Efficacy and Temporal Mortality of Selective Insecticides on Beet Armyworm Larvae in Lettuce

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Introduction

Several new insecticides with similar modes of activity, but different mode of action are currently being used or under development for control of beet armyworm, cabbage looper and Heliothis virescens in iceberg lettuce in Arizona. They are somewhat unique in that their primary mode of activity involves ingestion of the toxicant by the larvae to cause mortality. Some of these toxicants (ie. *Bacillus thuringiensis*, thiodicarb, RH5992) do not kill the larvae immediately like a contact insecticide, but rather cause the insect to stop feeding for a period of time prior to death. Actual death usually occurs 3-5 days after ingestion. Because many PCAs and growers are not familiar with this type of insecticidal activity, the performance of the insecticide is often questioned after field applications. This lack of understanding has resulted in misuse or overuse of some of the insecticides. The objectives of this study were to compare the efficacy of several insecticides with with modes of activity involving ingestion, and document the temporal mortality of these newer selective insecticides with similar modes of activities. The results of this study could provide information to PCAs for properly using these chemicals in their Lettuce Pest Management Programs.

Materials and Methods

Efficacy Studies were conducted from 1992-1994. In the 1992 test, lettuce was direct seeded into double-row beds on 17 Sep at the Yuma Valley Agricultural Center, Yuma, AZ. The plots were not thinned prior to the experiment. Each plot consisted of three, 50 ft long beds spaced 42 inches apart and bordered on each side by an untreated bed. Plots were arranged in a completely randomized block design with 4 replicates. Foliar treatments were applied on 8, 13, 19 Oct with a tractor-mounted boom sprayer (2 TX-8 nozzles/row) operated at 40 psi, delivering 25 gal/acre. Spreader-sticker (Dynamic) was included in all spray treatments at 0.125% v/v. Insecticide efficacy was determined by counting the total number of small (1st and 2nd instars) and large (> 2nd instar) BAW and CL larvae on 25 randomly selected lettuce plants per replicate. Insect counts were conducted on 7, 13, 19, and 25 Oct. Data were analyzed for treatment differences using ANOVA and a protected LSD.

In the 1993 test, lettuce was direct seeded into double-row beds on 16 Sep at the Yuma Valley Agricultural Center, Yuma, Az. The plots were not thinned prior to the experiment. Each plot consisted of four, 30 ft long beds spaced 42 inches apart and bordered on each side by an unplanted bed. Plots were arranged in a completely randomized block design with 4 replicates. Foliar treatments were applied on 7 and 12 Oct with a tractor-mounted boom sprayer (2 TX-8 nozzles/row) operated at 40 psi, delivering 20 gal/acre. Spreader-sticker (Dynamic) was included in all spray treatments at a rate of 0.025 v/v. Insecticide efficacy was determined by counting the total number of small (1st and 2nd instars) and large (> 2nd instar) BAW and CL larvae on 25 randomly selected lettuce plants per replicate. Insect counts were conducted on 7, 12, and 17 Oct. Data were analyzed for treatment differences using ANOVA and a protected LSD.

In the 1994 test, lettuce was direct seeded into double-row beds on 12 Sep at the Yuma Valley Agricultural Center, Yuma, Az. Plots consisted of four, 45 ft long beds spaced 42 inches apart and bordered on each side by two unplanted beds. Plots were arranged in a completely randomized block design with 4 replicates. Foliar treatments were applied on 7 and 12 Oct with a CO_2-powered backpack sprayer with a two-bed boom, having one nozzle per row (TX 12 hollow cone), and delivering 20.5 gal/acre at 40 psi. Latron CS-7 spreader-sticker was applied at 0.125% v/v with all treatments. Evaluations of efficacy were made on 6, 12 and 17 Oct by selecting 15 plants per replicate, removing all leaves, and counting the total number of small (1st and 2nd instars) and large (> 2nd instar) BAW, CL and TBW live larvae. Data were analyzed for treatment differences using ANOVA and a protected LSD.

Temporal Mortality Temporal mortality of beet armyworm larvae was investigated in the 1994 test by flagging individual plants within each replicate and making daily counts of larval mortality. Four individual plants in each replicate which contained at least two live 1st or 2nd instar larvae were identified and flagged. A minimum of 8 larvae per replicate were used in the study. Following the foliar application on 7 Oct, each flagged plant was sampled by direct observation for the presence of dead, alive or absent larvae at 1,2,3,& 5 days after treatment. Larvae were considered dead if they did not respond to touch or were visibly desiccated. Larvae were considered live if they responded to touch by moving. Larvae were considered absent if they could not be found on or beneath the plant on each inspection. Data were converted to percent alive, dead or absent and transformed using an arsine transformation. Differences between each treatment and the untreated check were determined using a Dunnett's Test ($P<0.05$).

Results

Beet armyworm populations were moderate-high in the 1992 test. There were no significant differences in armyworm numbers among the treatments on the 7 Oct pretreatment sample (Table 1). All treatments contained significantly fewer larvae than the untreated check on 13 Oct. After the second and third applications, all treatments significantly reduced the number of larvae to levels less than estimated in the untreated plots. Larval populations were low-moderate during the 1993 test. There were no significant differences in the number of samll larvae among the treatments on any sample date (Table 2). There were no differences in the number of large armyworm larvae on 7 and 12 Oct. All treatments except Dipel and Agree, contained significantly fewer large larvae than the untreated check after the second application (17 oct). Populations were moderate during the 1994 test. There were no significant differences in the pretreatment (6 Oct) counts of small or large armyworm larvae (Table 3). All treatments contained significantly fewer large larvae than the untreated check following each application. No phytotoxicity was observed in any of the tests.

Temporal mortality differed significantly among the insecticide treatments. Plants treated with Lannate and Stalker contained a significantly lower percentage of live BAW larvae than the check at 1 DAT (Figure 1). In addition, a high percentage of larvae were found dead on plants treated with the low rate of Stalker (Table 4). At 3 DAT, all treatments except Javelin contained significantly fewer live larvae than the untreated check. Also, it appeared that the percentage of larvae absent from the plants was greater for the high rate of each insecticide. At 5 DAT all treatments contained fewer live larvae than the untreated check.

Discussion

In summary, the new insecticides which require some level of ingestion for toxicity, appeared to provide consistent control of BAW similar to that found with the standard rate of Lannate. However, as suspected observed mortality varied among the insecticides. Larval mortality occurred within 24 hrs after treatment with Lannate and Stalker, whereas mortality on plants treated with RH 5992 and Larvin was greatest between 2-3 days following the application. Mortality of BAW was not significant in the Javelin plots until 5 DAT and control was generally not as good as the other chemistries.

Table 1. Pretreatment and 6 AT counts of live beet armyworm larvae on lettuce treated with various insecticides, Yuma, AZ, fall 1992.

		Mean no. armyworm larvae per 25 plants							
		7 Oct		13 Oct		19 Oct		25 Oct	
Treatment	Rate[1]	small	large	small	large	small	large	small	large
Lannate 90S	1.0	3.7 a	0.2 a	0.8 a	0.2 b	0.2 c	0.0 b	0.5 a	0.0 a
Larvin 3.2E	0.9	4.7 a	0.0 a	0.0 a	0.0 b	0.0 c	0.0 b	1.0 a	0.0 a
RH 5992 70WP	0.125	5.5 a	1.0 a	1.0 a	0.0 b	0.2 c	0.0 b	0.0 a	0.0 a
Stalker 2EC	0.2	4.7 a	1.0 a	0.2 a	0.0 b	0.2 c	0.0 b	0.5 a	0.0 a
Untreated	-	3.5 a	0.5 a	1.8 a	2.3 b	3.5 a	3.3 a	0.5 a	0.3 a

Means within a column followed by the same letter are not significantly different (P=0.05, LSD).

[1] Rate expressed as lb (AI)/acre.

Table 2. Pretreatment and 5 DAT counts of live beet armyworm larvae on lettuce treated with various insecticides, Fall 1993, Yuma Valley Ag Center

		Mean no. armyworm larvae per 25 plants					
		7 Oct		12 Oct		17 Oct	
Treatment	Rate (lbs/acre)	Small	Large	Small	Large	Samll	Large
Xentari	1.0	1.0 a	1.0 a	0.2 a	0.8 a	0.0 a	0.0 b
Dipel 2X	1.0	1.0 a	0.8 a	1.8 a	1.3 a	0.5 a	0.6 a
Agree	1.0	1.8 a	0.2 a	0.8 a	0.0 a	0.2 a	1.3 a
Stalker 2E	0.2	2.0 a	1.0 a	0.2 a	0.0 a	0.0 a	0.0 b
RH 5992 70WP	0.125	1.8 a	0.8 a	1.3 a	0.0 a	0.0 a	0.0 b
Larvin 3.2EC	0.75	1.0 a	0.2 a	0.2 a	0.0 a	0.0 a	0.0 b
Control	- -	2.7 a	0.0 a	2.8 a	1.3 a	0.2 a	1.7 a

Means within a column followed by the same letter are not significantly different (P=0.05, LSD).

[1] Rate expressed as lb (AI)/acre, except for Xentari, Dipel and Agree (lb formulated product/acre).

Table 3. Pretreatment and 5 DAT counts of live beet armyworm larvae on lettuce treated with various insecticides, Fall 1994, Yuma Valley Ag Center

		Mean (±SEM) larvae per 15 plants					
		6 October		12 October		17 October	
Treatment	Rate/acre[1]	small	large	small	large	small	large
Untreated	-	4.3 a	0.3 a	3.0 a	4.7 a	0.5 a	4.1 a
Javelin WG	1.0	8.0 a	0.0 a	1.3 ab	2.3 b	0.0 a	1.1 b
Lannate WSP	0.60	3.0 a	0.3 a	0.0 c	0.3 c	0.0 a	0.0 b
RH5992 70WP	0.125	3.3 a	0.3 a	2.3 a	0.3 c	0.0 a	0.0 b
RH5992 70WP	0.060	4.3 a	0.3 a	1.3 ab	0.0 c	0.0 a	0.0 b
Larvin 3.2	0.75	2.0 a	0.3 a	0.7 bc	0.0 c	1.1 a	0.0 b
Larvin 3.2	0.45	4.7 a	1.0 a	0.3 bc	0.0 c	0.0 a	0.0 b
Stalker 2EC	0.20	4.7 a	0.3 a	0.0 c	0.0 c	0.0 a	0.0 b
Stalker 2EC	0.10	3.7 a	0.3 a	0.0 c	0.0 c	0.0 a	0.0 b

Means within a column followed by the same letter are not significantly different (P=0.05, LSD).

[1] Rate expressed as lb AI/acre except for Javelin (lb product/acre).

Table 4. Temporal mortality of beet armyworm on lettuce 1, 2, 3, & 5 days after treatment with various insecticides, Fall 1994, Yuma Valley Ag Center.

		% Beet armyworm larvae alive, dead or absent from plant											
		1 DAT			2 DAT			3 DAT			5 DAT		
Treatment	Rate[1]	alive	dead	absent	alive	dead	absent	alive	dead	absent	alive	dead	absent
Untreated	-	71	0	29	71	0	29	71	0	29	65	0	35
Javelin WG	1.0	83	0	17	83	0	17	67	0	33	17*	0	83*
Lannate WSP	0.60	14*	47	39	0*	50*	50	0*	0	100*	0*	0	100*
RH5992 70WP	0.12	67	17	17	8*	8	83*	8*	8	83*	0*	0	100*
RH5992 70WP	0.06	83	0	17	14*	20	67	14*	20	67	0*	0	94*
Larvin 3.2	0.75	18	6	77	6*	0	94*	4*	4	92*	0*	0	100*
Larvin 3.2	0.45	21	46	33	21	46*	33	4*	29	67	0*	0	100*
Stalker 2EC	0.20	0*	50	50	0*	50*	50	0*	0	100*	0*	0	100*
Stalker 2EC	0.10	0*	82*	18	0*	50*	50	0*	33	67	0*	0	100*

* treatment is significantly different from the untreated control at $P<0.05$ (Dunnett's Test).

[1] Rate expressed as lb AI/acre except for Javelin (lb product/acre).

Fig. 1. Percent survival of larvae 1, 2, 3, and 5 days after treatment (DAT) with various insecticides.