage Trial #3.

Treatment / formulation	Rate lb (AI)/acre	% Dead (4DAT)
Steward 1.25 SC	0.11	97.80
Provado 1.6 F	0.047	100.00
Orthene 90 S	0.50	97.77
Actara 25 WG	0.047	100.00
Untreated		15.56
P>F (AOV)		0.05
LSD (0.05)		9.20

Table 7. Toxicity determinations taken 4 days after TPB exposure to formulated insecticides mixed with 10% sucrose solution using the waterfoam laboratory bioassay method.

Insecticide	n ^a	LC ₅₀	(95% CL) ^b
Provado	731	0.69	(0.53-0.92)
Actara 25 WG	240	0.08	(0.02-0.13)
Steward 1.25 SC	270	1.46	(0.65-1.71)

^aTotal number of tarnished plant bugs tested.

^bLC₅₀ expressed in ppm AI.

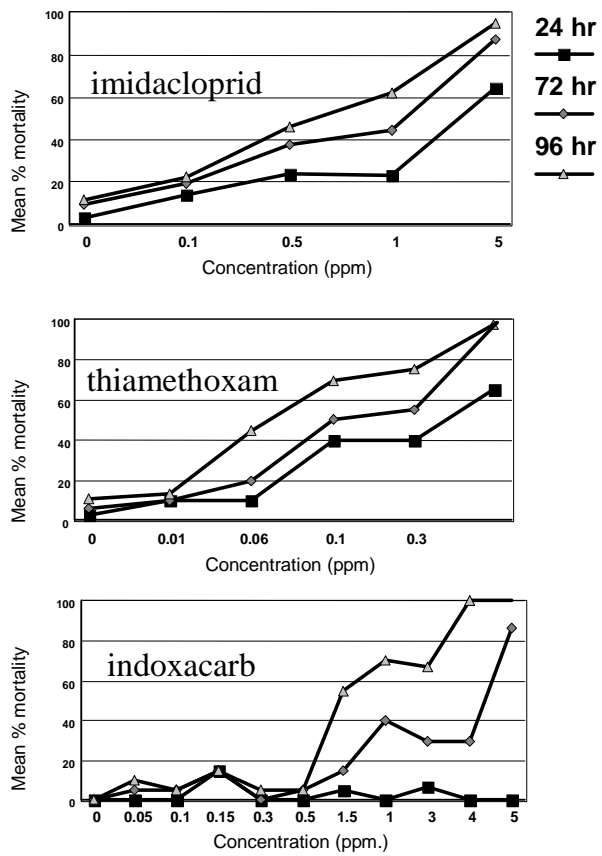


Figure 1. Mean % tarnished plant bug mortality 24, 72 and 96 hr after to exposure to the formulated insecticides, Provado (imidacloprid), Actara (thiamethoxam) and Steward (indoxacarb), mixed with 10% sucrose solution using the waterfoam laboratory bioassay method.