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Efficacy of Some Microbial Insecticides on Pupation Success of Diamond Back Moth (*Plutella xylostella* L.)

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A B S T R A C T

The efficacy of three commercial microbial formulations viz., *Bacillus thuringiensis*, *Beauveria bassiana* and *Metarhizium anisopliae* were evaluated at different doses on the percent pupation success of diamondback moth. These formulations were tested on 6 days old larvae of the pest in the laboratory of Department of Entomology, College of Agriculture, Central Agricultural University, Imphal during 2019-2020. In the present investigation it was observed that all the microbial formulations were effective to suppress pupation as compared to control treatment. At 72 days after treatment, larvae initiated pupation. After 144 hours of treatment, least pupation was observed with *Beauveria bassiana* @4g/l (25.00%) whereas all doses of *M.anisopliae* and *B. thuringiensis* reported percent pupation success ranging from 45-52.50% and 42.50-60% respectively. Considering the parameter mentioned, it was concluded that *Beauveria bassiana* was the most effective microbial insecticide to retard pupation of diamondback moth, followed by *M. anisopliae* and *B.thuringiensis.*

Introduction

Cabbage (*Brassica oleracea* var. *capitata*) is an important cruciferous crop belonging to the family Brassicaceae. It is a widely cultivated vegetable crop all over the world. Diamondback moth (*Plutella xylostella* L.) is one of the major pests of all cruciferous crops (Talekar and Shelton, 1993).In 1914, Diamondback moth (DBM) was first reported in India on cruciferous vegetables (Fletcher, 1914). DBM, a cosmopolitan and destructive pest on crucifers (Vanderberg *et al.*, 1998), can survive in all the agro-climatic zones of India. The pest infestation can be seen from February to April in summer crops and September to December in winters (Gill *et al.*, 2008). The infestation starts from the nursery. The pest caused nearly 52% loss of marketable yield in cabbage in India (Krishnakumar *et al.*, 1986). Economic Threshold Level of the pest is 2-5 larvae/plant (Rejesus *et al.*, 1995).

To control the pest, farmers rely heavily on the use of synthetic insecticides. But due to

resistance developed by this insect, conventional use of these insecticides often failed. DBM was the first insect to develop resistance to DDT and this was reported from Indonesia (Ankersmit, 1953). Moreover, these synthetic insecticides have hazardous effects on non-target organisms like beneficial insects, mammals as well as humans. To justify this, the focus should be diverted to use of eco-friendly means of pest control. Biological control of insect pests with microorganisms is more specific, economical and less hazardous to the ecosystem (Castillo *et al.,* 1997). The use of entomopathogenic microorganisms proves to be more efficient. Entomopathogenic microbes like *Bacillus thuringiensis*, *Metarhizium anisopliae* and *Beauveria bassiana* have a prospect to control the pest without causing harm to nature and other lives.

Materials and Methods

The study was undertaken at College of Agriculture, Central Agricultural University, Imphal, under laboratory conditions of Department of Entomology at ambient temperature and relative humidity. For the study, larvae and pupae were collected from untreated farmer's fields growing cabbage and cauliflower and collected larvae were reared on clean cabbage leaf pieces. The larvae were allowed to pupate. The emerged moths were released in insect rearing cage containing 4-5 leaf stage of cabbage plant for oviposition. The hatched larvae were reared on pieces of cabbage leaves. Ten number of DBM larvae were taken in each replication. Six days old larvae (2^{nd} instar) were taken for the study as they are easy to handle and moreover DBM takes around 10-12days to complete its larval period. The commercial formulations of the entomopathogenic microbial insecticides namely, Green Lipel (*Bacillus thuringiensis)*, Multiplex Baba *(Beauveria bassiana)* and Green Pacer (*Metarhizium anisopliae)* were collected from the market. Three doses for each microbial formulations i.e., 1g/l, 1.5g/l and 2g/l of Green Lipel and 3g/l, 4g/l and 5g/l each of Multiplex Baba and Green Pacer were taken to study their efficacy and was compared with untreated control treatment. The treatments were replicated four times and was subjected to Complete Randomized Design for statistical analysis. Leaf dip method of bioassay technique was employed for *Bacillus thuringiensis* treatments (Sharma *et al.,* 2000) and direct spray method on insect technique was employed for fungal microbial insecticides viz., *Beauveria bassiana* and *Metarhizium anisopliae*. For the control treatment, leaf discs were dipped in distilled water and fed to the larvae. The pupation data was recorded up to 144 hours (6 days) of treatment and percent pupation success was calculated by following the method:-

Number of pupae obtained / Number of larvae taken x 100

Results and Discussion

The study on the effect of different doses of some microbial insecticides on pupation success of DBM larvae is presented in Table (1). The data recorded during the investigation indicated that percent pupation was low in all microbial treatment as compared to control treatment. At 24 hours (1 day) and 48 hours (2days) after treatment, none of the larva had undergone pupation in all the treatments. At 72 days (3 days) after treatment, larvae initiated pupation with pupation percentage being low ranging from 7.50% - 40.00% only. Percent pupation success was however non-significant in all the treatments. Pupation of DBM ranged from 15.00% to 87.50% in the microbial treatment at 96 hours (4 days) after treatment. Least pupation was observed with *B. bassiana* @4g/l that gave 15.00% pupation success. *B.*

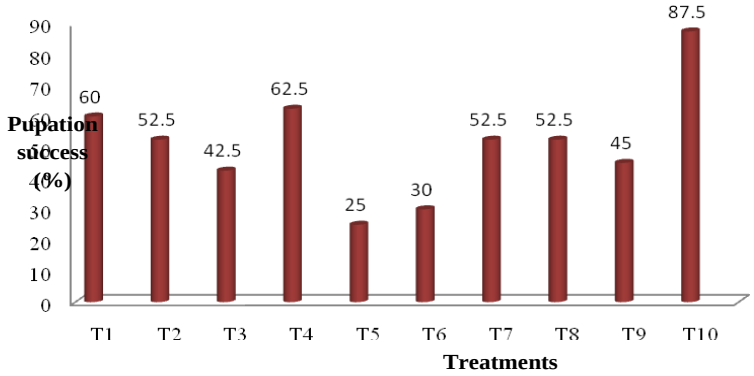
bassiana @3g/l (55.00%) recorded the highest pupation percentage among the tested microbial insecticides. After 120 hours (5 days) of treatment, the least percent pupation was observed with treatment *B. bassiana* @4g/l (22.50%). The remaining order of percent pupation success was *B. thuringiensis* @1.5g/l, *B. thuringiensis* @2g/l, *M. anisopliae* @3g/l and *M. anisopliae* @5g/l giving pupation percentage of 40.00%, 42.50%, 45.00% and 45.00% respectively and are statistically similar. The pupation success data obtained by bioassay of 6 day old DBM larvae after 144 hours (6 days) after treatment varied from 25.00% to 87.50%. The percent pupation caused by *B. bassiana* @4g/l recorded minimum pupation i.e. 25.00%, which was the least and proved to be most superior treatment. The succeeding percent pupation success was recorded in case of *B. bassiana* @5g/l which was 30.00%. Higher doses of *B. thuringiensis* (2g/l) and *M. anisopliae*(5g/l) were showing more or less similar results recording percent pupation42.50% and 45.00% respectively. The maximum pupation was recorded with treatment *B. bassiana* @3g/l (62.50%) which was statistically similar with other microbial treatments. Though microbial treatments varied in efficacy with respect to doses but they showed better result in suppressing pupation of larvae as compared to control treatment (87.50%) after 6 days of treatment.

Table.1 Effect of microbial insecticides on percent pupation success of 6 days old larva of DBM

	Treatments	**Dose**	**24 hrs**	**48 hrs**	**72 hrs**	**96 hrs**	**120 hrs**	**144 hrs**
T_1	*Bacillus thuringiensis*	1g/l	0.0	0.0	12.50 (17.14)*	42.50 (40.92)*b	55.00 (48.24)*c	60.00 (51.36)*c
T_2	*Bacillus thuringiensis*	1.5g/l	0.0	0.0	12.50 (17.14)	40.00 (39.26) ab	40.00 (39.26)abc	52.50 (46.73)c
T_3	*Bacillus thuringiensis*	2/l	0.0	0.0	7.50 (13.48)	35.00 (36.31)ab	42.50 (40.91)abc	42.50 (40.91)abc
T_4	*Beauveria bassiana*	3g/l	0.0	0.0	30.00 (30.66)	55.00 (48.05)b	62.50 (52.90)c	62.50 (52.90)c
T5	*Beauveria bassiana*	4g/l	0.0	0.0	15.00 (21.20)	15.00 (21.20)a	22.50 (28.07)ab	25.00 (30.07)a
T_6	*Beauveria bassiana*	5g/l	0.0	0.0	17.50 (22.86)	30.00 (32.60)ab	30.00 (32.60)ab	30.00 (32.60)ab
T_7	*Metarhizium anisopliae*	3g/l	0.0	0.0	20.00 (24.36)	35.00 (36.11)ab	45.00 (42.14)abc	52.50 (46.73)c
T_8	*Metarhizium anisopliae*	4g/l	0.0	0.0	20.00 (24.36)	35.00 (36.11)ab	52.50 (46.80)bc	52.50 (46.80)c
T_9	*Metarhizium anisopliae*	5g/l	0.0	0.0	10.00 (15.49)	32.50 (31.27)ab	45.00 (42.14)abc	45.00 (42.14)abc
T_{10}	Untreated control	-	0.0	0.0	40.00 (39.26)	87.50 (69.98)c	87.5 (69.98)d	87.50 (69.98)d
	SE (d)		-	-	-	9.09	7.46	6.91
	CD at 5%		-	-	NS	18.57	15.25	14.11

*Figures in parentheses are angular transformed values

Fig.1 Effect of different doses of microbial insecticides on the pupation success of diamondback moth after 144 hours(6 days) after treatment



Taking the above results into consideration, it can be stated that the higher doses of *B. bassiana* i.e., at 4g/l and 5g/l were the most effective in suppressing pupation of diamondback moth larvae. The result is in partial confirmation that *B.bassiana* was most effective showing delayed pupation with an increase in concentration to *Spodoptera littoralis* and *Agrotis ipsilon* larvae as given by El- Hawary and El-Salam (2009) and least pupation occur in tobacco caterpillar, *Spodoptera litura* (Fab.) larvae i.e. 43.33% when treated with highest concentration of *B.bassiana* as stated by Malarvannan *et al.*, (2010). Partial similarity in result also could be seen as documented by Torrado-León *et al.*, (2006) that interference in the molting process of nymphs occurred when treated with *B. bassiana* in nymphs of *B. tabaci*. Few pupae moulted from treated larvae showed deformities and died. Similar results of earlier scientists were seen as reported by Kpindou *et al.*, (2012) that some of the *Helicoverpa armigera* pupae resulting out of the larvae inoculated with isolates of *M. anisopliae* were deformed and dead. It was also reported that *B. bassiana* treated in *S. litura* resulted in malformed pupal stages (Malarvannan *et al.*, 2010).

In conclusion the lower pupation success was observed with all the microbial treatments in comparison to the untreated control treatment. Pupation decreased effectively when 6 day old larvae were exposed to the different doses of microbial formulations. The two higher doses of *Beauveria bassiana* i.e., 4g/l and 5g/l were the superior treatments. Effectiveness of the other two microbial insecticides i.e., *Metarhizium anisopliae* and *Bacillus thuringiensis* could be seen with their higher doses.

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