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Research Note

A Field Comparison between a Bioencapsulated Formulation of *Bacillus thuringiensis* var. kurstaki and Permethrin for Cabbage Looper Control and Impact on Looper Parasitoids in Fresh Market Cabbage

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ABSTRACT

A field study was conducted in fresh market cabbage to determine the efficacy of bioencapsulated *Bacillus thuringiensis* var *kurstaki* based on the Cellcap ™ system (MVP bioinsecticide) and permethrin (Pounce) for control of the cabbage looper, *Trichoplusia ni* (Hubner), by comparing marketable yields. Two blocks of 0.30 ha (0.75 acres) within a 0.81 ha (2.0 acre) field were treated every seven days (3 applications late season) in a comparative study with either MVP at 4.73 liters/ha (2 quarts of product/acre) or Pounce at 0.11 kg a.i./ha (0.10 lbs. a.i./acre). Harvest yields from each treatment block were taken at maturity and graded into 14-count and 18-count carton sizes and weighed. There was no significant difference in marketable yield with harvests of 16,592 kg (36,580 pounds) in the MVP block and 16,252 kg (35,830 pounds) in the Pounce block. A postharvest sampling of cabbage looper larvae and pupae was conducted to determine parasitoids and their percent parasitization. Two parasitoids were recovered with *Voria ruralis* (Fallen) predominating and a few *Microplitis brassicae* (Muesebeck) also recovered. The percent parasitization in the MVP block was 45.9% (78 parasitoids/170 larvae and pupae) and 25.0% (42 parasitoids/168 larvae and pupae) in the Pounce block. This study showed that the bioinsecticide provided cabbage looper control which was equivalent to the synthetic chemical standard based on marketable yields while having the least impact on the beneficial complex which is an essential component of an IPM program.

RESUMEN

Se realizó un estudio de campo en repollo destinado a la venta en fresco para determinar la eficacia de la bacteria *Bacillus thuringiensis* var. *kurstaki* bioencapsulada en base al sistema de Cellcap ™ (bioinsecticida MVP) y de permethrín (Pounce) para el control del gusano medidor de la col *Trichoplusia ni* (Hubner), mediante la comparación de los rendimientos de cosecha apta para mercado. Dos bloques de 0.30 ha (0.75 acres) dentro de un campo de 0.80 ha (2.0 acres) se trataron cada 7 días (3 aplicaciones en la estación tardía) en un estudio comparativo con MVP a una dosis de 4.73 liters/ha (2 cuartos de galón del producto por acre) o de Pounce a 0.11 kg a.i./ha (0.10 libras de i.a. por acre). La producción en cada bloque se cosechó al alcanzar la madurez, se clasificó en tamaños de acuerdo a su acomodo en cajas de cartón de 14 o 18 piezas y se pesó. No hubo diferencia significativa en los rendimientos en el mercado con cosechas de 16,592 kg (36,580 libras) en el bloque de MVP y 16,252 kg (35,830 libras) en el bloque de Pounce. Un muestreo postcosecha de las larvas y pupas del gusano medidor fué realizado para determinar la presencia de parasitoides y su porcentaje de parasitación. Se recobraron dos parasitoides, predominando *Voria ruralis* (Fallen) encontrándose pocos ejemplares de *Microplitis brassicae* (Muesebeck). El porcentaje de parasitación en el bloque de MVP fue 45.9% (78 parasitoides/170 larvas y pupas) y 25% (42 parasitoides/168 larvas y pupas) en el bloque de Pounce. Este estuduio mostró que en base a los rendimientos de mercado, el bioinsecticida poporcionó un control para el gusano medidor que fué equivalente al control químico sintético común, mientras que, tuvo un menor impacto sobre el complejo benéfico, componente esencial de un manejo de control integrado de plagas.

The cabbage looper, *Trichoplusia ni* (Hubner), has been the key insect pest affecting cabbage production in Lower Rio Grande Valley (LRGV), Texas since the 1950's (Schuster, 1959). Considerable difficulty has been reported by growers in controlling the cabbage looper by the use of many different classes of insecticides including bioinsecticides. Wene (1958) reports reducing severe cabbage looper infestations of an average of one or more loopers per plant to be very difficult. When cabbage is in an advanced stage of growth, Wene (1958) reports that 70% control is usually all that can be expected from synthetic chemical treatments. The cabbage looper has many natural enemies which suppress it's populations but they are adversely impacted by synthetic chemical insecticides. In theory, Integrated Pest Management (IPM) programs should conserve these natural enemies with pest selective insecticides which do not greatly impact these natural enemies.

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MATERIALS AND METHODS

This sudy was conducted to determine whether new biological insecticides such as MVP bioinsecticide (which is based on Mycogen's Cellcap™ bioencapsulation system that contains the *Bacillus thuringiensis* var. *kurstaki* biotoxin in killed *Pseudomonas fluorescens*) are as effective as standard synthetic chemicals such as permethrin (Pounce) and to determine their impact on beneficial insects. A two acre cabbage (var. Grand Slam) field near Alamo, Texas was selected. Although it had received one application of esfenvalerate (Asana) on February 1, 1991, a large looper population (0.85 loopers per plant from a 20 plant sample) was present in March. Two 0.30 ha (0.75 acre) blocks of cabbage separated by 0.20 ha (0.50 acre) buffer were treated with either MVP at 4.73 liters/ha (2 quarts of product/acre) or Pounce at 0.11 kg a.i./ha (0.10 lbs. a.i./acre) on March 14, 21 and 28. The blocks, which were near maturity (12 leaves with head formation), were sprayed using a 6-bed sprayer equipped with 4 hollow cone nozzles (Spraying Systems Co. TX-10) per bed arranged as two over the top and two dropped. The sprayer delivered 454 liters/ha (48 gallons per acre) and a surfactant, Bond®, was added to each treatment at 1 liter of product/800 liters of water (1 pint of product/100 gallons of water). The blocks were harvested with a commercial crew on April 1. The yields were graded into 14-count and 18-count carton sizes and weighed at a nearby truck scale. Cabbage looper larvae and pupae were collected individually after harvest to determine parasitoids and their percent parasitization.

Table 1. Yield of cabbage treated with MVP or permethrin. Alamo, TX 1991

	14 count cabbage (kg)	14 count cabbage (lbs.)	18 count cabbage (kg)	18 count cabbage (lbs)	Total (kg)	Total (lbs.)
MVP	6,609[z]	14,570	9,984	22,010	16,592	36,580a
Permethrin	7,062	15,570	9,190	20,260	16,252	35,830a

[z] Means within a column not followed by a common letter are significantly different (P=0.05) according to Duncan's New Multiple Range Test.

RESULTS AND DISCUSSION

Although there was no significant difference in marketable yields with harvests of 16,592 kg (36,580 lbs.) in the MVP block and 16,252 kg (35,830 lbs.) in the Pounce block (Table 1), this study showed the bioinsecticide provided cabbage looper control equivalent to the synthetic chemical standard. No larval counts were taken during the field study in the two blocks because they were being evaluated in small plot trials. In the small plot larval count trial, Pounce provided 86.0% control of loopers but was not statistically different (Duncan's New Multiple Range Test; $P>0.05$) during specific sampling dates, than MVP which provided 75.3% control (Anciso unpublished data.) In general, synthetic pyrethroids such as Pounce provide better control than *Bacillus thuringiensis* (B.t.) based products or other classes of insecticides on cabbage loopers but often not statistically different. Also, it is generally difficult to interpret yield (if a destructive sampling technique for larval counts is used) from small plot trials. Therefore, this larger scale study was conducted to look at marketable yield since a decreased level of control may still give equivalent marketable yields. Although the blocks were not replicated and no yield was harvested from the 0.20 ha (0.50 acre) buffer (check), the information provides a reference for comparison. Further studies are needed since additional information would strengthen grower confidence in using B.t. based products for cabbage looper control.

An average of 45.9% parasitization (78 parasitoids/170 larvae and pupae) was found in the MVP block and 25.0% (42 parasitoids/168 larvae and pupae) in the Pounce block. This represents a 45.5% reduction of parasitization in the synthetic chemical standard block. Two parasitoids were recovered which included the tachinid fly, *Voria ruralis* (Fallen) and a braconid, *Microplitis brassicae* (Muesebeck). Although these two parasitoids have been reported in the LRGV on *Heliothis zea* (Boddie) and *Heliothis virescens* (Fab.) during a systematic survey in 1969-73 (Harding 1976), there is no record of parasitoids of *T. ni* in the LRGV. These two parasitoids are known to commonly attack *T. ni* in many other parts of the United States (Flint, 1987; Quick, 1984).

The use of B.t. based products for cabbage looper control has not been widely accepted by LRGV growers because synthetic pyrethroids have proven to be cost-effective for cabbage looper control (approximately $6.00 per 0.40 ha (acre) with >80% control) when compared to B.t.'s (approximately $15.00 per 0.40 ha (acre) and 60-80% control). However, the results indicate that the benefits of comparable marketable yields and approximately twice as much parasitization in the B.t. block supports B.t. use for cabbage looper control in an IPM program. With the cabbage looper being the key pest throughout the cabbage season, products that are not nearly as disruptive on the natural enemies yet effective on loopers must be incorporated because of the problems that have surfaced with the diamondback moth, *Plutella xylostella* L., and potential resistance problems with the only chemical class that remains highly effective against the cabbage looper.

A resistance management strategy for the diamondback moth (DBM) can not be properly maintained without first addressing a cabbage looper control strategy in the LRGV. Since the DBM has demonstrated an ability to develop resistance under field conditions to synthetic chemical insecticides in the LRGV (Magaro and Edelson 1990), the prophylactic use of synthetic pyrethroids to control cabbage loopers early in the season will initiate the selection pressure for resistance in the DBM population that is surely present even though not problematic as well as the cabbage looper population. Also, several natural enemies of the DBM that exist in the LRGV (Anciso and Quick, 1990) would be adversely impacted and lead to the release of a pest that is considered to be of secondary status.

A cabbage looper control strategy and DBM resistance management strategy should utilize pest selective biological insecticides such as B.t. products during early season (until cupping or small head formation) provided good coverage is achieved and infestation levels are not heavy. In order to prevent excessive use of B.t. products that would create a possible B.t. resistant DBM population, growers can change or rotate to the synthetic chemicals in the mid- to late season for DBM and cabbage looper control. This strategy in an IPM program will provide early looper control while keeping the number of synthetic chemical applications down to a minimum and avoid control failures due to resistance problems to synthetic chemicals by both pests.

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