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Management of diamondback moth *Plutella xylostella* (Linn.) through microbial pesticides in cabbage crop

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Abstract
During 2015-16 and 2016-17, studies on control of diamondback moth using microbial pesticides were conducted at College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). Based on the summary evaluation of microbial pesticide treatments against SH infestation, the best microbial pesticide for SH management was found to be *Bacillus thuringiensis* (2.53 larvae/plant), followed by *Beauveria bassiana* (3.23 larvae/plant). The efficacy of microbial pesticide treatments was evaluated based on the cumulative percentage reduction over the control of *Bacillus thuringiensis* (56.67%) > *Beauveria bassiana* (44.69%) > *Metarhizium anisopliae* (39.56%) > *Verticillium lecanii* (29.96%). The effect of *Bacillus thuringiensis* (Kurstaki) treatment (17.50 kg/plot) on yield was found better than other treatments followed by *Beauveria bassiana* > *Metarhizium anisopliae* > *Verticillium lecanii* with 14.50 > 14.13 > 11.25 kg/plot, in this order.

Keywords: Cabbage, diamond back moth, microbial pesticides, yield

Introduction
Among vegetables, cruciferous vegetables are important winter crops consisting of cabbage, cauliflower, mustard, broccoli and radish. cabbage, Brassica oleracea var. capitata L. is a major temperate cruciferous crop widely cultivated in various climates around the world. Globally, India ranks second in cabbage production after China. Since it is mostly grown in large areas, there is likely to be a higher rate of pest infestation, which hinders its overall production and consumption. The diamondback moth, *Plutella xylostella* (L.), is considered the most destructive pest of Brassicaceae not only in Brazil but also in several other regions of the world (Talekar & Shelton 1993) [5]. However, the continuous use of synthetic pesticides in the control of agricultural pests often leads to various negative effects, such as the development of pest resistance, adverse effect on non-target organisms, and hazardous effect on the environment. These disadvantages have led to alternative approaches to control cruciferous pests that are cost-effective, biodegradable, with low toxicity to non-target organisms and environmentally friendly. However, long-term and excessive use of synthetic pesticides has led to several side effects such as development of pest resistance, adverse effect on non-target organisms, and hazardous effects on the environment. All these problems threaten the sustainability of the ecosystem. As the population of resistant pests and harmful effects on the environment increases, it requires continuous support to find alternative control measures to reduce their spread. One promising approach is to incorporate the use of biological resources, such as microbial pesticides, into the pest management system, resulting in less negative impacts on the ecosystem. (Mayanglambam *et al*., 2021) [1]. Several entomopathogens (viruses, bacteria, fungi and nematodes) offer effective means of pest control (Steinhaus, 1949) [4] (Wraight *et al*., 2001) [6]. In addition, microbial control agents (MCAs) are safe for the environment, beneficial insects, applicators, and can be applied just before harvest, and are often compatible with other control agents and produce little or no residue (Pearson and Callaway, 2005) [2].

Materials and Methods
The field studies were conducted at the experimental area of Indira Gandhi Agricultural University, Raipur (C.G.). The experiment was conducted during *rabi* season of years, 2015-16 and 2016-17 to assess the efficacy of microbial pesticides against diamondback moth

population at different intervals. Total three sprays of selective insecticides were applied during both the years. The larval population was recorded from randomly selected five plants from each plot, one day before application of insecticides as pre-treatment observation and after three, seven and fourteen days of spray as post treatment observations. Cabbage head yield was also recorded from each plot separately.

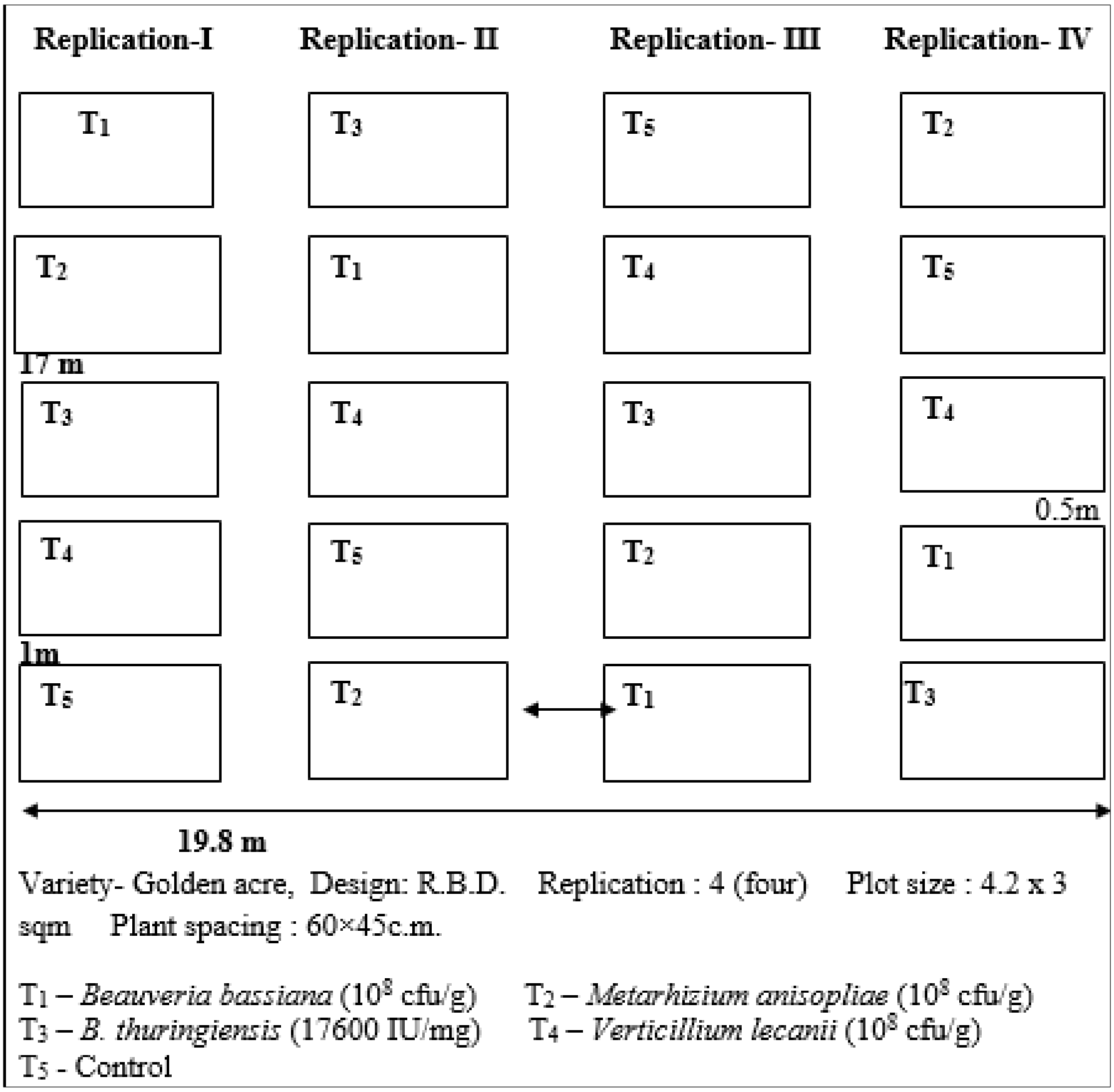

Fig 1: Layout plan for bio efficacy evaluation of microbial pesticides against DBM during *rabi* season (2015-16 and 2016-17

Table 1: Treatment details for microbial pesticides evaluation:

S. No.	Treatment	Dose g/ml/ha
1.	*Beauveria bassiana* (10^8cfu /g)	2500 g
2.	*Metarhizium anisopliae* (10^8cfu/g)	2500g
3.	*Bacillus thuringiensis (Kurstaki)* (17600 IU/mg)	1000 ml
4.	*Verticillium lecanii* (10^8cfu/g)	2500 g
5.	Control	-

Results and Discussion

Total three sprays were applied during both the years to assess the efficacy of microbial pesticides against diamondback moth population through field experiment.

First injection

A summary analysis of DBM larval burden showed a predominance of *Bacillus thuringiensis* (2.53 larvae per plant) based on the overall score for the first spray, but on days 3 and 7 of observation, efficacy was comparable to *Beauveria bassiana*. The order of efficacy of microbial pesticides based on the pooled mean reduction of diamondback moth larvae population in the first spray was found to be *Bacillus thuringiensis* (2.53 larvae/plant) > *Beauveria bassiana* (2.76 larvae/plant) > *Metarhizium anisopliae* (3.54 larvae/plant) > *Verticillium lecanii* (3.57 larvae/plant) (table no. 02).

Similarly, the impact of microbial pesticide treatment on SH larval infestation was also assessed and its order of effectiveness was ranked in descending order based on the cumulative percentage reduction over the control for the first spray as *Bacillus thuringiensis* (45%) > *Beauveria bassiana* (40%) > *Metarhizium anisopliae* (23.04%) > *Verticillium lecanii* (22.39%) (table no. 02).

Second injection

A summary analysis of DBM larvae after the second spray also showed the superiority of *Bacillus thuringiensis* (3.38 larvae/plant) based on the evaluation after the 3rd day of spraying and was found to be comparable to the efficacy of *Beauveria bassiana* (3.85 larvae/plant). The order of effectiveness of microbial pesticides based on the population of diamondback moth larvae in the second spray was found to be *Bacillus thuringiensis* (3.03 larvae/plant) > *Beauveria bassiana* (3.47 larvae/plant) > *Metarhizium anisopliae* (3.68 larvae/plant) > *Verticillium lecanii* (3.99 larvae/plant) (table no. 03).

Similarly, the impact of microbial pesticide efficacy was ranked in descending order based on cumulative percentage reduction over control for the first spray as *Bacillus thuringiensis* (41.27%) > *Beauveria bassiana* (32.75%) > *Metarhizium anisopliae* (28.68%) > *Verticillium lecanii* (22.67%) (Table no. 03).

Third injection

A review of the data presented in Table No. 04 followed a similar trend in treatment efficacy which revealed that the *Bacillus thuringiensis* treatment was found to be significantly superior on day 14 of observation with 2.23 larvae/plant. Treatment with *Beauveria bassiana* (3.18 larvae/plant) was next in efficacy followed by *Metarhizium anisopliae* (3.80 larvae/plant) and *Verticillium lecanii* (4.35 larvae/plant).

Based on a summary evaluation of microbial pesticide treatments for the third spray, *Bacillus thuringiensis* was found to be the best insecticide for SH management. The order of effectiveness of microbial pesticides based on the pooled mean reduction of diamondback moth larvae population in the third spray was found to be *Bacillus thuringiensis* (2.53 larvae/plant) > *Beauveria bassiana* (3.23 larvae/plant) > *Metarhizium anisopliae* (3.53 larvae/plant) > *Verticillium lecanii* (4.09 larvae/plant).

The effect of microbial pesticide treatment on DBM larval infestation of cabbage plant was also assessed and its order of effectiveness was ranked based on cumulative percentage reduction over control for the third spray as *Bacillus thuringiensis* (56.67%) > *Beauveria bassiana* (44.69%) > *Metarhizium anisopliae* (39.56%) > *Verticillium lecanii* (29.96%) (table no. 04).

When analyzing the data after grouping, the trend in treatment superiority did not deviate from year to year. An order of magnitude reduction in the number of larvae by the third spray was noted with *Bacillus thuringiensis* among other microbial pesticides. These findings are confirmed by the work of Rani and Jandial (2009) [3], who investigated the biological effectiveness of ecological pesticides, see B.t.k. (1.08 and 0.32 larvae/plant) and *Verticillium lecanii* formulation, (1.28 and 0.53 larvae/plant) after the first and second spraying. It was concluded that B.t.k. found superior in the treatment of *P. xylostella* compared to *Verticillium lecanii*. Conducted a field experiment to study the relative efficacy of different eco-friendly insecticides containing two Bt products (dipel and delphin), one entomopathogenic fungus *B. bassiana* (biorin) against diamondback borer (Plutella xylostella Linn.). All microbial pesticides were superior in controlling the diamondback moth population compared to the untreated control.

Cabbage yield in the rabies season, 2015-16 and 2016-17 (combined)

The data recorded on the yield during the Rabi period in both the years were collected to better assess the effectiveness of different treatments against the untreated control and shown in Table No. 05. The collected yield data presented in the table clearly showed that the maximum (17.50 kg/plot / 138.89 q/ha) and minimum (11.25 kg/plot / 89.28 q/ha) yield harvested from plots treated with *Bacillus thuringiensis* (Kurstaki) and *Verticillium lecanii*, respectively. This data also showed that the effect of *Bacillus thuringiensis* (Kurstaki) (17.50 kg/plot / 138.89 q/ha) on yield was found better than other treatments followed by *Beauveria bassiana* > *Metarhizium anisopliae* > *Verticillium lecanii* with 14.50 > 14.13 > 11.25 kg/plot / 115.07 > 112.14 > 89.28 q/ha,

Table 2: Effect of microbial pesticides on diamondback moth, *Plutella xylostella* (Linn.) management in cabbage during both years (2015-16 and 2016-17) after first spray (pooled)

	Treatment	*Mean larval population of *P. xylostella* per plant									Mean of Pooled values	Percent reduction over control
		Days after treatment										
		3		Pooled value	7		Pooled value	14		Pooled value		
		2015-16	2016-17		2015-16	2016-17		2015-16	2016-17			
T_1	*Beauveria bassiana* (10^8 cfu /g)	3.25 (2.05)	3.20 (2.04)	3.23 (2.05)	1.95 (1.70)	2.05 (1.73)	2.00 (1.72)	3.00 (1.99)	3.10 (2.02)	3.05 (2.01)	2.76 (1.92)	40.00
T_2	*Metarhizium anisopliae* (10^8cfu/g)	3.85 (2.20)	3.80 (2.19)	3.83 (2.19)	3.30 (2.07)	3.35 (2.08)	3.33 (2.07)	3.40 (2.09)	3.50 (2.11)	3.45 (2.10)	3.54 (2.12)	23.04
T_3	*Bacillus thuringiensis* (Kurstaki) (17600 IU/mg)	3.30 (2.06)	3.25 (2.05)	3.28 (2.06)	1.75 (1.65)	1.80 (1.66)	1.78 (1.66)	2.85 (1.96)	2.20 (1.78)	2.53 (1.87)	2.53 (1.86)	45.00
T_4	*Verticillium lecanii* (10^8cfu/g)	3.90 (2.21)	3.85 (2.20)	3.88 (2.20)	3.35 (2.08)	3.45 (2.10)	3.40 (2.09)	3.60 (2.14)	3.25 (2.06)	3.43 (2.10)	3.57 (2.13)	22.39
T_5	Control	4.65 (2.37)	4.50 (2.34)	4.58 (2.36)	4.70 (2.38)	4.75 (2.39)	4.73 (2.39)	4.60 (2.36)	4.40 (2.32)	4.50 (2.34)	4.60 (2.36)	
	S.Em ±	0.06	0.06	0.06	0.07	0.08	0.07	0.02	0.06	0.03		
	CD at 5%	0.20	0.20	0.20	0.22	0.25	0.23	0.08	0.21	0.11		

Table 3: Effect of microbial pesticides on diamondback moth, *Plutella xylostella* (Linn.) management in cabbage during both years (2015-16 and 2016-17) after second spray (pooled)

Treatment		*Mean larval population of *P. xylostella* per plant									Mean of Pooled values	Percent reduction over control
		Days after treatment										
		3		Pooled value	7		Pooled value	14		Pooled value		
		2015-16	2016-17		2015-16	2016-17		2015-16	2016-17			
T_1	*Beauveria bassiana* (10^8 cfu /g)	3.75 (2.17)	3.95 (2.22)	3.85 (2.20)	3.00 (1.99)	3.75 (2.17)	3.38 (2.09)	3.25 (2.05)	3.10 (2.02)	3.18 (2.04)	3.47 (2.11)	32.75
T_2	*Metarhizium anisopliae* (10^8 cfu/g)	4.00 (2.23)	4.10 (2.25)	4.05 (2.24)	3.40 (2.09)	3.85 (2.20)	3.63 (2.15)	3.45 (2.10)	3.25 (2.05)	3.35 (2.08)	3.68 (2.15)	28.68
T_3	*Bacillus thuringiensis* (Kurstaki) (17600 IU/mg)	3.45 (2.10)	3.30 (2.07)	3.38 (2.09)	2.80 (1.94)	2.75 (1.93)	2.78 (1.94)	3.05 (2.01)	2.80 (1.94)	2.93 (1.98)	3.03 (2.00)	41.27
T_4	*Verticillium lecanii* (10^8 cfu/g)	4.05 (2.24)	4.15 (2.26)	4.10 (2.25)	3.70 (2.16)	3.95 (2.22)	3.83 (2.19)	4.00 (2.23)	4.05 (2.24)	4.03 (2.23)	3.99 (2.22)	22.67
T_5	Control	4.70 (2.38)	5.10 (2.46)	4.90 (2.42)	4.85 (2.41)	5.40 (2.52)	5.13 (2.47)	5.35 (2.51)	5.55 (2.55)	5.45 (2.53)	5.16 (2.47)	
	S.Em ±	0.03	0.03	0.02	0.04	0.03	0.03	0.04	0.05	0.03		
	CD at 5%	0.11	0.11	0.07	0.13	0.11	0.09	0.13	0.15	0.12		

* Mean of four replications, Figures in parentheses are square root transformed values

Table 4: Effect of microbial pesticides on diamondback moth, *Plutella xylostella* (Linn.) management in cabbage during both years (2015-16 and 2016-17) after third spray (pooled)

Treatment		*Mean larval population of *P. xylostella* per plant									Mean of Pooled values	Percent reduction over control
		Days after treatment										
		3		Pooled value	7		Pooled value	14		Pooled value		
		2015-16	2016-17		2015-16	2016-17		2015-16	2016-17			
T_1	*Beauveria bassiana* (10^8 cfu/g)	3.70 (2.16)	3.95 (2.22)	3.83 (2.19)	2.75 (1.93)	2.60 (1.84)	2.68 (1.91)	3.40 (2.09)	2.95 (1.98)	3.18 (2.04)	3.23 (2.04)	44.69
T_2	*Metarhizium anisopliae* (10^8 cfu/g)	3.85 (2.20)	3.75 (2.17)	3.80 (2.19)	3.25 (2.05)	2.75 (1.92)	3.00 (1.99)	4.05 (2.24)	3.55 (2.11)	3.80 (2.18)	3.53 (2.12)	39.56
T_3	*Bacillus thuringiensis* (Kurstaki) (17600 IU/mg)	3.25 (2.04)	3.15 (2.02)	3.20 (2.04)	2.25 (1.80)	2.05 (1.74)	2.15 (1.77)	2.45 (1.85)	2.00 (1.72)	2.23 (1.79)	2.53 (1.86)	56.67
T_4	*Verticillium lecanii* (10^8 cfu/g)	4.10 (2.25)	4.25 (2.28)	4.18 (2.27)	3.55 (2.12)	3.95 (2.22)	3.75 (2.17)	4.45 (2.33)	4.25 (2.29)	4.35 (2.31)	4.09 (2.25)	29.96
T_5	Control	5.25 (2.49)	5.85 (2.61)	5.55 (2.55)	5.40 (2.52)	6.10 (2.66)	5.75 (2.59)	6.30 (2.70)	6.15 (2.66)	6.23 (2.68)	5.84 (2.60)	
	S.Em ±	0.08	0.07	0.04	0.07	0.06	0.06	0.04	0.09	0.05		
	CD at 5%	0.27	0.24	0.14	0.24	0.21	0.19	0.14	0.29	0.16		

* Mean of four replications, Figures in parentheses are square root transformed value

Table 05: Impact of microbial pesticides treatment on cabbage yield during *rabi* season of 2015-2016 and 2016-2017 (pooled)

	Treatments	Dose (g/ml/ ha)	*Mean weight of harvested heads (kg/plot)			Total yield (kg/plot)	Overall mean yield of cabbage q/ha
			1st pick	2nd pick	3rd pick		
T_1	*Beauveria bassiana* (10^8 cfu /g)	2500 g	3.88	4.63	6.00	14.50	115.07
T_2	*Metarhizium anisopliae* (10^8 cfu/g)	2500 g	4.13	4.38	5.63	14.13	112.14
T_3	*Bacillus thuringiensis* (Kurstaki) (17600 IU/mg)	1000 ml	4.63	5.63	7.25	17.50	138.89
T_4	*Verticillium lecanii* (10^8 cfu/g)	2500 g	2.88	4.13	4.25	11.25	89.28
T_5	Control	-	2.13	2.88	3.38	8.38	66.50
S.Em. ±			0.06	0.10	0.06		
CD at 5%			0.21	0.33	0.20		

Conclusion:

Using microbial pesticides for managing the diamondback moth in cabbage crops shows promise, offering effective pest control, environmental safety, and potential yield improvements, aligning with sustainable agricultural practices. Further research is encouraged to optimize application methods.

References

1. Mayanglambam S, Singh KD, Rajashekar Y. Current biological approaches for management of crucifer pests. Sci Rep. 2021 Jun 4;11(1):11831. Doi: 10.1038/s41598-021-91088-4. Erratum in: Sci Rep. 2021 Sep 28;11(1):19658. PMID: 34088925; PMCID: PMC8178325.

2. Pearson DE, Callaway RM. Indirect non target effects of host-specific biological control agents: Implications for biological control. Biol Control. 2005;35:288-298.
3. Rani P, Jandial VK. Rice Brown Planthopper, *Nilaparvata lugens* (Stal.) Outbreak In Relation To Weather Factors. Indian J Entomol. 2009;72(2):176-178.
4. Steinhaus EA. Principles of Insect Pathology. Mc. Graw Hill Book Co. Inc.; c1949. 757 p.
5. Talekar NS, Shelton AM. Biology, ecology, and management of the Diamondback moth. Annu Rev Entomol. 1993;38:275-301.
6. Wraight SP, Jackson MA, De Kock SL. Production, stabilization and formulation of fungal biocontrol agents. In: Butt TM, Jackson CW, Magan N, editors. Fungi as biocontrol agents: Progress, problems and potential. CAB International; c2001. p. 253-287.