Mating Disruption of Beet Armyworm in Lettuce by Synthetic Pheromone

David L. Kerns, Tony Tellez and Jeff Nigh

Abstract

The beet armyworm pheromone dispenser, Yotoh-con-S, was evaluated for its ability to inhibit mate location and subsequent population growth of beet armyworm in head lettuce. Pheromone dispensers were very effective in preventing male beet armyworm moths from locating point pheromone sources. Pheromone dispensers also appeared to result in an approximately 75 % reduction in beet armyworm larvae relative to untreated fields.

Introduction

Beet armyworm, *Spodoptera exiqua* (Hübner) (BAW), is one of the most serious lepidopterous pest attacking lettuce in Arizona. Presently, pest control advisors (PCAs) and growers rely primarily on Lannate (methomyl) or Larvin (thiodicarb) to control this pest. However, these products have limited utility. In recent years, high level of resistance to Lannate has led to control failures in portions of Yuma County, and at normal use rates, Larvin is limited to two applications. Although, several new insecticide chemistries are been developed for control of BAW in lettuce, there is much interest in non-insecticide biorational approaches to pest control in lettuce.
The objective of this study was to collect preliminary data on the ability of Yotoh-con-S BAW phermone dispenser (Shin-Etsu Chemical Co,. Ltd.) to disrupt mate location and copulating of BAW in head lettuce, and to determine if mating disruption results in a decrease in BAW populations.

Materials and Methods

The test site consisted of two approx. 50 acre phermone treated fields of head lettuce grown by the Barkley Co. of Arizona, located in the South Gila River Valley in Yuma. The lettuce was grown in double rows on 40-in beds. Each field was split to form two replicates (231E - 231W and 232E - 232W), for a total of four replicates. Each replicate was treated independently as needed for insect pests.

The Yotoh-con-S phermone is a brown 20-cm long "twist tie" dispenser, consisting of a polyethylene tube with an aluminum wire. The tube contains approximately 160 mg of a 70:30 blend of (Z,E)-9, 12-tetradecadien-1-ol acetate and (Z)-9-tetradecen-1-ol acetate. To prevent the pheromone dispensers from coming in contact with the ground or the lettuce, they were attached to 18-in long by 0.25-in wide bamboo splits. The phermone dispensers were attached by twisting them around the top 4-in of the bamboo split. The phermones were applied when approximately at thinning on 3 Oct in field 232 and 17 Oct in field 231, by inserting the bamboo split approximately 5-inches into the soil in the seed line. The bamboo splits with phermone dispensers were uniformly distributed in the fields at a rate of 100 pheromone dispensers per acre. It required 30 people approximately 45 minutes to apply the pheromones in each replicate.

Pheromone traps were used to determine whether or not the male beet armyworm moths could locate a pheromone

point source in the pheromone treated fields and in untreated check areas. Yellow/white/green Unitrap pheromone bucket traps (Agrisense/Biosys) were used to trap the male moths. Eight bucket traps were placed in each pheromone treated field, and 20 buckets were placed in the surrounding untreated areas. Buckets in the untreated areas were arranged in groups of five distributed approximately 1.0 mi. north, south and west, and 0.5 mi east of the pheromone treated fields. Each of the four directions constituted a replicate. The buckets at each of the untreated replicates were spaced approximately 0.2-mi apart and oriented parallel to the pheromone treated fields. Traps in the pheromone treated fields were placed inside the field approximately 166 ft. from the edge and were uniformly spaced within each replicate. In the untreated areas, the traps were located on the edges of lettuce fields. Pheromone traps were placed in field 232 and 231 on 4 Oct and 11 Oct respectively. Traps were placed in the untreated areas on two separate occasions, two traps were placed in each of the four untreated replicates on 4 Oct. The other three traps were added to each location on 18 Oct.

The bucket traps were baited with BAW pheromone (rubber septa, Trece, Inc.). Bucket lures were replaced every 2 weeks throughout the evaluation period. Each bucket trap contained a 1 by 3-inch Vapona strip to kill captured moths. The bucket traps were supported by 4 ft long 0.25-in thick metal rods with a hook on the end. The bar was inserted approximately 1 foot into the soil, so that the bucket was suspended about 3 feet off the ground. Moths were collected from the bucket traps on 11, 18 and 25 Oct, and 1, 15, 22 and 29 Nov, and 5 Dec. However, all traps were not in place until 11 Oct. Thus, data from the 11 Oct collection was not included in the data analysis.

BAW populations were estimated by counting the numbers of egg masses and small (1st and 2nd instar), medium (3rd instar) and large (4th and 5th instar) larvae from 100 plants per replicate. Lettuce fields located about 1.0 mile north, south and west, and 0.5 mile east of the pheromone treated field each served as an untreated replicate for BAW infestation estimations. BAW population estimates were made on 14, 21 and 28 Oct, and 4, 19 and 26 Nov. However, because pheromone dispensers were not place in field 231 until 18 Oct, and field 232 and the north check field were harvested on 20 Nov, only data from 21 and 28 Oct, and 4 and 19 Nov were included in the data analysis.

All data were transformed using a $\log_{10}$ transformation for analysis (non-transformed values presented). These data were analyzed using pairwise T-tests.

Results and Discussion

Trap Counts

Trap counts from traps within the pheromone treated fields were significantly lower than from traps located outside the treated area on all collection dates (Table 1), indicating that the pheromone dispensers were effective in preventing male BAW moths from finding a pheromone point source. Thus, suggesting that mating within the pheromone treated field would be disrupted.

BAW Population Counts

Differences in BAW population estimations were detected only on 28 Oct. (Table 2). On 28 Oct, the number of small BAW larvae and total (small + medium + large larvae) in the pheromone treated fields were significantly lower than in the untreated area. The pheromone treated area contained 76.92 and 73.68 % fewer small and total BAW larvae respectively than the untreated areas. Prior to the Oct 28 evaluation, field 231 was treated with insecticides on Oct 19, while field 232 had not been treated for several weeks. Thus, the low numbers of BAW in the pheromone treated fields was not due to insecticides.

Differences in BAW populations on other sample dates were not significantly different probably because the untreated areas were being treated for BAW on a regular basis. However, because these fields did not belong to the Barkley Co. of Arizona, we could not obtain spray application records to confirm our supposition.

Overall, the Yotoh-con-S BAW phermone dispenser did appear to disrupt BAW mating which appeared to result in

a decrease in BAW population densities in the treated area. An approximate 75 % reduction in BAW populations is commercially significant during late October when traditionally BAW populations are not severe, and appeared to reduce the need for insecticide applications targeting BAW. However, a true test of the ability of these dispensers would be better evaluated in September and early October, when BAW population are normally 5 to 10-fold those of late October. BAW are rarely the only lepidopterous pest present in lettuce in Arizona at an one time. Insecticide applications targeting BAW are almost always also targeting cabbage looper, *Trichoplusia ni* (Hübner) and sometimes Heliothinae. An evaluation of a cabbage looper pheromone dispenser in combination with the BAW pheromone dispenser would greatly enhance the fit of this technology in lettuce production in Arizona.

Table 1. Mean ± SEM number of BAW moths trapped in seven day periods in bucket pheromone traps in pheromone treated and untreated lettuce.

Treatment	25 Oct[1]	1 Nov	8 Nov	15 Nov	22 Nov
Phermone	0.13 ± 0.07	0.50 ± 0.23	0.06 ± 0.06	0.06 ± 0.06	0.00 ± 0.00
Untreated	43.90 ± 18.53	49.95 ± 22.71	63.35 ± 17.73	40.90 ± 12.78	10.50 ± 3.15
t, df, P	8.38, 6, 0.0002	6.88, 6, 0.0005	12.09, 6, <0.00001	12.40, 6, <0.00001	9.33, 6, 0.0001

Data were transformed using a $\log_{10}$ transformation for analysis (non-transformed values presented). These data were analyzed using pairwise T-tests.
[1]Collection date.

Table 2. Mean ± SEM number of BAW egg masses, small, medium and large larvae, and total larvae per 100 plants in pheromone treated and untreated lettuce.

			28 Oct		
Treatment	eggs	sm. lar.	med. lar.	lg. lar.	total lar.
Pheromone	0.00 ± 0.00	0.75 ± 0.25	0.50 ± 0.29	0.00 ± 0.00	1.25 ± 0.48
Untreated	1.00 ± 0.58	3.25 ± 0.63	1.25 ± 0.48	0.25 ± 0.25	4.75 ± 1.03
t, df, P	1.73, 6, 0.13	3.99, 6, 0.007	1.15, 6, 0.30	1.00, 6, 0.36	3.08, 6, 0.02
			4 Nov		
Pheromone	0.00 ± 0.00	0.50 ± 0.29	0.50 ± 0.29	0.00 ± 0.00	1.00 ± 0.41
Untreated	0.00 ± 0.00	3.75 ± 3.09	0.75 ± 0.48	0.00 ± 0.00	4.50 ± 2.90
t, df, P	N/A	1.09, 6, 0.32	0.30, 6, 0.77	N/A	1.12, 6, 0.31
			19 Nov		
Pheromone	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.25 ± 0.25	0.25 ± 0.25
Untreated	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.50 ± 0.29	0.50 ± 0.29
t, df, P	N/A	N/A	N/A	0.66, 6, 0.54	0.66, 6, 0.54

All data were transformed using a $\log_{10}$ transformation for analysis (non-transformed values presented). These data were analyzed using pairwise T-tests.

Table 3. Insecticide use in the pheromone treated fields during the evaluation period.[1]

Date of Application	Field 231	Field 232
Oct 19	Xentari at 1.5 lbs/A + Thiodan 3EC at 1.3 qts/A	NA[2]
Nov 09	Xentari at 1.5 lbs/A + Mustang 1.5EW at 4 ozs/A + Pounce 3.2EC at 6.7 ozs/A	Xentari at 1.5 lbs/A + Mustang 1.5EW at 4 ozs/A + Pounce 3.2EC at 6.7 ozs/A

[1]Insecticides applied in pheromone treated areas since Oct 17. Data not available for surrounding non-pheromone fields.
[2]No insecticides applied.