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Efficacy of bio-pesticides against spotted pod borer (*Maruca testulalis* (Geyer) on green gram (*Vigna radiata* L.) at Prayagraj

Harshal Anil Patil and Usha Yadav

Abstract
The experiment was carried out during the Kharif season of 2022 on the research plot of the Department of Agricultural Entomology at Central Research Farm (CRF), Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. The Experiment was laid in Randomised Block Design (RBD) with eight treatments each replicated thrice evaluated against spotted pod borer i.e., (T1) *Beauveria bassiana* (2x108 Spores/ml) @ 2.5 ml/lit, (T2) *Verticillium lecanii* (1x108 Spores/g) @ 5 g/lit, (T3) *Metarhizium anisopliae* (1x108 Spores/g) @ 5 g/lit, (T4) Karanj oil 2% @ 20 ml/lit, (T5) Neem Oil 10000 ppm @ 10 ml/lit, (T6) Azadirachtin 0.15% @ 5 ml/lit, (T7) NSKE 5% @ 50 ml/l and (T0) Control. At intervals of 15 days, each biopesticide was applied twice. One day before each treatment, three, seven, and fourteen days after each spray were used to observe the spotted pod borer infestation on each plant. The outcomes showed that, in comparison to the control, the pest infestation was greatly decreased by all of the biopesticides evaluated. The maximum percent reduction of larval population was recorded in *Beauveria bassiana* (2x108 Spores/ml) (38.32), (58.84) followed by *Metarhizium anisopliae* (1x108 Spores/g) (35.74), (56.53), NSKE 5% (31.21), (52.95), Karanj oil 2% (26.57), (52.16), Neem oil 10000 ppm (21.86), (46.40) and least effective treatment were Azadirachtin 0.15% (19.33), (42.67) and *Verticillium lecanii* (1x108 Spores/g) (17.50), (38.82). The highest yield and C:B ratio of green gram was recorded in *Beauveria bassiana* (2x108 Spores/ml) (17.10 q ha^{-1}), (1:4.48) followed by *Metarhizium anisopliae* (1x108 Spores/g) (14.81 q ha^{-1}), (1:3.70) NSKE 5% (13.32 q ha^{-1}), (1:3.04) and Karanj oil 2% (12.75 q ha^{-1}), (1:2.81). The lowest yield was recorded from the plots sprayed with Control (6.59 q ha^{-1}), (1:1.17).

Keywords: *Beauveria bassiana***,** cost benefit ratio, efficacy, green gram, *Maruca estulalis*, yield

Introduction
In addition to providing vital amino acids, vitamins, and minerals, pulses are a great source of protein and a great way to round out a diet that includes grains. They have a protein content of 22–24%, approximately double that of rice and roughly half that of wheat. A number of non-communicable illnesses, including colon cancer and cardiovascular disorders, are known to be reduced by the major nutritional and health advantages of pulses. Frequently referred to as "poor man's meat," pulses. Despite being the world's largest producer of pulses, India's production on average is quite poor due to biotic and abiotic stressors. An average of 2.5 to 3.0 mt. of pulses are lost each year because of insect issues. Rabindra *et al.*, (2004) [9].
The green gramme has a lot of protein, is easily digested, and does not induce gas like many other legumes. Its seed is composed of 60.4% carbs, 1.3% fat, and 24.2% protein. The supply of pulses per capita has significantly decreased due to stagnating pulse output and ongoing population growth. In 1951, there were 60 g of pulses available per person per day; towards the end of the year, there were only 47.2 g left (Bisti *et al.*, 2022) [4]. The availability per person per year shows a similar downward trend from 22.1 kg in 1951 to 17.2 kg. However, the tendency towards growth can be seen in both per capita daily intake (52.9 g) and per capita annual intake (19.3 kg), respectively. This demonstrates abundantly how population expansion impacts the per capita availability of pulses. (Anonymous, 2017) [3].
The crop is produced on 5.0 million ha^{-1} worldwide, producing 2.5 MT, whereas it is grown on around 26.06 million ha in India, producing 16.10 million tonnes and producing 619 kg ha^{-1} per hectare. With a 351 kg ha^{-1} average output of green gramme, Andhra Pradesh ranks as the fourth-largest state in India and contributes 15.5% of the country's production (Anonymous, 2007) [2]. The enormous vegetative canopy causes more than 200 insect pests to attack green gramme from seedling to harvest stage, severely reducing yields. Since green gramme is mostly grown in tropical settings, insect pests are crucial to the crop's successful cultivation

(Anonymous, 2013) [1].

It belongs to the Lepidoptera order and the Crambidae family. In Asia, Africa, Australia, and America, it is extensively dispersed. It assaults the crop by eating on flower buds, blooms, and pods by webbing from the pre-flowering through the pod maturation stages. 25–50% financial loss in the green gramme. (Sravani and Mahalakshmi 2016) [11].

Materials and Methods

The experiment was carried out in the kharif season of 2022 at Central Research Farm, Naini, Prayagraj, Uttar Pradesh, India, using variety Arka Anamika seeds in a plot size of 2 m×1 m at a spacing of 30cm×10cm and a recommended set of practises excluding plant protection. The soil of the experimental site was well drained and medium high. The climate of the experimental site is sub-tropical characterized by normal rainfall. Naini is situated at 25.22 '45.1" N North Latitude 81.52' 37.44" East Longitude of 95.63 meter above sea level. The treatments used in experiment are *viz.*, *Beauveria bassiana* (2x108 Spores/ml) @ 2.5 ml/lit, *Verticillium lecanii* (1x108 Spores/g) @ 5 g/lit, *Metarhizium anisopliae* (1x108 Spores/g) @ 5 g/lit, Karanj oil 2% @ 20 ml/lit, Neem Oil 10000 ppm @ 0.5 ml/lit, Azadirachtin 0.15% @ 5 ml/lit, NSKE 5% @ 50 ml/lit and Control.

According to the needs of the study, data were gathered on a variety of factors. The number of infected pods containing larva from 5 randomly chosen plants per plot were counted and recorded at weekly intervals after being carefully examined for the presence of the spotted pod borer. The mean was recorded in the Larva population of spotted pod borer number of larvae per plant divided by total number of chosen plants one day before spraying, three, seven, and fourteen days after spraying. The cost- benefit ratio should be established by comparing the gross returns from each treatment to the control, and then the ratio of the gross returns to the cost of cultivation is used to get the C:B ratio (Sireesha and Kumar 2022) [10]. The mean larval population of green gramme pods by the green gramme spotted pod borer was calculated using numbers.

Results and Discussion

The results on the decrease in spotted pod borer larvae population one day prior to spraying, three, seven, and fourteen days following the initial spraying showed that all treatments are considerably better than controls. Among all the treatments the overall mean of maximum reduction in larval population spotted pod borer was recorded in *Beauveria bassiana* (2x108 Spores/ml) (38.32), followed by *Metarhizium anisopliae* (1x108 Spores/g) (35.74), NSKE 5% (31.21), Karanj oil 2% (26.57), Neem oil 10000 ppm (21.86) and least effective treatment were Azadirachtin 0.15% (21.86), (42.67) and *Verticillium lecanii* (1x108 Spores/g) (17.50).

The findings on the second spray's ability to reduce the larval population of spotted pod borers showed that all of the treatments outperform the control by a large margin. Among all the treatments the overall mean of maximum reduction in larval population of spotted pod borer was recorded in *Beauveria bassiana* (2x108 Spores/ml) (58.84) followed by *Metarhizium anisopliae* (1x108 Spores/g) (56.53), NSKE 5% (52.95), Karanj oil 2% (52.16), Neem oil 10000 ppm (46.40) and least effective treatment were Azadirachtin 0.15% (42.67) and *Verticillium lecanii* (1x108 Spores/g) (38.82).

The highest yield and C:B ratio of green gram was recorded in *Beauveria bassiana* (2x108 Spores/ml) (17.10 q ha^{-1}), (1:4.48) followed by *Metarhizium anisopliae* (1x108 Spores/g) (14.81 q ha^{-1}), (1:3.70), NSKE 5% (13.32 q ha^{-1}), (1:3.04), Karanj oil 2% (12.75 q ha^{-1}), (1:2.81), Azadirachtin 0.15% (11.48 q ha^{-1}), (1:4.89), Neem oil 10000 ppm (10.26q ha^{-1}), (1:3.67), *Verticillium lecanii* (1x108 Spores/g) (9.05q ha^{-1}), (1:2.46) and Control (6.59 q ha^{-1}), (1:1.17).

In *Beauveria bassiana* (2x108 Spores/ml), the values obtained in the first and second sprays were (48.58) Sreekanth *et al.*, (2018) [12] and *Metarhizium anisopliae* (1x108 Spores/g) (46.14) both support these findings. Kudikilla and Tayde (2022) [8] show comparable findings, NSKE 5% (42.08). These findings concur with those of Byrappa *et al.*, (2012) [5].

Beauveria bassiana (2x108 Spores/ml), which was reported by Ghugal *et al.*, (2013) [6], had the highest cost-benefit ratio (1:4.48), followed by *Metarhizium anisopliae* (1x108 Spores/g), which had similar findings reported by Kudikilla and Tayde (2022) [8], and NSKE 5% (1:3.04), which had the same findings reported by Konda and Kumar (2022) [7].

Table 1: Efficacy of biopesticide against spotted pod borer [(*Maruca testulalis* (Geyer)] on green gram of both sprays

S. No.	Selected biopesticides	Mean percent larval reduction over control								Overall mean	Yield q ha^{-1}	C:B Ratio
		First spray				Second spray						
		1 DBS	3 DAS	7 DAS	14 DAS	1 DBS	3 DAS	7 DAS	14 DAS			
T1	*Beauveria bassiana* (2x108 Spores/ml)	5.47	30.13a (33.17)	43.42a (41.20)	41.42a (40.03)	4.13	52.73a (46.56)	64.94a (52.89)	58.86a (50.10)	48.58	17.10	1:4.48
T2	*Verticillium lecanii* (1x108 Spores/g)	6.13	10.32d (18.09)	20.61e (26.74)	21.58e (27.52)	5.53	30.88e (33.73)	45.28c (42.26)	40.30c (39.38)	28.16	9.05	1:1.88
T3	*Metarhizium anisopliae* (1x108 Spores/g)	5.53	28.11a (32.04)	40.45ab (39.47)	38.66ab (37.82)	4.33	49.12ab (44.49)	63.22a (52.72)	57.25ab (48.61)	46.14	14.81	1:3.70
T4	Karanj oil 2%	5.67	18.76bc (25.66)	30.72cd (33.65)	30.22cd (33.33)	4.93	41.89cd (40.32)	59.77ab (50.67)	54.81ab (47.78)	39.37	12.75	1:2.81
T5	Neem oil 10000 ppm	6.33	12.47cd (20.59)	26.68de (30.96)	26.43de (30.88)	5.20	35.42de (36.46)	55.83abc (48.38)	47.94bc (43.81)	34.13	10.26	1:2.35
T6	Azadirachtin 0.15%	6.20	11.50cd (22.39)	23.82e (29.17)	22.67e (28.42)	5.47	34.54e (35.99)	49.08bc (44.47)	44.38c (41.76)	31.00	11.48	1:1.99
T7	NSKE 5%	5.47	24.16ab (29.37)	35.64bc (36.59)	33.82bc (35.53)	4.60	43.75bc (41.38)	60.62a (51.15)	54.48ab (47.58)	42.08	13.32	1:3.04
T8	Control	5.87	0.00e	0.00f	0.00f	7.07	0.00f	0.00d	0.00d	0.00	6.59	1:1.17
	F-Test	NS	S	S	S	S	S	S	S	-	-	-
	C.D. at 0.05%	0.739	5.547	6.71	5.50	0.418	6.547	11.16	8.83	-	-	-
	S.Ed.(±)	0.345	2.58	3.11	2.56	0.195	3.05	5.20	4.19	-	-	-

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