Biological insecticides in controlling diamondback moth, *Plutella xylostella* (Lepidoptera: Plutellidae) on cabbage in south Florida

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Abstract

Peptides are important and safe tools for combating insect pests. Much research studies need to be conducted to understand the fit of peptides in the modern IPM system. Peptides in rotation with Radiant showed significant reduction of DBM larvae in the present study. Similar result was obtained when peptide was rotated with peptide. Peptides also reduced DBM feeding damage as compared to the untreated control and other treatments. Peptide in combination or rotation with other biological products (Leprotec, and Xentari) performed effectively as the all-conventional rotation (Torac and Knack).

Introduction

Diamondback moth (DBM), *Plutella xylostella* is a economically important pest of all cruciferous crops. If suitable control is not undertaken, the yield loss caused by this insect pest may be up to 100% (Sudarwohadi 1975). Growers use insecticides to manage this pest. However, DBM developed resistance to many of those insecticides leaving only a few which can control this pest. We have therefore been trying to use biological insecticides which are fairly new and require lot of research studies to evaluate thaeir efficacy in controlling DBM. In the present study, we will evaluate some peptide and *Bacillus thuringiensis*- based products to control diamondback moth.

Materials and Methods

We conducted three studies in the research plots of University of Florida-IFAS, Tropical Research and Education Center, Homestead, FL. Plot Size in all studies was 25 ft long one bed replicated four times. Plots were separated by a nonplanted 5 ft area. Plant spacing was one foot within the bed and three feet in between bids. All other practices to maintain plants were as mentioned in the Vegetable Handbook. In the first study, we evaluated effectiveness of Spear-Lep (GS-Omega/Kappa-Hxlx-Hvla), a fermentation product manufactured for Vestaron Corporation, in combination with Leprotec (Bacillus thuringiensis ssp. Kurstaki strain and compared that with Spear-Lep in combination with Xentari and untreated control. Evaluation of parameters were made by counting the number of DBM larvae and feeding damage/ plant for five randomly selected plants/plot.

In the second study, we rotated peptide with Radiant (peptide with conventional), Radiant with Proclaim (all conventional), Radiant alone, and no conventional where Spear -Lep was used in rotation with Basin (U1-AGTX-TA1b-QA). Evaluation of parameters were same as the first study.

In the third study, we applied Torac (Tolfenpyrad) and Dipel (Bt sp. Kurtstaki) alone and also in rotation. We evaluated treatments by counting larvae/plant.

In all above studies, all treatments were applied four times at weekly intervals.

Table 1. Mean number of DBM larvae on cabbage plants treated with Vesteron Bt-strains on different sampling dates

Treatment*	No.	Rate/acre	Mean number of DBM larvae/plant: 26 Apr pre-spray	29 Apr	6 May	13 May	20 May	27 May
Untreated	**1**		5.25ab	6.05a	5.20a	1.20a	0.45a	1.00a
Spear-Lep Leprotec	**2**	2.0 pt 0.25pt	4.75ab	2.30bc	4.30a	0.45bc	0.25ab	0.00b
Spear-Lep Leprotec	**3**	2.0 pt 0.50 pt	6.45a	3.90ab	3.10ab	0.55bc	0.05b	0.05b
Spear-Lep Leprotec	**4**	2.0 pt 0.75 pt	4.10b	3.00bc	2.85ab	0.60b	0.05b	0.20b
Spear-Lep Leprotec	**5**	2.0 pt 1.0 pt	4.55ab	3.10bc	1.95bc	0.15cd	0.20ab	0.05b
Spear-Lep Xentari	**6**	2.0 pt 0.50 lb	5.95a	2.15bc	1.30c	0.25b-d	0.15ab	0.05b
Spear-Lep Xentari	**7**	2.0 pt 1.0 lb	5.85ab	2.30c	1.15c	0.00d	0.00b	0.05b
Torac in rotation Knack	**8**	21.0 oz 8.0 oz	6.65a	4.00bc	0.80c	0.10cd	0.00b	0.20b

Means within a column followed by a same letter do not differ statistically (P > 0.05; DMRT).

* Dyne-Amic @ 0.125% v/v on all treatments

Table 2. Mean rating of DBM feeding damage on cabbage foliage treated with Vesteron Bt-strains on different sampling dates

Treatment*	No.	Rate/acre	Mean feeding damage rating/treatment plot: 29 Apr	6 May	13 May	20 May	27 May
Untreated	**1**		1.05a	1.12a	0.62ab	0.75a	0.87a
Spear-Lep Leprotec	**2**	2.0 pt 0.25pt	0.50b	0.75a	0.87a	0.42a-c	0.00c
Spear-Lep Leprotec	**3**	2.0 pt 0.50 pt	0.92ab	0.62a	0.50ab	0.12cd	0.12c
Spear-Lep Leprotec	**4**	2.0 pt 0.75 pt	1.00a	0.50a	0.37ab	0.25b-d	0.25c
Spear-Lep Leprotec	**5**	2.0 pt 1.0 pt	0.75ab	0.75a	0.27ab	0.52ab	0.12c
Spear-Lep Xentari	**6**	2.0 pt 0.50 lb	0.60ab	0.62a	0.57ab	0.57ab	0.15c
Spear-Lep Xentari	**7**	2.0 pt 1.0 lb	0.75a	0.62a	0.12b	0.00d	0.32bc
Torac in rotation Knack	**8**	21.0 oz 8.0 oz	0.82ab	0.37a	0.27ab	0.05d	0.65ab

Means within a column followed by a same letter do not differ statistically (P > 0.05).

* Dyne-Amic @ 0.125% v/v on all treatments

Table 3. Mean number of DBM Larvae on cabbage plants treated with Vestaron peptide formulations on different sampling dates

reatment	No.	Rate/acre	Mean number of DBM larvae: pre-count	7dat1	14dat1	21dat1	28dat1	35dat1
ntreated	1		5.25a	5.55a	5.20a	1.20a	0.45a	1.00a
roclaim rotation adiant	2	4.8 oz.wt 8.0 fl oz	5.40a	2.00c	0.50b	0.00c	0.00b	0.00b
pear-Lep + eptrotec rotation adiant	3	2.0 pt 1.0 pt 8.0 fl oz	6.35a	2.25c	0.45b	0.00c	0.10b	0.00b
ST7300 + eprotec rotation adiant	4	18 g a.i. 1.0 pt 8.0 fl oz	6.10a	2.40bc	0.60b	0.10c	0.00b	0.00b
adiant	5	8.0 fl oz	5.20a	0.60d	0.30b	0.00c	0.05b	0.00b
pear-Lep + eprotec rotation ST7300 + eprotec	6	2.0 pt 1.0 pt 18 g a.i. 1.0 pt	6.30a	4.10ab	3.70a	0.50b	0.15ab	0.25b
ST7300 + eprotec rotation pear-Lep + eprotec	7	18 g a.i. 1.0 pt 2.0 pt 1.0 pt	6.55a	2.85bc	1.25b	0.10c	0.20ab	0.00b

Means within a column followed by a same letter do not differ statistically.

* Dyne-Amic @ 0.125% v/v on all treatments

Table 4. Mean rating of DBM feeding damage on cabbage foliage treated with Vestaron peptide formulations on different sampling dates

Treatments	Rate/acre	Mean feeding damage rating: 29 April	6 May	13 May	20 May	27 May
Untreated		0.37ab	1.50a	1.00a	0.75a	1.25a
Proclaim In rotation with Radiant	4.8 oz 8.0 oz	0.65a	0.37bc	0.12b	0.00b	0.00b
Spear-Lep + Leptrotec In rotation with Radiant	2.0 pt 1.0 pt 8.0 oz	0.42ab	0.12c	0.00b	0.12b	0.00b
VST7300 + Leprotec In rotation with Radiant	18 g a.i. 1.0 pt 8.0 oz	0.40ab	0.00c	0.00b	0.00b	0.00b
Radiant	8.0 oz	0.22b	0.00c	0.00b	0.00b	0.00b
Spear-Lep + Leprotec In rotation with VST7300 + Leprotec	2.0 pt 1.0 pt 18 g a.i 1.0 pt	0.17b	0.75a	0.00b	0.12b	0.12b
VST7300 + Leprotec In rotation with Spear-Lep + Leprotec	18 g a.i 1.0 pt 2.0 pt 1.0 pt	0.30ab	0.25a	0.00b	0.12b	0.12b

Means within a column followed by a same letter do not differ statistically (P > 0.05; DMRT).

Table 5. Mean number of DBM larva/cabbage plant on different sampling dates treated with Torac and DiPel

Treatment	Rate/acre	15 April	22 April	29 April	6 May
DiPel	2.0 lb	0.05b	0.00b	0.10b	2.50a
Torac	21.0 oz	0.10b	0.00b	0.00b	0.00b
Torac DiPel	21.0 oz 2.0 lb	0.00b	0.00b	0.00b	0.00b
Untreated		1.00a	2.80a	4.90a	4.85a

Means within a column followed by a same letter do not differ statistically (P > 0.05; DMRT).

* Dyne-Amic @ 0.25% v/v on all treatments.

DBM damage on cabbage

DBM larvae on cabbage

Results and Discussion

Study 1

DBM larvae (Table 1): Population abundance of DBM was medium on cabbage during this study (pre-spray sample). On the *pre-spray* sampling date (26 April), mean number of DBM in different plots did not differ statistically. On the *first post spray* sampling date (29 April), all insecticide treatments, except Treatment 3 containing Spear-Lep (2.0 pt/A) plus Leprotec (0.50 pt/A), significantly reduced mean number of DBM/plant as compared to the untreated control. On the *second post spray* sampling date (6 May), Treatments 2, 3 & 4 having Leprotec 0.25 pt to 0.75 pt/A did not differ from the untreated control in the mean numbers of DBM/plant. However, all other treatments provided significant reduction of DBM larvae per plants as compared to the untreated control. On the *third post spray* sampling date (13 May), all insecticide treatments significantly reduced DBM larvae when compared with the untreated control. On the *fourth post spray* sampling date (20 May), treatments containing Leprotec at 0.25 and 1.0 pt/A (Treatments 2, 5), and Spear-Lep + Xentari Bta low (Treatment 6) did not differ from the control in the mean number of DBM larvae. Other treatments had significantly fewer DBM larvae than the untreated control. On the *fifth post spray* sampling date (27 May), all insecticide treatments significantly reduced DBM larvae as compared to the untreated control. Btk (Leprotec) and Bta (Xentari), irrespetive of rates, almost performed similar in controlling DBM larvae.

DBM Feeding damage rating (Table 2): On the *first post spray* sampling date (29 April), mean feeding damage rating scores for different treatment plots did not differ from the untreated control, except in Treatment 2 containing Spear-Lep at 2 pt/A + Leprotec at 0.25 pt/A (Table 3). On the *second (May 6) and third (May 13) post spray sampling dates*, insecticide treatments did not differ from the untreated control in the mean rating of feeding damage. On the *fourth post spray* sampling date (May 20), Treatments containing Leprotec 0.50 pt, Leprotec 0.75 pt/acre and Xentari at 1.0lb/A, respectively; and Torac/Knack containing treatment significantly reduced foliage damage as compared to the untreated control; other treatments did not. On the *fifth sampling* date (27 May), all treatments, except Torac-Knack, had significantly reduced feeding damage as compared to the control plants.

Study 2

DBM larvae (Table 3). Population abundance of DBM was medium on cabbage during this study (Table 3, pre *spray sample*). On the *pre-spray sampling* date (26 April), mean number of DBM larvae among different treatment plots did not differ statistically (Table 3). On the *first post spray* sampling date (29 April), all treatments containing Radiant significantly reduced DBM larvae as compared to the untreated control. Among the other treatments, mean number of DBM larvae in the peptide program 2/Trt. no. 7) where Basin was used on the 1st and 3rd spray and Spear-Lep was used on the 2nd and 4th spray) was significantly fewer than the control, but peptide program 1/Trt. No 6 (Basin: 2nd and 4th spray and Spear-Lep: 1st and 3rd spray) did not differ from the control. On the *second post spray* sampling date (6 May), the effect of different treatments on DBM larvae mirrored the first post spray sampling. On the *third post spray* sampling date (May 13), all treatments performed similar to Radiant showing significant reduction in the mean number of DBM larvae as compared to the untreated control. On the *fourth post spray* sampling date (20 May), all treatments, except peptide programs 1 and 2 (Treatments 6 & 7), had significantly fewer larvae than the untreated control. On the fifth sampling date (27 May), all treatments significantly reduced DBM larvae as compared to the untreated control.

DBM Feeding damage rating (Table 4): On the *first post spray* sampling date (29 April), feeding damage rating among treatments did not differ significantly from the untreated control (Table 3). On the *second post spray* sampling date (6 May), all insecticides, except peptide programs (Treatment 6 & 7), had significantly lower mean rating than the untreated control. On the third, fourth and fifth *post spray* sampling dates, all insecticide treatments significantly differed from the untreated control in the mean rating of DBM feeding damage.

Study 3

DBM larvae. Population abundance of DBM was medium (1-5 larvae/plant) on cabbage during this study. On the first sampling date (15 April), all insecticide treatments (Torac and Dipel) significantly reduced DBM larvae as compared to the nontreated check (Table 1). On the second sampling date (22 April), DBM larvae were absent on all treated plants and was significantly fewer than the nontreated check. On the third sampling date (29 April), DiPel treated plants had few larvae (0.10 plants/plant), although did not differ statistically from the Torac treated plants. All treatment plants had significantly fewer larvae than the untreated control. On the fourth sampling date (6 May), DiPel alone treated plants did not differ from the untreated control in the mean number of DBM larvae; other two treatments containing Torac did not have any larvae.

In summary, peptide based biological insecticides are effective in controlling populations of DBM in cabbage. This group of insecticides are safe to our environment and should be included in our commercial pest management program.

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