Evaluation of Biological Insecticides for Control of Beet Armyworm in Lettuce

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Abstract

A field study was conducted at Yuma in 1990 to examine the efficacy of several biological insecticide formulations on beet armyworm in seedling lettuce. After a single application at thinning, none of the insecticides adequately reduced larval populations below damaging levels. Reductions in plant stand by larval feeding were significantly lower in plots treated with Lannate, Javelin, Biobit and Dipel. Lettuce seedling densities were reduced greater than 80% in untreated plots.

Introduction

Beet armyworm, *Spodoptera exigua* Hubner, is an annual pest of fall lettuce grown in Arizona. Larvae are very damaging to seedling lettuce plants and if left untreated are capable of causing significant stand reductions. The action threshold for larvae is very low in seedling lettuce (0.10 larvae per plant). As a result, insecticides are frequently applied to prevent larvae from reaching damaging levels. However, public concern of pesticide use on edible vegetable commodities and threats of pest resistance to conventional insecticides has prompted the improvement of alternative pest management strategies for vegetable production. Biological insecticides, formulated from entomopathogens such as *Bacillus thurengiensis* Kurstaki (Bt), offer a potential alternative control for lepidopterous larvae. Currently several commercial formulations of Bt are available. Growers are presently integrating these insecticides into their pest management programs, but information regarding efficacy and timing are lacking.

Materials and Methods

During the fall of 1990, a field trial was established at the Yuma Valley Agricultural Center to examine the comparative efficacy of several commercial Bt formulations on beet armyworm larvae on seedling lettuce. The lettuce variety 'Empire' was direct seeded on August 15, 1990 into double row beds (12 inch spacing between rows). Plants were thinned at 8 inch intervals within rows on August 29. Plants had an average of 2 true leaves at the time of thinning. Each plot consisted of 2 beds, 30 feet in length spaced 40 inches apart and bordered on each side by an untreated bed.

Treatments were arranged in a randomized complete block design with 4 replicates. Insecticide formulations evaluated at a single rate in this study included: Biobit 32B, Cutlass WP, Javelin WG, Larvo-Bt, Dipel 2X, Karate 1EC, and Lannate 90WSP. All of the materials except Karate are currently registered for use in lettuce. A single foliar application was made at 0700 hours on August 29, coinciding with early thinning stage (2-3 leaf stage). Sprays were applied in distilled water using a CO_2-powered sprayer equipped with a 48-inch boom and 2 TX-8 TeeJet nozzles/bed delivering 20 gallons/ acre at 60 psi.

Evaluations of the efficacy were based on samples taken from each plot at 1 day pre-treatment and 4 & 7 days after treatment (DAT). Beet armyworm population density was estimated by counting the number of live larvae found in 25 randomly selected plants per replicate (100/treatment). Reduction in plant stand due to larval feeding was evaluated by counting the total number of plants per 30 row feet in 1 bed of each replicate at 4, 7 and 14 DAT.

Results and Discussion

The efficacy of the insecticides on beet armyworm larvae are shown in Table 1. Pre-treatment counts indicated that initial larval numbers were very high in seedling lettuce. Mean numbers ranged from 0.36-0.64larvae per plant, exceeding the action threshold by a 3-6 fold margin. At 4 DAT, all treatments showed a reduction in larval numbers, but only Lannate reduced the numbers below the threshold. At 7 DAT, larval numbers had not changed significantly. However, at both 4 and 7 DAT none of the biological or conventional insecticide treatments had significantly fewer larvae than the untreated check. Among the biological insecticides, Larvo-Bt had significantly more beet armyworm larvae per plant at 4 DAT than either Javelin or Cutlass.

Upon first analysis it appeared that none of the materials had a significant impact on the beet armyworm populations. This was suggested by the lack of differences in larval numbers between treatments and the untreated control. However, differences in percent stand reduction clearly indicated that a few materials had influenced the amount of feeding by surviving larvae (Table 2). After 4 and 7 days, the Biobit, Javelin, Dipel and Lannate treatments had significantly more lettuce plants per 30 row feet, ranging from 10-35 % stand reduction. At 14 DAT only Lannate and Dipel had significantly more plants than the control. In the untreated plots the lettuce stand had been reduced 80% or more at 7 and 14 DAT. These results partially explain the reduction of larvae in control plots. Larvae quickly reduced plant numbers in these plots and probably migrated into border rows and adjacent plots or dropped to the soil and pupated.

The dramatic seedling damage caused by beet armyworm in this study further indicates the need for effective control prior to and immediately following thinning of seedling lettuce. Although this study lacks replication, it does suggest two important points. First, until Bt formulations can be further evaluated under field conditions, currently registered Bt insecticides probably should not be used alone on seedling lettuce for the control of beet armyworms. Unlike most conventional insecticides, larval mortality from Bt occurs by the ingestion of Bt toxins from the plant surface. As a result, larval mortality is dependant on the insects ability to feed on leaf tissues. However, lettuce seedlings can not tolerate much larval feeding. This study also demonstrated that beet armyworms can severely reduce plant densities if lettuce is not treated at the appropriate time. Allowing the beet armyworm to exceed action thresholds 2-3 fold before initiating control, may result in unacceptable plant stands. Thus, it is important to monitor fields frequently as seedlings emerge and follow prescribed treatment guidelines when control is necessary.

Table 1. Mean number of beet armyworm larvae per plant in seedling lettuce (2 leaf stage) at 4 and 7 days after treatment with biological and conventional insecticides, Yuma, AZ, 1990.

Treatment	Rate [1]	Mean no. beet armyworm larvae per plant		
		Pre-treatment	4-DAT	7-DAT
Biobit 32B	3.0 pt	0.36 a	0.17 ab	0.10 a
Cutlass WP	2.0 lb	0.41 a	0.11 a	0.12 a
Javelin WG	1.3 lb	0.49 a	0.10 a	0.12 a
Larvo-Bt	4.5 oz	0.61 a	0.31 b	0.25 a
Dipel 2X	1.0 lb	0.64 a	0.23 ab	0.15 a
Karate 1EC	0.03 lb	0.52 a	0.12 a	0.17 a
Lannate 90WSP	1.0 lb	0.47 a	0.07 a	0.12 a
Untreated	-	0.46 a	0.20 ab	0.20 a

Means followed by the same letter are not significantly different ($P=0.05$, Tukey's)

[1] Rates for treatments are expressed as the amount of formulated product per acre except for Karate and Lannate which are expressed as lb(ai)/acre.

Table 2. Plant densities of seedling lettuce (2 leaf stage) at 4, 7 and 14 days after treatment with biological and conventional insecticides, Yuma, AZ 1990.

Treatment	Rate [1]	Mean number of lettuce seedlings / 30 row ft (% stand reduction)			
		Pre-treatment	4 DAT	7 DAT	14 DAT
Biobit 32B	3.0 pt	84.0 a	65.3 bc (23)	54.8 bcd (35)	43.0 abc (48)
Cutlass WP	2.0 lb	77.3 a	57.8 abc (26)	44.8 abc (42)	29.3 ab (61)
Javelin WG	1.3 lb	85.5 a	69.3 c (18)	56.8 bcd (34)	43.5 abc (49)
Larvo-Bt	4.5 oz	90.0 a	42.0 ab (53)	27.5 ab (70)	16.8 a (81)
Dipel 2X	1.0 lb	89.0 a	69.3 c (22)	63.5 cd (29)	49.8 bc (44)
Karate 1EC	0.03 lb	86.0 a	61.8 abc (29)	46.3 abcd (46)	33.0 ab (61)
Lannate 90WSP	1.0 lb	88.0 a	79.3 c (10)	75.0 d (15)	63.5 c (28)
Untreated	-	84.8 a	37.3 a (58)	17.8 a (80)	15.3 a (82)

Means followed by the same letter are not significantly different (P=0.05, Tukey's)

[1] Rates for treatments expressed as the amount of formulated product per acre except for Karate and Lannate which are expressed as lb(ai)/acre.