

Residual Activity of New Insecticide Chemistries Against Beet Armyworm in Lettuce

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Abstract

Three new insecticide chemistries (*Alert*, *Success* and *Confirm*) were evaluated and compared with standard chemistries for residual activity to beet armyworm in lettuce. Lettuce was treated in the field with the insecticides and left for 0, 3, 5 and 7 days. Leaves from treated plants were then brought into the laboratory where second instar beet armyworms were reared on them. Mortality was estimated 5 days after the worms were placed on the leaves. Bioassays were conducted at the thinning, heading, and harvest stages of lettuce. Under high temperature and light intensity, only *Alert* and *Confirm* provided the best residual control of beet armyworm, exhibiting good activity for about 3 days after application. *Success* had better residual activity than *Lannate*, and both were better than *Xentari*. Under cool temperatures and low light intensity conditions, *Alert*, *Confirm* and *Larvin* exhibited good activity for at least 5 days following an application, (7 days or greater for *Alert* and *Confirm*). *Lannate* and *Xentari* both had greater residual activity late in the season, but were not as effective as *Alert*, *Confirm* or *Larvin*. Late season activity of *Success* did not appear to differ much from early season observations, and did not appear to provide more than 3 days residual activity.

Introduction

Beet armyworm, *Spodoptera exiqua* (Hübner), is the most severe lepidopterous pest attacking lettuce in Arizona. Presently, pest control advisors (PCAs) and growers rely primarily on *Lannate* and *Larvin* to control these pests. Unfortunately these products are structurally very similar, and resistance to these products is of great concern. Additionally, there is concern that highly toxic and non-specific products such as *Lannate*, are being targeted by the Environmental Protection Agency for discontinuation. Identifying alternative control measures for beet armyworm is critical.

Within recent years, several new insecticides have begun development for beet armyworm control in lettuce. Unlike many of the products developed in the past, these insecticides are more target specific and more mundane to the environment. *Alert*, chlorfenapyr (American Cyanamid), is in a novel class of insecticide and has a unique mode of action. It acts as a mitochondrial poison, and disrupts the electron transport chain. Basically, it shuts down the insects power generating capabilities. Although *Alert* has contact activity and a rapid knockdown, it is most toxic after consumption. Once ingested, the insect convert the molecule into a more toxic structure. *Alert* is translaminar and will move into the leaf tissue where contacted, but is not systemic. *Alert* appears to be toxic to a broad range of lepidopterous pests and mites. Additionally, it has demonstrated good activity against several species of thrips and possibly leafminers. *Confirm*, tebufenozide (Rohm and Hass), is a unique insect growth regulator specific to lepidopterous pests and will not have any direct impact on other insect pests and beneficials. It acts by imitating the insect's molting hormone. Thus, *Confirm* is relatively slow acting, and may require up to 5 days for complete activity. However, in the interim, the worms do not feed. *Success*, spinosad (Dow), is a fermentation by-product produced by the bacterium *Saccharopolyspora spinosa*. *Success* has demonstrated good activity against a broad range of lepidopterous pests, and is effective against some species of leafminers and thrips. Like *Alert*, it has translaminar activity and will move into the leaf tissue, and is most active after ingestion. Although its mode of action is not known, it is thought to be a nerve poison. *Success* is very safe to beneficial insects and is low in toxicity to mammals. The objective of this study was to compare and document the residual activity of several new and currently available insecticides against beet armyworm larvae after they have been applied to lettuce.

Materials and Methods

Lettuce 'Desert queen' was direct seeded into double-row beds on 8 Sep at the Yuma Valley Agricultural Center, Yuma, Az. Each plot consisted of four, 30 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. The following insecticides were evaluated: Alert (American Cyanamid) at 0.15 lb-ai/A; Lannate (DuPont) at 0.75 lb-ai/A; Success (Dow Elanco) at 0.09 lb-ai/A; Larvin (Rhone Poulenc) at 0.75lb-ai/A; Confirm (Rohm and Hass) at 0.13 lb-ai/A and Xentari (Abbott) at 1.0 lb-material/A. Research conducted the past 3 years shows that the above rate for each insecticide is adequate to achieve control in field conditions. An untreated control was also replicated in the study.

Foliar applications of the treatments were made on 10 Oct (thinning stage), 25 Oct (heading stage) and 1 Dec (harvest) with a hand-held CO₂ sprayer operated at 60 psi, delivering 20 gal/ acre. Spreader-sticker (Triton-X) was included in all spray treatments at a rate of 0.25% of the total volume. Lettuce leaves that were fully expanded at application were collected at 0, 3, 5 and 7 days after treatment (DAT) and full exposure to field environmental conditions. Four leaves were collected from each plot. These leaves were transported to the laboratory where they were placed in 100x15 mm petri dishes and infested with five 2nd instar beet armyworm larvae, sealed with masking tape and held at ambient room temperature. A moist piece of filter paper was placed in the bottom of each dish to reduce leaf desiccation. To insure that the beet armyworms were not resistant to any of the insecticides tested, we obtained the beet armyworm larvae from a known susceptible laboratory strain cultured at the USDA-ARS Insectary, Stoneville, MS. Egg masses received in the mail were placed on artificial diet and allowed to hatch and develop to 2nd instars. Mortality in each petri dish was estimated every day for five days following infestation. Although we have temporal mortality for all assays conducted, only data from the 5th day of exposure will be presented. Individual worms were considered dead if they could not move about freely. Mean % mortality was calculated for each replicate by summing up the number of dead larvae and dividing by the total numbers of larvae. Data were converted to percent dead and transformed using an arcsine transformation for statistical analysis. Differences between treatments was determined using GLM and an F-protected LSD_{0.05}.

Results and Discussion

At thinning (Oct 10), when the insecticides on the lettuce were exposed to environmental field conditions for < 12 hr (0 DAT), all products were equally effective, (>98% mortality) in killing beet armyworms (Table 1, Fig 1). After 3 days of field exposure (3 DAT), Confirm and Alert were providing 90% or higher mortality. Mortality in the Larvin and Success treatments had dropped to ca. 80 and 72% respectively, and Lannate had dropped to ca. 39%. Xentari was not significantly different from the untreated. After 7 days of field exposure (7 DAT), Alert, Confirm and Larvin were providing the best residual activity, ca. 50% mortality, while none of the other treatments differed from the untreated.

At heading (Oct 25), overall residual control of beet armyworm appeared slightly greater than at thinning (Table 2). Mortality at 0 DAT was similar to the thinning stage but activity of Xentari had dropped to 66% mortality, possibly because spray coverage was reduced due to increased plant size (Table 1, Fig 1). At 3 DAT, Alert, Confirm and Larvin were still providing 100% mortality, while none of the remaining treatments differed from the untreated. Trends were similar 7 DAT, but mortality had dropped to ca. 55% for Alert, Confirm and Larvin.

When lettuce was near harvest, residual activity was greater than during the other sampling periods (Table 2). Alert and Confirm provided greater than 90% mortality for at least 7 days after application (Table 1, Fig 1). Mortality in the Xentari treatment never exceeded 70%, and by 5 DAT was not different from the untreated. Lannate exhibited good activity for 3 DAT, while Success showed moderate activity by 3 DAT. Insecticide residual activity increased for most insecticides as the season progressed, probably because light intensity and/or temperatures were lower, and insecticide degradation was reduced. Success was the only insecticide that did not seem to exhibit increased residual control later in the season.

In summary, early season, under high temperature and light intensity, Alert and Confirm appear to provide the best residual control of beet armyworm, about 3 days (Table 2). Success had better residual activity than Lannate, and both were better than Xentari. Late season, under cool, low light intensity conditions, Alert, Confirm and Larvin exhibited good activity for at least 5 days following an application, (7 or greater for Alert and Confirm). Lannate and Xentari both had greater residual activity later in the season, while Success did not appear to differ much from early season observations. Because, beet armyworms tend to lay their eggs primarily on the underside of fully or near fully expanded leaves in lettuce, insecticides providing longer residual activity should allow PCAs and growers to stretch their application intervals. However, new growth will not be protected by residual materials, and if egg laying is particularly high, the probability of beet armyworms laying eggs on new growth will be greater, particularly on young plants.

Table 1. Mean residual activity of selected insecticides to beet armyworm in lettuce after 0, 3, 5 and 7 days of field exposure (DAT¹), 1995.

Treatment ²	Thinning - Oct 10			Heading - Oct 25			Harvest - Dec 1			
	0 DAT	3 DAT	7 DAT	0 DAT	3 DAT	7 DAT	0 DAT	3 DAT	5 DAT	7 DAT
Alert	100.0a	89.7ab	51.3a	100.0a	100.0a	57.5a	100.0a	100.0a	100.0a	100.0a
Confirm	100.0a	98.8a	46.3a	100.0a	100.0a	54.6a	100.0a	98.8a	92.9a	100.0a
Lannate	98.8a	38.8d	6.3b	100.0a	55.5b	3.8b	98.8a	86.3a	44.8b	38.5c
Larvin	100.0a	80.3bc	48.8a	100.0a	100.0a	54.8a	96.3b	100.0a	97.1a	81.3b
Success	100.0a	71.9c	12.5b	93.1a	66.6b	13.8b	100.0a	65.6b	22.1c	26.6cd
Xentari	98.8a	15.6e	15.3b	65.8b	52.7b	5.6b	69.7c	47.5b	18.2c	26.0cd
Untreated	31.3b	1.3e	17.5b	15.3c	48.4b	5.0b	0.0d	6.3c	0.0c	2.8d






Means in a column followed by the same letter are not significantly different (F protected, LSD_{0.05}).

¹# DAT - number of days treated lettuce plants were exposed to field environmental conditions before being assayed.

²Alert at 0.15 lb-ai/A; Lannate at 0.75 lb-ai/A; Success at 0.09 lb-ai/A; Larvin at 0.75 lb-ai/A; Confirm at 0.13 lb-ai/A and Xentari at 1.0 lb-material/A.

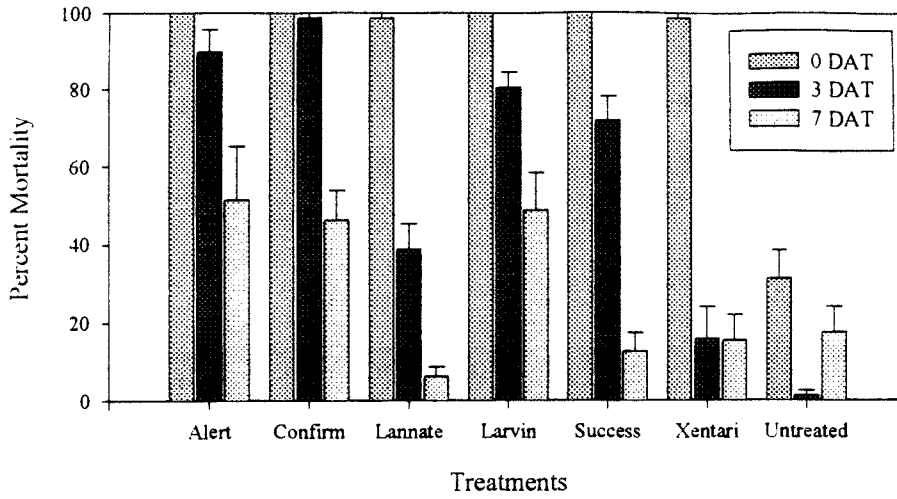
Table 2. General residual activity ratings of selected insecticides for beet armyworms on lettuce.

Treatment	Thinning - Oct 10	Heading - Oct 25	Harvest - Dec 1
Alert	Excellent	Excellent	Excellent
Confirm	Excellent	Excellent	Excellent
Lannate	Fair	Fair	Moderate
Larvin	Moderate	Moderate	Excellent
Success	Fair	Fair	Fair
Xentari	Fair	Fair	Fair

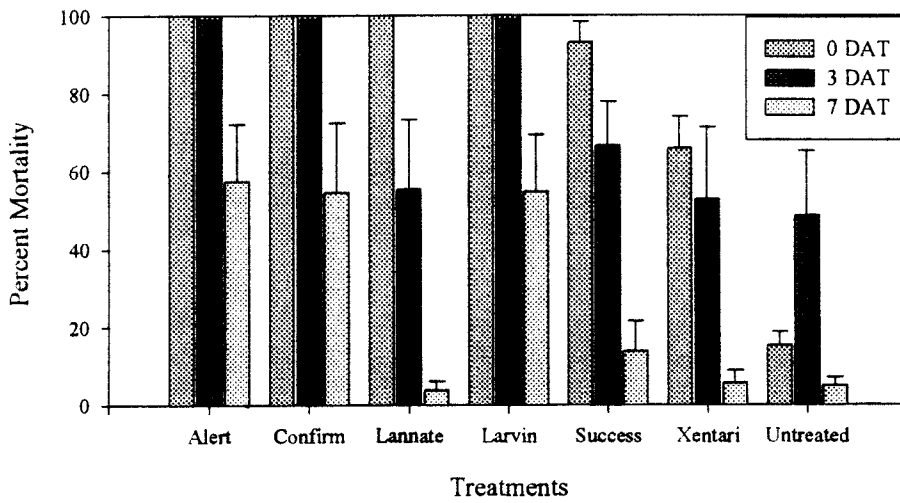
 = Excellent
  = Good
  = Moderate
  = Fair
  = Poor

ca. Excellent = >90% mortality 7 day old residue, Good = >90% mortality 3 to 5 day old residue,
 Moderate = 50 to 90% mortality 7 day old residue, Fair = 50 to 90% mortality 3 to 5 day old residue,
 and Poor = < 50% mortality 3 to 5 day old residue.

Residual Control - Thinning, Oct 10, 1995



Residual Control - Heading, Oct 25, 1995



Residual Control - Harvest, Dec 1, 1995

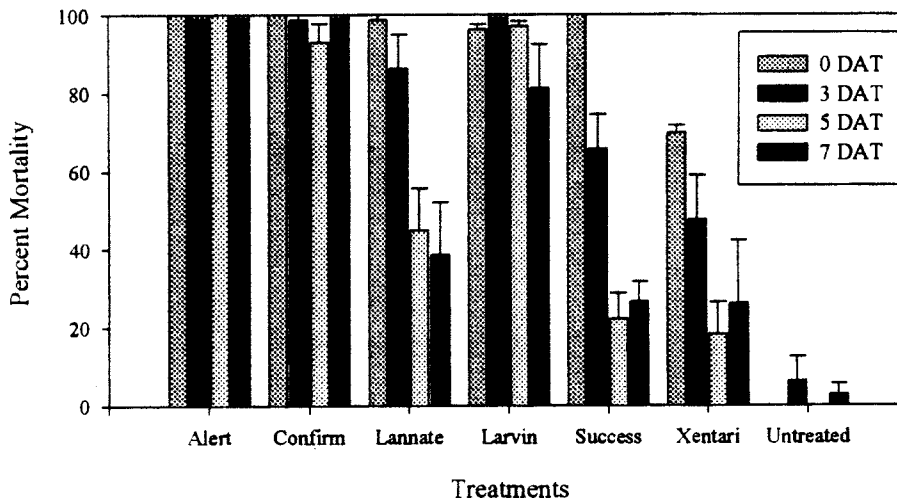


Figure 1. Residual activity of selected insecticides to beet armyworms, YAC 1995.