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To Study the Effect of Biopesticides Against leaf Webber and Diamondback Moth on Mustard

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ABSTRACT: The field trial was conducted to evaluate the effect of biopesticides against leaf Webber and Diamondback moth on mustard at Research-cum-Instructional Farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur (Chhattisgarh), India. The treatments used in experiment are T_1-Neem leaf extract, T_2- *Bacillus thuringiensis,* T_3- *Lecanicillium lacanii,* T_4- Neem oil, T_5- *Beauveria bassiana,* T_6- *Metarhizium anisopliae,* T_7- Untreated control. The overall effect on the population of leaf webber after three, seven and ten days of first and second spraying revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.08 larvae/plant). The overall influence on the population of diamondback moth after three, seven and ten days of first and second spraying revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.06 larvae/plant).

Keywords: *Beauveria bassiana*, neem oil, *Metarhizium anisopliae* biopesticides, leaf Webber**,** Diamondback mot.

INTRODUCTION

Indian agriculture recognized as an important component of the Indian economy. Mustard (*Brassica juncea*) a member of the cruciferae plant family, is one of the earliest oilseed crops grown during the Rabi season. It was the initial indigenous crop. According to Sanskrit literature from around 3000 BC, mustard was one of the first species to be found (Mehra, 1968). The popular name for mustard is "rai." In Hindi, it is also known as "sarson."

India generated 13.14 percent of global production. Rajasthan contributes 38.07% of the country's land area and 43.69% of its output. Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat, Assam, West Bengal, Punjab, Chhattisgarh, and Maharashtra are the leading mustard and rapeseed-producing states in India (Anonymous 2019). Mustard has grown to be an important part of the national economy, second only to peanuts in terms of acreages. It is the world's second-largest oil seed, with a volume of 68.87 million tons (Anonymous, 2021). With a total land area of 6.23 mha, an output of 9.34 mt, and a productivity of 14.99 q ha^{-1}. A significant oilseed crop grown in tropical and subtropical climates worldwide is mustard. The second-largest producer of this crop worldwide is India (Vinyas *et al.,* 2022). 47542 hectares are under mustard cultivation. In Chhattisgarh, the output is 26,999 metric tons (Sonvanee and Pathak 2016).

The insect-pests of the mustard crop can be categorized into important pests based on their economic value. Major pests: aphid (*Lipaphis erysimi*), sawfly (*Athalialugens proxima* Klug), painted bug (*Bagrada cruciferarum* Kirkaldy), new pests: leaf webber (*Crocidolomia binotalis* Zeller), Diamondback moth (*Plutella xylostella* L.) (Pal *et al.,* 2020).

There are many different types of soil suitable for mustard cultivation, from light loam to deep loam. However, the optimum soils for producing mustard are those that are medium-to-deep and have enough drainage. Mustard varieties range in pH from 6.0 to 7.5. The ideal temperature range for mustard crop is between 10 and 25 degrees Celsius.

Biorational pesticide management should be the safest option for pest control. They are less harmful, more plentiful, less costly, less dangerous, biodegradable, and harmless to people and beneficial insects.

MATERIAL AND METHODS

The field trial was conducted to evaluate the effect of biopesticides against leaf Webber and Diamond back moth on mustard at Research-cum-Instructional Farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur (Chhattisgarh). A randomized block design with three replications was used to test seven treatments, including a control plot. Treatment details are presented in Table 1. The crop variety was Chhattisgarh Sarson and has plot size 18 × 19 m^2. This location experiences a maximum temperature of over 42°C and a minimum temperature of 2°C.

Ten plants per plot were observed the adult population of the leaf webber and Diamondback moth. The data on population of adult was recorded from randomly selected ten plants from each plot of 6 × 2.7 m^2 from before one day spraying and three, seven, ten days after spraying the biopesticides by visual count method.

The data obtained on insect population was taken into consideration for calculating the analysis of variance subjected to square root transformation $\sqrt{x + 0.5}$ these values were then analyzed statistically by using techniques of analysis of variance for randomized block design and interpretation of the data was carried out in accordance with Cochran and Cox (1957).

Table 1: Details of insecticides.

Sr. No.	Treatment details	Formulation	Dosage/ lit of water
1.	Neem leaf extract	0.03%EC	5 ml
2.	*Bacillus thuringiesis*	10% (1×10^9 CFU/ ml min.)	10 ml
3.	*Lecanicillium lacanii*	10% 1×10^8 CFU/ ml	10 ml
4.	Neem oil	0. EC	5 ml
5.	*Beauveria bassiana*	10% (1×10^8 CFU/ ml min.)	10 ml
6.	*Metarhizium anisopliae*	10% (1×10^8 CFU/ ml min.)	10 ml
7.	Control	-	-

RESULT AND DISCUSSION

A. The effect of biopesticides on the population of leaf webber after the first spray and second spray

The effect of biopesticides on infestation of leaf webber one day before and three, seven and ten days after first and second spraying is presented in Table 2 and graphically shown in Fig. 1.

Table 2 revealed that there was no significant difference between all treatments, including the control, one day before the first spraying.

The crop loss due to leaf webber recorded three days after first spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average leaf webber population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.13 larvae/plant). It was followed by *Lecanicillium lecanii* (0.17 larvae/plant), neem leaf extract (0.23 larvae/plant), *Bacillus thuringiensis* (0.27 larvae/plant), neem oil (0.30 larvae/plant). The highest count among the treatments was found in *Metarhizium anisopliae* (0.33 larvae/plant). The untreated control recorded (0.67 larvae/plant).

Seven days after first spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average leaf webber population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.07 larvae/plant). It was followed by *Lecanicillium lecanii* (0.13 larvae/plant), neem leaf extract (0.17 larvae/plant), *Bacillus thuringiensis* (0.20 larvae/plant), neem oil (0.23 larvae/plant). The highest count among the treatments was found in *Metarhizium anisopliae* (0.27 larvae/plant). The untreated control recorded (0.73 larvae/plant).

The leaf webber data collected ten days after the first spraying showed that all biopesticide treatments outperformed the untreated control. The plots treated with *Beauveria bassiana* and *Lecanicillium lecanii* had the lowest average leaf webber population following treatment (0.17 larvae/plant). Then came neem leaf extract, *Metarhizium anisopliae* (0.20 larvae/plant) and *Bacillus thuringiensis* (0.23 larvae/plant). The maximum number of larvae per plant was recorded in neem oil treatment (0.27 larvae/plant). The untreated control recorded (0.80 larvae/plant).

The leaf webber recorded three days after second spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average leaf webber population after treatment revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.07 larvae/plant). It was followed by *Lecanicillium lecanii* (0.10 larvae/plant), neem leaf extract (0.13 larvae/plant), *Bacillus thuringiensis* (0.17 larvae/plant), neem oil (0.20 larvae/plant). The highest count among the treatments was found in *Metarhizium anisopliae* (0.23 larvae/plant). The untreated control recorded (0.97 larvae/plant).

The leaf webber recorded seven days after second spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average leaf webber population after treatment revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.03 larvae/plant). It was followed by *Lecanicillium lecanii* and neem leaf extract (0.07 larvae/plant), *Bacillus thuringiensis* (0.10 larvae/plant), neem oil (0.13 larvae/plant). The highest count among the treatments was found in *Metarhizium anisopliae* (0.17 larvae/plant). The untreated control recorded (1.07 larvae/plant).

The leaf webber recorded ten days after second spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average leaf webber population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.00 larvae/plant). It was followed by *Lecanicillium lecanii* and neem leaf extract (0.03 larvae/plant), *Bacillus thuringiensis* (0.07 larvae/plant), neem oil (0.10 larvae/plant). The highest count among the treatments was found in *Metarhizium anisopliae* (0.13 larvae/plant). The untreated control recorded (1.17 larvae/plant).

The overall influence on the population of leaf webber after three, seven and ten days of first and second spraying demonstrated that the average leaf webber population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.08 larvae/plant). It was followed by *Lecanicillium lecanii* (0.11 larvae/plant), neem leaf extract (0.14 larvae/plant), *Bacillus thuringiensis* (0.17 larvae/plant), neem oil (0.21 larvae/plant). The highest count among the treatments was found in *Metarhizium anisopliae* (0.22 larvae/plant). The untreated control recorded (0.90 larvae/plant).

Vinyas *et al.* (2022) recorded that the larval population, *Beauveria bassiana* had better control (0.83 larvae/plant), followed by *Lecanicillium lecanii* (0.98 larvae/plant). Other treatments with identical levels of control (1.13 larvae/plant) were Azadirachtin and NSKE, followed by Cow urine (1.52 larvae/plant).

B. The effect of biopesticides on the population of diamondback moth after the first spray and second spray

The effect of biopesticides on infestation of diamondback moth one day before and three, seven and ten days after first and second spraying is presented in Table 3 and graphically shown in Fig. 2.

Table 3 revealed that there was no significant difference between all treatments, including the control, one day before the first spraying.

The diamondback moth population recorded three days after first spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.10 larvae/plant). It was followed by *Metarhizium anisopliae* (0.13 larvae/plant), neem oil (0.20 larvae/plant), *Lecanicillium lecanii* (0.23 larvae/plant), neem leaf extract (0.27 larvae/plant). The highest count among the treatments was found in *Bacillus thuringiensis* (0.30 larvae/plant). The untreated control recorded (0.50 larvae/plant).

The crop loss due to diamondback moth recorded seven days after first spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.03 larvae/plant). It was followed by *Metarhizium anisopliae* (0.07 larvae/plant), neem oil (0.13 larvae/plant), *Lecanicillium lecanii* (0.17 larvae/plant), neem leaf extract (0.20 larvae/plant). The highest count among the treatments was found in *Bacillus thuringiensis* (0.23 larvae/plant). The untreated control recorded (0.57 larvae/plant).

The average diamondback moth recorded ten days after first spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.13 larvae/plant). It was followed by *Metarhizium anisopliae* and neem oil (0.17 larvae/plant), *Lecanicillium lecanii* (0.20 larvae/plant), neem leaf extract (0.23 larvae/plant). The highest count among the treatments was found in *Bacillus thuringiensis* (0.27 larvae/plant). The untreated control recorded (0.63 larvae/plant).

The diamondback moth recorded three days after second spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.07 larvae/plant). It was followed by *Metarhizium anisopliae* (0.10 larvae/plant), neem oil (0.13 larvae/plant), *Lecanicillium lecanii* (0.17 larvae/plant), neem leaf extract (0.20 larvae/plant). The highest count among the treatments was found in *Bacillus thuringiensis* (0.26 larvae/plant). The untreated control recorded (0.70 larvae/plant).

The crop loss due to diamondback moth recorded seven days after second spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.03 larvae/plant). It was followed by *Metarhizium anisopliae* and neem oil (0.07 larvae/plant), *Lecanicillium lecanii* (0.10 larvae/plant), neem leaf extract (0.13 larvae/plant). The highest count among the treatments was found in *Bacillus thuringiensis* (0.17 larvae/plant). The untreated control recorded (0.80 larvae/plant).

The crop loss due to diamondback moth recorded ten days after second spraying demonstrated that all biopesticide treatments were significantly superior to the untreated control. The average diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* and *Metarhizium anisopliae* recorded the lowest (0.00 larvae/plant). It was followed by neem oil (0.03 larvae/plant), *Lecanicillium lecanii* (0.07 larvae/plant), neem leaf extract (0.10 larvae/plant). The highest count among the treatments was found in *Bacillus thuringiensis* (0.13 larvae/plant). The untreated control recorded (0.87 larvae/plant).

The overall influence on the population of diamondback moth after three, seven and ten days of first and second spraying demonstrated that average diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.06 larvae/plant). It was followed by *Metarhizium anisopliae* (0.09 larvae/plant), neem oil (0.12 larvae/plant), *Lecanicillium lecanii* (0.16 larvae/plant), neem leaf extract (0.19 larvae/plant). The highest count among the treatments was found in *Bacillus thuringiensis* (0.22 larvae/plant). The untreated control recorded (0.68 larvae/plant).

According to the preceding discussion, the current work's conclusions are near consistent with the findings of previous researchers. Kommoji and Tyade (2022) recored that the diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded (67.06%) population.

Table 2: Effect of biopesticides on the population of leaf webber after first and second spraying.

Tr. No.	Treatments	Average leaf webber population per 10 plants (Days after first spraying)				Average leaf webber population per 10 plants (Days after second spraying)				Overall mean of 3 and 7 days after first and second spray
		One day before	3 days after	7 days after	10 days after	One day before	3 days after	7 days after	10 days after	
T_1	Neem leaf extract	0.70 (1.10)	0.23 (0.86)	0.17 (0.82)	0.20 (0.83)	0.50 (1.00)	0.13 (0.79)	0.07 (0.75)	0.03 (0.73)	0.14 (0.80)
T_2	*Bacillus thuringiesis*	0.67 (1.08)	0.27 (0.87)	0.20 (0.84)	0.23 (0.86)	0.43 (0.96)	0.17 (0.82)	0.10 (0.77)	0.07 (0.75)	0.17 (0.82)
T_3	*Lecanicillium lacanii*	0.60 (1.05)	0.17 (0.82)	0.13 (0.79)	0.17 (0.82)	0.40 (0.95)	0.10 (0.77)	0.07 (0.75)	0.03 (0.73)	0.11 (0.78)
T_4	Neem oil	0.87 (1.17)	0.30 (0.89)	0.23 (0.86)	0.27 (0.87)	0.63 (1.07)	0.20 (0.84)	0.13 (0.80)	0.10 (0.77)	0.21 (0.84)
T_5	*Beauveria bassiana*	0.73 (1.11)	0.13 (0.79)	0.07 (0.75)	0.17 (0.82)	0.50 (1.00)	0.07 (0.75)	0.03 (0.73)	0.00 (0.71)	0.08 (0.76)
T_6	*Metarhizium anisopliae*	0.70 (1.09)	0.33 (0.91)	0.27 (0.87)	0.20 (0.84)	0.50 (1.00)	0.23 (0.86)	0.17 (0.82)	0.13 (0.79)	0.22 (0.85)
T_7	Untreated control	0.57 (1.03)	0.67 (1.08)	0.73 (1.11)	0.80 (1.14)	0.87 (1.17)	0.97 (1.21)	1.07 (1.23)	1.17 (1.29)	0.90 (1.18)
	SE±	0.030	0.020	0.018	0.020	0.030	0.025	0.037	0.026	
	CD at 5%	N/A	0.061	0.057	0.064	0.092	0.079	0.115	0.081	

Table 3: Effect of biopesticides on the population of Diamondback moth after first and second spraying.

Tr. No.	Treatments	Average Diamondback moth population per 10 plants (Days after first spraying)				Average Diamondback moth population per 10 plants (Days after second spraying)				Overall mean of 3 and 7 days after first and second spray
		One day before	**3 days after**	**7 days after**	**10 days after**	**One day before**	**3 days after**	**7 days after**	**10 days after**	
T_1	Neem leaf extract	0.57 (1.03)	0.27 (0.87)	0.20 (0.83)	0.23 (0.85)	0.33 (0.91)	0.20 (0.83)	0.13 (0.79)	0.10 (0.77)	0.19 (0.83)
T_2	*Bacillus thuringiesis*	0.53 (1.02)	0.30 (0.89)	0.23 (0.86)	0.27 (0.87)	0.37 (0.93)	0.23 (0.85)	0.17 (0.82)	0.13 (0.79)	0.22 (0.85)
T_3	*Lecanicillium lacanii*	0.53 (1.02)	0.23 (0.86)	0.17 (0.81)	0.20 (0.83)	0.30 (0.89)	0.17 (0.81)	0.10 (0.77)	0.07 (0.75)	0.16 (0.81)
T_4	Neem oil	0.73 (1.11)	0.20 (0.83)	0.13 (0.79)	0.17 (0.81)	0.27 (0.87)	0.13 (0.80)	0.07 (0.75)	0.03 (0.73)	0.12 (0.79)
T_5	*Beauveria bassiana*	0.63 (1.07)	0.10 (0.77)	0.03 (0.73)	0.13 (0.79)	0.23 (0.86)	0.07 (0.75)	0.03 (0.73)	0.00 (0.71)	0.06 (0.75)
T_6	*Metarhizium anisopliae*	0.60 (1.05)	0.13 (0.79)	0.07 (0.75)	0.17 (0.82)	0.27 (0.88)	0.10 (0.77)	0.07 (0.75)	0.00 (0.71)	0.09 (0.77)
T_7	Untreated control	0.43 (0.97)	0.50 (1.00)	0.57 (1.03)	0.63 (1.07)	0.67 (1.08)	0.70 (1.10)	0.80 (1.14)	0.87 (1.17)	0.68 (1.09)
	SE±	0.038	0.020	0.039	0.024	0.021	0.029	0.019	0.016	
	CD at 5%	N/A	0.063	0.122	0.076	0.065	0.090	0.060	0.051	

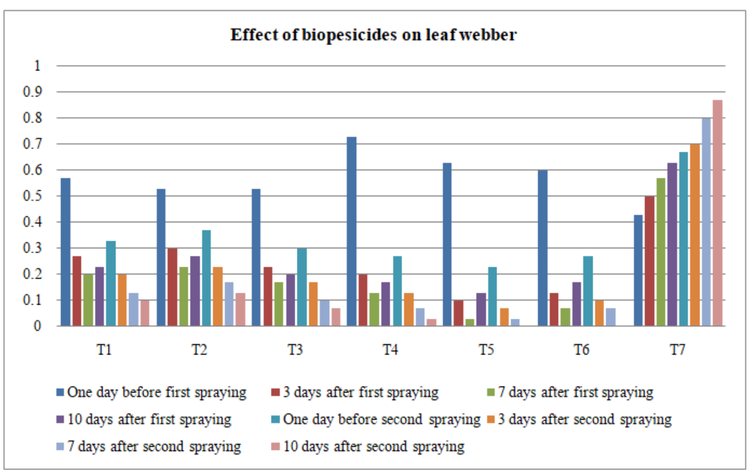

Fig. 1. Effect of biopesticides on Leaf webber after first and second spraying.

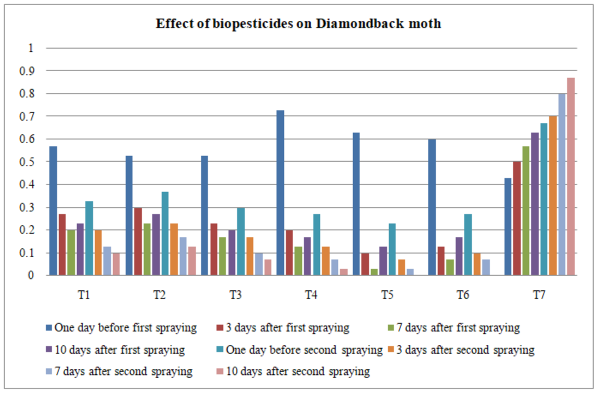

Fig. 2. Effect of biopesticides on Diamondback moth after first and second spraying.

CONCLUSIONS

The effect on the population of leaf webber after three, seven and ten days of first and second spraying demonstrated that the average leaf webber population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.08 larvae/plant). In order to control leaf webber, the most effective biopesticides were *Beauveria bassiana* > *Lecanicillium lecanii* > Neem leaf extract > *Bacillus thuringiensis* > Neem oil > *Metarhizium anisopliae* > Control.

The overall influence on the population of diamondback moth after three, seven and ten days of first and second spraying demonstrated that average diamondback moth population after treatment application revealed that the plots applied with *Beauveria bassiana* recorded the lowest (0.06 larvae/plant). In order to suppress the diamondback moth, the most effective biopesticides were *Beauveria bassiana* > *Metarhizium anisopliae* > neem oil > *Lecanicillium lecanii* > neem leaf extract > *Bacillus thuringiensis* > control.

FUTURE SCOPE

All biopesticide treatments were found significant and eco-friendly management with respect to diamondback moth and leaf webber which is safer to environment.

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