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Efficacy of Biopesticides against Sucking Pests Infesting Moth Bean [*Vigna aconitifolia* (Jacq.) Marechal]

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at College of Agriculture, NAU, Bharuch (Gujarat) to study the efficacy of biopesticides against sucking pests of moth bean during *kharif* -2023. Results revealed that among the different biopesticides tested against sucking pests of moth bean, *Beauveria bassiana*(1 x 10^8 cfu g^{-1}), neem oil 0.5% and NSKE 5% was found most effective whereas, treatments of *Lecanicillium lecanii* (1x 10^8 cfu g^{-1}) , *Metarhizium anisopliae* (1 x 10^8 cfu g^{-1}) and azadirachtin 0.15 EC found moderately effective against jassid, *Empoasca motti* (Pruthi.) and whitefly, *Bemisia tabaci* (Genn.) populations. Treatments of neem oil 0.5% and azadirachtin 0.15 EC was found most effective whereas, *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) and NSKE 5% found moderately effective against thrips, *Caliothrips indicus* (Bagnall).

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Keywords: Moth bean; sucking pests; jassid; white fly; thrips; Beauveria bassiana.

1. INTRODUCTION

Vigna aconitifolia (Jacq.) Marechal, also referred to as "moth," is a vital pulse crop that thrives in the country's dry and semi-arid regions. It is the kharif pulse that can withstand drought the best. In addition to covering a wide surface area, plants also retain moisture and prevent soil erosion. A member of the Papilionaceae subfamily of the Leguminosae family is the moth bean. An annual plant is the moth bean. Because of its deeper tap roots, it may draw moisture from the soil's lower strata. The plant height is between 30 and 35 cm, and the stem is branching. The trifoliate leaves have lobed leaflets that are separated into three to five sections. Flowers are papilionaceous and mostly self-pollinated (Kukvaya et al., 2018). In India, moth bean occupies an area of 9.68 lakh ha with production of 3.21 lakh tonnes and productivity of 332 kg/ha whereas in Gujarat, it occupies an area of 0.12 lakh ha with production of 0.05 lakh tonnes and productivity of 462 kg/ha during year 2019 – 2020 (Anon., 2021). Jassids and whiteflies also act as vector of yellow mosaic virus apart from causing direct damage by desaping (Satyavir et al., 1984). Termites, galerucid beetles, mites and surface grass hoppers are minor pests, while jassid, whitefly, thrips, black weevil, pulse beetle and white grubs are major pests of moth bean (Bhathesar et al*.,* 2021). Sucking pests cause considerable damage on moth bean and management through chemical pesticides kill the natural enemies and cause pest resurgence (Saxena et al., 2014, Srinivasan et al., 2019, Bairwa et al., 2006). Hence in this study biopesticides were tested for their efficacy against sucking pests of moth bean.

2. MATERIALS AND METHODS

A field experiment was conducted at College of Agriculture, NAU, Bharuch (Gujarat) to study the efficacy of biopesticides against sucking pests of moth bean during *kharif* -2023. For this, moth bean var. GMO-2 was selected and sown at a distance of 45 cm x 10 cm in Randomized Block Design with eight treatments and three replications having gross plot of Gross: 2.7 m x 4.0 m and net plot of 1.8 m x 3.8 m. The moth bean variety GMO-2 was raised by adopting all recommended agronomical practices. Two spray of biopesticides were given, first spray at time of appearance of pest *i.e.,* at 01/09/2023 and second spray was given at 10 days after first spray with manually operated knapsack sprayer. An untreated check was also maintained for comparison. The observations were recorded one day prior to first spray as well as 3rd, 7th, and 9th days after each spray. Standard methodology was adopted for recording pest population. Five plants were randomly selected from each plot and observations were recorded before and after each spray. The population of adults and nymphs of jassid [*Empoasca motti* (Pruthi.)], whitefly [*Bemisia tabaci* (Genn.)] and thrips [*Caliothrips indicus* (Bagnall)] were recorded from three leaves (upper, middle and lower) of each randomly selected plants and mean pest population was worked out.

3. RESULTS AND DISCUSSION

3.1 Jassid, *Empoasca motti* (Pruthi.)

3.1.1 First spray

Pooled over periods result of first spray (Table 1) revealed that the lower jassid population was observed in the plot treated with *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) (2.70 per 3 leaves) and it was at par with neem oil 0.5% (2.77 per 3 leaves) and NSKE 5% (2.83 per 3 leaves). The next effective treatment was *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (4.13 per 3 leaves), it was at par with *Metarhizium anisopliae*(1 x 10^8cfu g^{-1}) (4.20 per 3 leaves), azadirachtin 0.15 EC (4.26 per 3 leaves) and novel plus 0.1% (4.53 per 3 leaves) were found less effective. The highest jassid population was recorded in control (6.44 per 3 leaves).

3.1.2 Second spray

Pooled over periods result of second spray (Table 2) revealed that the lowest jassid population was observed in the plot treated with *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) (1.67 per 3 leaves) and it was at par with neem oil 0.5% (1.73 per 3 leaves) and NSKE 5% (1.80 per 3 leaves). The next effective treatment was *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (2.76 per 3 leaves) and it was at par with *Metarhizium anisopliae*(1 x 10^8cfu g^{-1}) (2.80 per 3 leaves) and azadirachtin 0.15 EC (2.88 per 3 leaves). The treatment of novel plus 0.1% (3.46 per 3 leaves) was found less effective. The highest jassid population was recorded in control (5.77 per 3 leaves).

Table 1. Efficacy of biopesticides against jassid in moth bean after first spray

Sr. no.	Treatments	Mean no. of Jassid/3 leaves				
		Before spray	Days after spray (DAS)			Pooled over periods
			3	7	9	
T1	*Beauveria bassiana* 1.15 WP (1 x 10^8 cfu g^{-1})	2.51 (5.80)	1.90 (3.12)	1.66 (2.25)	1.79 (2.72)	1.78 (2.70)
T2	*Metarhizium anisopliae* 1.15 WP (1 x 10^8cfu g^{-1})	2.73 (6.95)	2.27 (4.64)	2.04 (3.68)	2.19 (4.28)	2.16 (4.20)
T3	*Lecanicillium lecanii* 2% AS (1x 10^8 cfu g^{-1})	2.63 (6.42)	2.25 (4.55)	2.02 (3.60)	2.18 (4.24)	2.15 (4.13)
T4	Azadirachtin 0.15 EC (1500 ppm)	2.80 (7.36)	2.26 (4.62)	2.06 (3.74)	2.22 (4.42)	2.18 (4.26)
T5	Neem oil @ 0.5%	2.67 (6.65)	1.92 (3.20)	1.67 (2.30)	1.82 (2.80)	1.80 (2.77)
T6	Novel plus @ 0.1%	2.65 (6.53)	2.28 (4.70)	2.19 (4.32)	2.25 (4.56)	2.24 (4.53)
T7	NSKE @ 5%	2.62 (6.35)	1.94 (3.25)	1.69 (2.36)	1.84 (2.88)	1.82 (2.83)
T8	Control (water spray)	2.54 (5.94)	2.58 (6.15)	2.58 (6.17)	2.74 (7.01)	2.63 (6.44)
	S.Em.±	0.12	0.09	0.09	0.10	0.05
	S.Em.± (P×T)	-	-	-	-	0.09
	CD at 5 %	NS	0.29	0.28	0.29	0.15
	CD at 5 % (P×T)	-	-	-	-	NS
	CV %	7.38	7.67	7.90	7.84	7.82

Figure in parentheses are retransformed value whereas, those outside are $\sqrt{x + 0.5}$ *transformed*

Table 2. Efficacy of biopesticides against jassid in moth bean after second spray

Sr. no.	Treatments	Mean no. of Jassid/3 leaves				
		Days after spray (DAS)			Pooled over periods	Pooled Over two sprays
		3	7	9		
T1	*Beauveria bassiana* 1.15 WP (1 x 10^8 cfu g^{-1})	1.78 (2.68)	1.32 (1.24)	1.26 (1.08)	1.45 (1.67)	1.62 (2.18)
T2	*Metarhizium anisopliae* 1.15 WP (1 x 10^8cfu g^{-1})	2.08 (3.84)	1.77 (2.64)	1.56 (1.92)	1.80 (2.80)	1.99 (3.50)
T3	*Lecanicillium lecanii* 2% AS (1x 10^8 cfu g^{-1})	2.07 (3.80)	1.76 (2.60)	1.54 (1.88)	1.79 (2.76)	1.97 (3.44)
T4	Azadirachtin 0.15 EC (1500 ppm)	2.09 (3.88)	1.79 (2.72)	1.60 (2.05)	1.83 (2.88)	2.00 (3.57)
T5	Neem oil @ 0.5%	1.80 (2.74)	1.36 (1.34)	1.27 (1.12)	1.48 (1.73)	1.64 (2.25)
T6	Novel plus @ 0.1%	2.24 (4.50)	2.02 (3.58)	1.67 (2.30)	1.98 (3.46)	2.11 (3.99)
T7	NSKE @ 5%	1.81 (2.79)	1.39 (1.44)	1.30 (1.18)	1.50 (1.80)	1.66 (2.32)
T8	Control (water spray)	2.71 (6.87)	2.66 (6.58)	2.09 (3.86)	2.49 (5.77)	2.56 (6.11)
	S.Em.±	0.09	0.08	0.10	0.05	0.05
	S.Em.± (P×T)	-	-	-	0.09	0.08
	CD at 5 %	0.28	0.26	0.29	0.15	0.14
	CD at 5 % (P×T)	-	-	-	NS	NS
	CV %	7.72	8.29	10.93	8.83	7.78

Figure in parentheses are retransformed value whereas, those outside are $\sqrt{x + 0.5}$ *transformed*

3.1.3 Pooled over two sprays

The pooled over two spray (Table 2) revealed that all the biopesticides were found significantly superior over control. Among different treatments, significantly lowest population of jassid was recorded in plots treated with *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) (2.18 per 3 leaves) and it was at par with neem oil 0.5% (2.25 per 3 leaves) and NSKE 5% (2.32 per 3 leaves). The next effective treatment was *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (3.44 per 3 leaves) and it was at par with *Metarhizium anisopliae*(1 x 10^8cfu g^{-1}) (3.50 per 3 leaves) and azadirachtin 0.15 EC (3.57 per 3 leaves). The treatment of novel plus 0.1% (3.99 per 3 leaves) was found less effective. The highest jassid population was recorded in control (6.11 per 3 leaves).

Sujatha and Bharpoda (2017) observed that among different treatments lowest jassid population was observed in *Beauveria bassiana* in green gram. Thus, present findings are in accordance with the earlier findings.

3.2 White fly, *Bemisia tabaci*(Genn.)

3.2.1 First spray

Pooled over periods result of first spray (Table 3) revealed that the lowest whitefly population was observed in the plot treated with *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) (2.76 per 3 leaves) and it was at par with neem oil 0.5% (2.90 per 3 leaves) and NSKE 5% (2.99 per 3 leaves). The next effective treatment was *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (4.10 per 3 leaves), it was at par with *Metarhizium anisopliae*(1 x 10^8cfu g^{-1}) (4.16 per 3 leaves) and azadirachtin 0.15 EC (4.28 per 3 leaves). The treatment of novel plus 0.1% (4.87 per 3 leaves) was found less effective. The highest whitefly population was recorded in control (6.56 per 3 leaves).

3.2.2 Second spray

Pooled over periods result of second spray (Table 4) revealed that the lowest whitefly population was observed in the plot treated with *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) (1.72 per 3 leaves) and it was at par with neem oil 0.5% (1.81 per 3 leaves) and NSKE 5% (1.91 per 3 leaves). The next effective treatment was *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (2.73 per 3 leaves) and it was at par with *Metarhizium anisopliae*(1 x 10^8cfu g^{-1}) (2.86 per 3 leaves)and azadirachtin 0.15 EC (2.97 per 3 leaves). The treatment of novel plus 0.1% (3.65 per 3 leaves) was found less effective. The highest whitefly population was recorded in control (5.07 per 3 leaves).

3.2.3 Pooled over two sprays

The pooled over two spray (Table 4) revealed that all the biopesticides were found significantly superior over control. Among different treatments, significantly lowest population of whitefly was recorded in plots treated with *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) (2.24 per 3 leaves) and it was at par with neem oil 0.5% (2.35 per 3 leaves) and NSKE 5% (2.45 per 3 leaves). The next effective treatment was *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (3.41 per 3 leaves) and it was at par with *Metarhizium anisopliae*(1 x 10^8cfu g^{-1}) (3.51 per 3 leaves) and azadirachtin 0.15 EC (3.63 per 3 leaves). The treatment of novel plus 0.1% (4.26 per 3 leaves) was found less effective. The highest whitefly population was recorded in control (5.81 per 3 leaves).

Singh et al. (2018) found that among different treatments *Beauveria bassiana* was highly effective against whitefly in green gram. thus, present findings are in confirmation with earlier findings.

3.3 Thrips, *Caliothrips indicus*(Bagnall)

3.3.1 First spray

Pooled over periods result of first spray (Table 5) revealed that the lowest thrips population was observed in the plot treated with neem oil 0.5% (3.05 per three leaves) and it was at par with azadirachtin 0.15 EC (3.25 per 3 leaves). The next effective treatment was *Beauveria bassiana* (1 x 10^8 cfu g^{-1}) (3.88 per 3 leaves) and it was at par with NSKE 5% (3.94 per three leaves). The remaining treatments *viz*., *Metarhizium anisopliae* (1 x 10^8cfu g^{-1}) (4.71 per 3 leaves), *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (4.87 per 3 leaves) and novel plus 0.1% (5.11 per 3 leaves) were found less effective and they were at par with each other.

3.3.2 Second spray

Pooled over periods result of second spray (Table 6) revealed that lowest thrips population was observed in the plot treated with neem oil 0.5% (2.14 per three leaves) and it was at par with azadirachtin 0.15 EC (2.22 per 3 leaves). The next effective treatment was *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) (3.10 per 3 leaves) and it was at par with NSKE 5% (3.10 per three leaves). The remaining treatments *viz*., *Metarhizium anisopliae* (1 x 10^8cfu g^{-1}) (3.83 per 3 leaves), *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (4.07 per 3 leaves) and novel plus 0.1% (4.17 per 3 leaves) were found less effective and they were at par with each other. The highest thrips population was recorded in control (5.26 per 3 leaves).

Table 3. Efficacy of biopesticides against whitefly in moth bean after first spray

Sr. no.	Treatments	Mean no. of Whitefly/3 leaves				
		Before Spray	Days after spray (DAS)			Pooled over periods
			3	7	9	
T1	*Beauveria bassiana* 1.15 WP (1 x 10^8 cfu g^{-1})	2.57 (6.10)	1.90 (3.12)	1.66 (2.25)	1.85 (2.92)	1.80 (2.76)
T2	*Metarhizium anisopliae* 1.15 WP (1 x 10^8cfu g^{-1})	2.59 (6.22)	2.30 (4.80)	2.03 (3.62)	2.14 (4.07)	2.16 (4.16)
T3	*Lecanicillium lecanii* 2% AS (1x 10^8 cfu g^{-1})	2.61 (6.32)	2.28 (4.69)	2.02 (3.58)	2.13 (4.02)	2.14 (4.10)
T4	Azadirachtin 0.15 EC (1500 ppm)	2.56 (6.06)	2.33 (4.92)	2.05 (3.72)	2.17 (4.20)	2.18 (4.28)
T5	Neem oil @ 0.5%	2.76 (7.12)	1.97 (3.40)	1.68 (2.31)	1.87 (2.98)	1.84 (2.90)
T6	Novel plus @ 0.1%	2.61 (6.32)	2.37 (5.14)	2.22 (4.42)	2.36 (5.05)	2.32 (4.87)
T7	NSKE @ 5%	2.63 (6.42)	1.99 (3.48)	1.73 (2.48)	1.87 (3.00)	1.86 (2.99)
T8	Control (water spray)	2.54 (5.98)	2.65 (6.51)	2.66 (6.57)	2.66 (6.59)	2.66 (6.56)
	S.Em.±	0.12	0.09	0.08	0.09	0.05
	S.Em.± (P×T)	-	-	-	-	0.08
	CD at 5 %	NS	0.27	0.26	0.26	0.14
	CD at 5 % (P×T)	-	-	-	-	NS
	CV %	8.06	6.84	7.36	7.02	7.06

Figure in parentheses are retransformed value whereas, those outside are $\sqrt{x + 0.5}$ transformed values

Table 4. Efficacy of biopesticides against whitefly in moth bean after second spray

Sr. no.	Treatments	Mean no. of Whitefly/3 leaves				
		Days after spray (DAS)			Pooled over periods	Pooled Over two sprays
		3	7	9		
T1	*Beauveria bassiana* 1.15 WP (1 x 10^8 cfu g^{-1})	1.81 (2.77)	1.35 (1.32)	1.26 (1.08)	1.47 (1.72)	1.64 (2.24)
T2	*Metarhizium anisopliae* 1.15 WP (1 x 10^8cfu g^{-1})	2.10 (3.92)	1.79 (2.72)	1.56 (1.94)	1.82 (2.86)	1.99 (3.51)
T3	*Lecanicillium lecanii* 2% AS (1x 10^8 cfu g^{-1})	2.09 (3.85)	1.72 (2.45)	1.54 (1.88)	1.78 (2.73)	1.96 (3.41)
T4	Azadirachtin 0.15 EC (1500 ppm)	2.13 (4.02)	1.82 (2.82)	1.61 (2.08)	1.85 (2.97)	2.02 (3.63)
T5	Neem oil @ 0.5%	1.83 (2.85)	1.41 (1.48)	1.26 (1.10)	1.50 (1.81)	1.67 (2.35)
T6	Novel plus @ 0.1%	2.24 (4.50)	2.06 (3.73)	1.80 (2.73)	2.03 (3.65)	2.17 (4.26)
T7	NSKE @ 5%	1.85 (2.92)	1.46 (1.62)	1.30 (1.20)	1.54 (1.91)	1.70 (2.45)

Sr. no.	Treatments	Mean no. of Whitefly/3 leaves				
		Days after spray (DAS)			Pooled over periods	Pooled Over two sprays
		3	7	9		
T8	Control (water spray)	2.64 (6.48)	2.38 (5.14)	2.02 (3.59)	2.35 (5.07)	2.50 (5.81)
	S.Em.±	0.09	0.08	0.07	0.04	0.04
	S.Em.± (P×T)	-	-	-	0.08	0.08
	CD at 5 %	0.27	0.25	0.21	0.13	0.13
	CD at 5 % (P×T)	-	-	-	NS	NS
	CV %	7.40	8.03	7.76	7.75	7.21

Figure in parentheses are retransformed value whereas, those outside are √x + 0.5 transformed values

Table 5. Efficacy of biopesticides against thrips in moth bean after first spray

Sr. no.	Treatments	Mean no. of Thrips/3 leaves				
		Before Spray	Days after spray (DAS)			Pooled over periods
			3	7	9	
T1	*Beauveria bassiana* 1.15 WP (1 x 10^8 cfu g^{-1})	2.90 (7.93)	2.14 (4.08)	1.97 (3.39)	2.16 (4.18)	2.09 (3.88)
T2	*Metarhizium anisopliae* 1.15 WP (1 x 10^8cfu g^{-1})	2.66 (6.60)	2.35 (5.03)	2.13 (4.02)	2.36 (5.07)	2.28 (4.71)
T3	*Lecanicillium lecanii* 2% AS (1x 10^8 cfu g^{-1})	2.65 (6.52)	2.39 (5.20)	2.16 (4.18)	2.39 (5.22)	2.31 (4.87)
T4	Azadirachtin 0.15 EC (1500 ppm)	2.90 (7.92)	2.07 (3.80)	1.83 (2.84)	1.90 (3.12)	1.93 (3.25)
T5	Neem oil @ 0.5%	2.83 (7.49)	1.99 (3.48)	1.77 (2.62)	1.88 (3.05)	1.88 (3.05)
T6	Novel plus @ 0.1%	2.67 (6.61)	2.41 (5.29)	2.25 (4.56)	2.45 (5.48)	2.37 (5.11)
T7	NSKE @ 5%	2.90 (7.93)	2.16 (4.19)	1.98 (3.43)	2.17 (4.20)	2.11 (3.94)
T8	Control (water spray)	2.55 (6.01)	2.70 (6.78)	2.71 (6.83)	2.74 (7.00)	2.72 (6.87)
	S.Em.±	0.13	0.09	0.09	0.09	0.05
	S.Em.± (P×T)	-	-	-	-	0.09
	CD at 5 %	NS	0.28	0.29	0.28	0.15
	CD at 5 % (P×T)	-	-	-	-	NS
	CV %	8.15	7.02	7.83	7.05	7.29

Figure in parentheses are retransformed value whereas, those outside are √x + 0.5 transformed values.

3.3.3 Pooled over two sprays

The pooled over two spray (Table 6) revealed that all the biopesticides were found significantly superior over control. Among different treatments, significantly lowest population of thrips was recorded in plots treated with neem oil 0.5% (2.60 per three leaves) and it was at par with azadirachtin 0.15 EC (2.74 per 3 leaves). The next effective treatment was *Beauveria bassiana*(1 x 10^8 cfu g^{-1}) (3.49 per 3 leaves) and it was at par with NSKE 5% (3.52 per three leaves). The remaining treatments *viz*., *Metarhizium anisopliae* (1 x 10^8cfu g^{-1}) (4.27 per 3 leaves), *Lecanicillium lecanii*(1x 10^8cfu g^{-1}) (4.47 per 3 leaves) and novel plus 0.1% (4.64 per 3 leaves) were found less effective and they were at par with each other. The highest thrips population was recorded in control (6.02 per 3 leaves).

Chaudhary et al*.* (2018) found that among different treatments neem oil 0.15%was highly effective against thrips in soybean which is in agreement with present findings.

Table 6. Efficacy of biopesticides against thrips in moth bean after second spray

Sr. no.	Treatments	Mean no. of Thrips/3 leaves				
		Days after spray (DAS)			Pooled over periods	Pooled Over two sprays
		3	7	9		
T1	*Beauveria bassiana* 1.15 WP (1×10^8 cfu g^{-1})	2.14 (4.10)	1.89 (3.08)	1.62 (2.12)	1.89 (3.10)	1.99 (3.49)
T2	*Metarhizium anisopliae* 1.15 WP (1×10^8cfu g^{-1})	2.35 (5.04)	2.12 (4.01)	1.72 (2.45)	2.07 (3.83)	2.17 (4.27)
T3	*Lecanicillium lecanii* 2% AS (1×10^8 cfu g^{-1})	2.37 (5.12)	2.14 (4.06)	1.88 (3.02)	2.13 (4.07)	2.22 (4.47)
T4	Azadirachtin 0.15 EC (1500 ppm)	1.89 (3.08)	1.70 (2.39)	1.30 (1.18)	1.63 (2.22)	1.78 (2.74)
T5	Neem oil @ 0.5%	1.87 (2.99)	1.68 (2.32)	1.27 (1.12)	1.61 (2.14)	1.74 (2.60)
T6	Novel plus @ 0.1%	2.40 (5.26)	2.15 (4.12)	1.90 (3.12)	2.15 (4.17)	2.26 (4.64)
T7	NSKE @ 5%	2.15 (4.12)	1.89 (3.09)	1.61 (2.09)	1.88 (3.10)	1.99 (3.52)
T8	Control (water spray)	2.70 (6.76)	2.48 (5.47)	2.20 (3.54)	2.46 (5.26)	2.59 (6.02)
	S.Em.±	0.10	0.10	0.09	0.05	0.05
	S.Em.± (P×T)	-	-	-	0.09	0.08
	CD at 5 %	0.29	0.31	0.28	0.16	0.14
	CD at 5 % (P×T)	-	-	-	NS	NS
	CV %	7.39	8.82	9.68	8.57	7.30

Figure in parentheses are retransformed value whereas, those outside are $\sqrt{x + 0.5}$ transformed values

4. CONCLUSION

Among the different biopesticides tested against sucking pests of moth bean, *Beauveria bassiana*(1×10^8 cfu g^{-1}), neem oil 0.5% and NSKE 5% was found most effective against jassid,*Empoasca motti* (Pruthi.) and whitefly,*Bemisia tabaci*(Genn.) whereas neem oil 0.5% and azadirachtin 0.15 EC was found most effective against thrips, *Caliothrips indicus* (Bagnall).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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