Field Evaluation of Efficacy of Bioinsecticides against the Diamondback Moth on Chinese Kale in Chiang Mai

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ABSTRACT

The diamondback moth (DBM), Plutella xylostella (L.), is considered to be the most serious pest by both Brassica seed and fresh market growers in north and northeast Thailand. The insect exhibits high resistance to organophosphorous group, synthetic pyrethroid group, insect-growth-regulator group and recently demonstrates moderate resistance even to Bacillus thuringiensis Berliner.

On-farm trials were conducted at Sarapee, Chiang Mai, Thailand. A 300 m^2 (0.03 ha) field was planted to Chinese kale (Brassica oleracea var. alboglaba Bailey). The field was divided into 20 plots, 10 m^2 (10.0 m long and 1.0 m wide) each. Experiments were arranged in a randomized complete block design with four replications. Five treatments of selected bioinsecticides were evaluated under field conditions for their efficacy against DBM. These included Centari and Dipel WP each at 20 gm/20 liters of water, Florbac FC at 20 ml/20 liters of water, Vertimec at 10 ml + White oil at 10 ml/20 liters of water and Check (untreated). All applications were made with a knapsack sprayer, equipped with a single hollow-cone nozzle, in the evening at 5:00 pm. at weekly interval for a total of four times. Whole-plant examination for DBM living larva counts were performed 8 times on a twice-weekly basis on randomly- selected plants (20 plants/plot, 80 total plants/treatment) in the morning at 8:00 am. on each sampling date.

Overall, a combination of Vertimec (10 ml/20 L) plus white oil (10 ml/20 L) and Centari (20 gm/20 L) exhibited significantly better control of DBM larvae than Florbac FC (20 ml/20 L), Dipel WP (20 gm/20 L) and the untreated check. Vertimec treatment provided a superior control of DBM on Chinese kale, yielding the lowest seasonal larval population average of 0.31 insect per plot per sampling date. However, the impacts of these chemicals on human, beneficial arthropods and the crop ecosystem should be further investigated.

Key words: Bioinsecticides, Diamondback moth: *Plutella xylostella* (L.), Chinese kale: *Brassica oleracea* var. *alboglaba* Bailey

INTRODUCTION

The diamondback moth (DBM), *Plutella xylostella* (L.) (Lepidoptera: Yponomeutidae), is one of the cosmopolitan agricultural insect pests. The distribution of this insect has been recorded beyond latitude 60°N in Iceland, in the temperate zone and in the tropics. Thus, it has a great ability to survive under a wide range of temperatures (Ooi, 1986). Hardy (1938) reported that DBM prefers a warmer environment for its development and suggested the Mediterranean region as its most probable origin habitat.

Rushtapakornchai and Vattanatangum (1986) classified the commercial cruciferous-vegetable growing areas of Thailand into three categories: the yearñround suburban planted areas, the highland areas and the sporadic winter-growing areas. They had also provided a brief history of insecticide applications against DBM in Thailand during 1965–1984. DBM is considered to be the most serious pest by both *Brassica* seed and fresh market growers in north and northeast Thailand, although easier to control in the north than in the central region. DBM is still the major pest, its infestations vary considerably in time and space (Rowell et al., 1992). Development of DBM resistance to several insecticides has been observed in Thailand since 1972. The insect exhibits high resistance to organophosphorous group: phenthoate, prothiophos, pyraclofos and mevinphos; synthetic pyrethroid group: fenvalerate, cypermethrin, cycloprothrin, ethofenprox, permethrin and cyhalothrin L.; insect-growth-regulator group; chlorfluazuron, teflubenzuron, methoprene and NK-081 and recently demonstrates moderate resistance even to *Bacillus thuringiensis* Berliner (Miyata et al., 1988; Rushtapakornchai et al., 1988, 1990).

The primary objective of this experiment was to determine the efficacy of some selected bioinsecticides on DBM, *Plutella xylostella* (L.) on Chinese kale in Chiang Mai. The application of this research work outcomes as additional and relevant chemical tool for controlling DBM in the northern Thailand would highly encourage the integrated pest management program of the region.

MATERIALS AND METHODS

In 1996, on-farm trials were conducted at Sarapee, Chiang Mai, Thailand. A 300 m^2 (0.03 ha) field was planted to Chinese kale (*Brassica oleracea* var. *alboglaba* Bailey). By hand broadcasting of the seeds at the rate of 10.5 kg/ha on 12 January, a stand of approximately 683,550 plants/ha was obtained. The field was divided into 20 plots, 10 m^2 (10.0 m long and 1.0 m wide) each. Experiments were arranged in a randomized complete block design with four replications.

Due to a high flea beetle infestation in the study field very early in the growing season, all plots were chemically treated once with Celecron 500 EC (profenofos 50% EC) at the rate of 30 ml/20 L, employed on 23 January, in order to preclude their interferential activities to the trials.

Bioinsecticide testing

Five treatments of selected bioinsecticides or microbial insecticides were evaluated under field conditions for their efficacy against DBM as follow:

1. Centari	20 gm/20 liters of water
2. Dipel WP	20 gm/20 liters of water
3. Florbac FC	20 ml/20 liters of water
4. Vertimec + White oil	10 ml + 10 ml/20 liters of water
5. Check	untreated

All applications were made with a knapsack sprayer equipped with a single hollow-cone nozzle, in the evening at 5:00 pm. The first application was executed on 6 February and then repeated on 13, 20, and 27 February, at weekly interval.

In order to avoid bias to the treatment efficacy, all plots were "blind checked" by all person involved in the assessments, hence, they did not realize what treatment they were evaluating.

DBM larva monitoring

Whole-plant examination for DBM living larva counts were performed 8 times on randomly-selected plants (20 plants/plot, 80 total plants/treatment) in the morning at 8:00 am. on each sampling date. Sampling was commenced on 6 February and continued on a twice-weekly basis through 1 March.

RESULTS AND DISCUSSION

Seasonal abundance patterns of DBM larvae on Chinese kale according to treatment applications are graphically illustrated in Figure 1. Since the DBM larval population exhibited clumped spatial distribution throughout the growing season, all total insect numbers for each replication on each sampling date were adjusted by + 1 and took the common log before performing the analysis of variances.

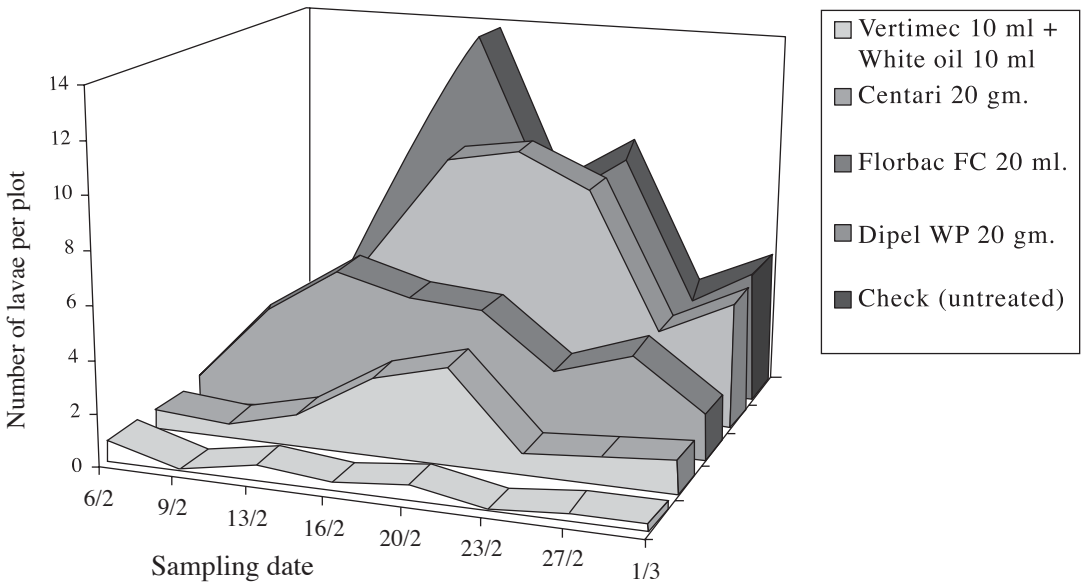

Figure 1. Patterns of bioinsecticide treatments on DBM larval populations on Chinese kale at Sarapee, Chiang Mai, 1996.

DBM larval populations did not differ among most treatments in 1996 early growing season, however, differences in efficacy were more apparent as the season progressed (Table 1). Vertimec (10 ml/20 L) in combination with white oil (10 ml/20 L) was consistently more efficacious (although not always significant) at reducing DBM populations. It significantly yielded the lowest DBM larval population among all other treatments with the seasonal average of 0.31 larva per plot per sampling date. DBM larvae were also less abundant on plants treated with Centari at the rate of 20 gm/20 L, yielding the second-lowest seasonal average of 1.53 larvae per plot per sampling date which was significantly lower than on plants treated with other microbial insecticides and on untreated plants. Although plants treated with either Florbac FC (20 ml/20 L) or Dipel WP (20 gm/20 L) demonstrated less DBM larval populations with the seasonal averages of 3.59 and 5.59 larvae per plot per sampling date, respectively, as compared to 6.66 larvae obtained from untreated plants, nevertheless, there were no statistically significant differences among these treatments.

Table 1. Efficacy of bioinsecticide treatments on DBM larval populations on Chinesekale at Sarapee, Chiang Mai, 1996.*

Treatment	**Mean number of larvae per plot on sampling date								Seasonal	
	6/2	9/2	13/2	16/2	20/2	23/2	27/2	1/3	Total	Average
Centari 20 gm	0.75^{a}	0.50^{d}	1.25^{b}	3.00^{b}	3.75^{c}	0.75^{c}	1.00^{b}	1.25^{b}	12.25	1.53^{b}
Dipel WP 20 gm	1.00^{a}	1.50^{c}	5.50^{a}	9.50^{a}	10.00^{a}	8.75^{a}	3.50^{a}	5.00^{a}	44.75	5.59^{a}
Florbac FC 20 ml	1.00^{a}	4.00^{a}	5.75^{a}	5.00^{b}	4.75bc	2.75^{b}	3.75^{a}	1.75^{b}	28.75	3.59^{a}
Vertimec 10 ml + White oil 10 ml	0.75^{a}	0^{d}	0.50^{b}	0.25c	0.50^{d}	0^{d}	0.25^{b}	0.25^{c}	2.50	0.31^{c}
Check (untreated)	0.50^{a}	3.50^{b}	9.00^{a}	13.75^{a}	7.75^{ab}	9.50^{a}	4.00^{a}	5.25^{a}	53.25	6.66^{a}

* Means within columns followed by the same letter are not significantly different ($P \geq 0.05$, Duncan's Multiple Range Test).

** Each figure is the average number of DBM larvae determined from total counts on 20 plants per plot (80 total/treatment) on sampling date.

Overall, a combination of Vertimec (10 ml/20 L) and white oil (10 ml/20 L) and Centari (20 gm/20 L) exhibited significantly better control of DBM larvae than Florbac FC (20 ml/20 L), Dipel WP (20 gm/20 L) and the untreated check. Vertimec treatment provided the most superior control of DBM on Chinese kale yielding the lowest seasonal average of the larval population. However, the impacts of these chemicals on human, beneficial arthropods and the crop ecosystem should be further investigated.

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