

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; 10(8): 802-806
www.biochemjournal.com
Received: 16-06-2026
Accepted: 19-07-2026

Aniket Krushna Tayde
P.G. Scholar, Department of
Entomology, Dr. PDKV,
Akola, Maharashtra, India

Dr. Pradnya S Kadam
Professor (CAS), Pulse
Research Unit, Dr. PDKV,
Akola, Maharashtra, India

Dr. DB Undirwade
Head Department of
Entomology, Dr. PDKV,
Akola, Maharashtra, India

Dr. PN Mane
Professor (CAS), Oilseed
Research Unit, Dr. PDKV,
Akola, Maharashtra, India

KM Idhol
Ph.D. Scholar, Department of
Entomology, Dr. P. D. K. V.,
Akola, Maharashtra, India

SD Adhagale
P.G. Scholar, Department of
Entomology, Dr. PDKV,
Akola, Maharashtra, India

Newton Reang
P.G. Scholar, Department of
Entomology, Dr. PDKV,
Akola, Maharashtra, India

Corresponding Author:
Aniket Krushna Tayde
P.G. Scholar, Department of
Entomology, Dr. PDKV,
Akola, Maharashtra, India

Efficacy of bio-pesticides and insecticides against pod borer in black gram (*Vigna mungo*)

Aniket Krushna Tayde, Pradnya S Kadam, DB Undirwade, PN Mane, KM Idhol, SD Adhagale and Newton Reang

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i8j.9792>

Abstract

The present investigation entitled “Efficacy of bio-pesticides and insecticides against pod borer in black gram” (*Vigna mungo*) was conducted during Kharif 2025-26 at the Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in a Randomized Block Design with nine treatments and three replications. The treatments included bio-pesticides and insecticides applied as two sprays at 45 and 60 days after emergence. Among the evaluated modules, M5 (Flubendiamide 39.35 SC @ 2 ml/10 L followed by Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC @ 4 ml/10 L) was the most effective in reducing the pod borer complex. It recorded the lowest mean larval population of *Spodoptera litura* (0.56 larvae/plant), *Helicoverpa armigera* (0.63 larvae/plant) and *Maruca vitrata* (0.67 larvae/plant). Modules M7 and M4 were the next most effective treatments, recording 0.58 and 0.68 larvae/plant for *S. litura*, 0.64 and 0.68 larvae/plant for *H. armigera*, and 0.72 and 0.76 larvae/plant for *M. vitrata*, respectively. Similarly, M5 recorded the lowest pod damage due to *H. armigera* (3.37%) and *M. vitrata* (8.30%), followed by M7 (3.68% and 8.50%) and M4 (4.08% and 8.91%), respectively. The highest grain yield was also recorded in M5 (13.17 q/ha), followed by M7 (12.15 q/ha) and M4 (11.80 q/ha), with these treatments being statistically at par.

Keywords: Black gram, *Vigna mungo*, *Maruca vitrata*, *Helicoverpa armigera*, *Spodoptera litura*

Introduction

Black gram (*Vigna mungo* (L.) Hepper) is a member of the leguminous group of crops belonging to the Fabaceae family and genus *Vigna* (Verdcourt, 1970) [20]. About 18 to 20 species of insect pests attack black gram in India (Nayar *et al.*, 1976 and Singh and Singh, 1977) [9, 14]. As many as 30 different insect pests belonging to various categories occur sequentially in various stages of growth of black gram crop (Dhuri and Singh, 1983) [6]. In India, quantitative avoidable losses (7 to 35%) caused by insect pest complex have been observed in black gram and green gram under various agroclimatic conditions. Annual yield loss due to insect pests has been estimated to 30 percent in urd bean and mung bean (Hamad and Dubey, 1983) [7]. The avoidable loss in yield due to insect pests in black gram was found to be 34.7 percent (Saxena, 1983) [12]. Every year, 2.5 to 3.0 million tonnes of pulses are lost due to pest problem (Rabindra *et al.*, 2004) [10]. Various insect pests cause damage to black gram during entire crop life span, right from planting to harvesting as well as during post-harvest storage period (Lal and Sachan, 1987) [8]. Noteworthy among the insect pests that cause serious economic damage to farmers are spotted pod borer (*Maruca vitrata* Geyer), gram pod borer (*Helicoverpa armigera* Hübner), blue butterfly (*Lampides boeticus* L.), plume moth (*Exelastis atomosa* Walsingham), and pod bug (*Clavigralla gibbosa* Spinola), (Reddy *et al.*, 1998) [11]. *Maruca vitrata* has a devastating effect as it enters into pods of leguminous crops to feed on the grains internally. Climatic factors such as temperature, humidity, and rainfall, all varying according to location and season, have an important role in the development and proliferation of these insect pests. These factors affect both the incidence of pest outbreak and damage caused by them to the crop. Moreover, pest population is regulated by the ecological factors such as presence of natural enemies (Becker, 1974) [3]. Hence, study of population dynamics of the pest becomes crucial for understanding their biological cycles as well as their ecological interactions.

This information is essential for formulating pest management practices according to their biological as well as the growth periods of the crop.

Materials and Methods

The present investigation was carried out to study the “Efficacy of bio-pesticides and insecticides against pod borer in black gram.” The field experiment was conducted during the *Kharif* season of 2025 at the Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola. The experiment was laid out in a Randomized Block Design (RBD) comprising nine treatment modules, including an untreated control, with three replications. The black gram variety PDKV Black Gold was used for the experiment. The crop was sown on 13 July 2025 at a spacing of 30 × 10 cm. The treatment modules consisted of different sequences of bio-pesticides and insecticides evaluated against the pod borer. Module M1 comprised *Bacillus thuringiensis* @ 20 g per 10 litres of water followed by *Bacillus thuringiensis* @ 20 g per 10 litres; Module M2 involved neem oil 2% followed by *Beauveria bassiana* (1 × 10⁸) @ 40 ml per 10 litres; Module M3 consisted of neem seed extract (NSE) 5% followed by *Metarhizium anisopliae* (1 × 10⁸) @ 40 ml per 10 litres; Module M4 included flubendiamide 39.35 SC @ 2 ml per 10 litres followed by novaluron 5.25% + indoxacarb 4.50 SC @ 17.5 ml per 10 litres; Module M5 comprised flubendiamide 39.35 SC @ 2 ml per 10 litres followed by chlorantraniliprole 9.3% + lambda-cyhalothrin 4.6 ZC @ 4 ml per 10 litres; Module M6 consisted of thiodicarb 75% WP @ 16 g per 10 litres followed by novaluron 5.25% + indoxacarb 4.50 SC @ 17.5 ml per 10 litres; Module M7 comprised thiodicarb 75% WP @ 16 g per 10 litres followed by chlorantraniliprole 9.3% + lambda-cyhalothrin 4.6 ZC @ 4 ml per 10 litres; Module M8 involved monocrotophos 36 EC @ 12.5 ml per 10 litres followed by chlorantraniliprole 18.5 SC @ 2.5 ml per 10 litres; and Module M9 was maintained as the untreated control. The first spray was applied at 50% flowering, while the second spray was applied 15 days after the first spray. Spraying was carried out using a knapsack sprayer with a spray volume of 500 litres/ha. The observations on the pod borer larval population were recorded from five randomly selected plants from each net plot. Observations were recorded 1 day before spraying and at 3, 7 and 10 days after each spray. The percentage reduction in pest population over the untreated control was calculated. At harvest, pod damage was recorded from five selected plants in each plot. The percentage pod damage was calculated using the following formula:

$$\text{Percentage of pod damage} = \frac{\text{Total no. of damaged pods.}}{\text{Total no. of examined pods.}} \times 100$$

Results and Discussion

Effect of different bio-pesticides and insecticides modules on larval population of *Helicoverpa armigera* (Mean).

The mean data on the larval population of *Helicoverpa armigera* recorded at 3, 7 and 10 days after the first and second sprays are presented in Table 1. The results revealed that the different bio-pesticides and insecticides modules were effective in reducing the larval population of *H. armigera* compared with the untreated control. Among the

different modules, Module M5, comprising Flubendiamide 39.35 SC @ 2 ml/10 L followed by Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC @ 4 ml/10 L, recorded the lowest mean larval population of 0.63 larvae plant⁻¹ and emerged as the most effective module. It was statistically at par with Module M7 (0.64 larvae plant⁻¹), Module M4 (0.68 larvae plant⁻¹), Module M6 (0.73 larvae plant⁻¹) and Module M8 (0.78 larvae plant⁻¹). The next effective group consisted of Module M1, in which *Bacillus thuringiensis* @ 1 kg ha⁻¹ was applied twice, recording a mean larval population of 0.95 larvae plant⁻¹, followed by Module M3 (0.99 larvae plant⁻¹), consisting of NSE 5% followed by *Metarhizium anisopliae* 1 × 10⁸ @ 40 ml/10 L, and Module M2 (1.04 larvae plant⁻¹), consisting of neem oil 2% followed by *Beauveria bassiana* 1 × 10⁸ @ 40 ml/10 L. The untreated control, Module M9, recorded the highest mean larval population of 1.62 larvae plant⁻¹. Thus, the sequential application of chemical insecticides, particularly M5, provided better suppression of *H. armigera* than the bio-pesticides-based modules.

The present findings are in close agreement with Taggar *et al.* (2021) [18], who evaluated novel insecticides against the pod borer complex in pigeon pea and reported that chlorantraniliprole 18.5 SC @ 150 ml/ha was highly effective against *H. armigera*, recording the lowest larval population of 0.22 larvae plant⁻¹ at 7 days after spray, followed by flubendiamide 480 SC @ 125 ml/ha with 0.37 larvae plant⁻¹. Similarly, Sireesha and Kumar (2022) [15] reported that chlorantraniliprole 18.5 SC provided the highest suppression of *H. armigera*, with an overall mean larval reduction of 74.32% across two sprays, followed by spinosad and indoxacarb.

Aleem and Yadav (2023) [1], who reported that chlorantraniliprole 18.5 SC was most effective against *Helicoverpa armigera*, recording the lowest larval population (1.122 larvae/plant), followed by spinosad 45 SC (1.289) and indoxacarb 14.5 SC (1.467). Sireesha and Kumar (2022) [15] reported maximum larval reduction with chlorantraniliprole (74.32%), followed by spinosad (70.00%) and indoxacarb (66.64%). Taggar *et al.* (2021) [18] recorded only 0.22 larvae/plant with chlorantraniliprole 18.5 SC, compared with 2.66 larvae/plant in the untreated control. Bhushan *et al.* (2011) [4] reported minimum larval population of 0.37 larvae/plant with NSKE, demonstrating its effectiveness against the pest.

Effect of different bio-pesticides and insecticides modules on larval population of *Maruca vitrata* (Mean).

The efficacy of different bio-pesticides and insecticides modules was evaluated based on the mean larval population of *Maruca vitrata* recorded at 3, 7 and 10 days after the first and second sprays, as presented in Table 1. The results revealed that all the tested bio-pesticides and insecticides modules significantly reduced the larval population of *M. vitrata* compared with the untreated control. Among the different modules, Module M5, comprising Flubendiamide 39.35 SC @ 2 ml/10 L followed by Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC @ 4 ml/10 L, recorded the lowest mean larval population of 0.67 larvae plant⁻¹ and emerged as the most effective module. It was statistically at par with Module M7 (0.72 larvae plant⁻¹), Module M4 (0.76 larvae plant⁻¹), Module M6 (0.82 larvae plant⁻¹) and Module M8 (0.88 larvae plant⁻¹).

The next effective group consisted of Module M1, comprising *Bacillus thuringiensis* @ 1 kg ha⁻¹ followed by *B. thuringiensis* @ 1 kg ha⁻¹, which recorded a mean larval population of 1.47 larvae plant⁻¹. It was followed by Module M3 (1.68 larvae plant⁻¹), consisting of NSE 5% followed by *Metarhizium anisopliae* 1 × 10⁸ @ 40 ml/10 L, and Module M2 (2.07 larvae plant⁻¹), consisting of neem oil 2% followed by *Beauveria bassiana* 1 × 10⁸ @ 40 ml/10 L. In contrast, the untreated control, Module M9, recorded the highest mean larval population of 4.83 larvae plant⁻¹. Thus, all the tested modules were superior to the untreated control in reducing the larval population of *M. vitrata*.

The present findings are in close agreement with Sonune *et al.* (2010) [16], who reported that chemical insecticides were highly effective against *Maruca vitrata* in black gram. Spinosad 0.009% recorded high larval mortality of 90.43, 90.48 and 85.05% at 3, 7 and 10 days after the first spray, respectively. It was followed by indoxacarb 0.008%, profenophos 0.05% and lambda-cyhalothrin 0.005%, which were statistically at par with spinosad. These findings support the present observation that insecticides-based modules were more effective in reducing *M. vitrata* larval population than the bio-pesticides-based modules.

Table 1: Effect of different bio-pesticides and insecticides modules on larval population of pod borer complex black gram.

Tr. No. (Module)	Module details	Average No. of <i>H. armigera</i> larvae/plant		Average No. of <i>M. vitrata</i> larvae/plant	
		1 DBS	Mean of two spray	1 DBS	Mean of two spray
M1	<i>Bacillus thuringiensis</i> 1Kg/ha fb <i>Bacillus thuringiensis</i> 1Kg/ha	1.56 (1.25)	0.95 (0.97)	4.53 (2.12)	1.47 (1.19)
M2	Neem oil 2% fb <i>Beauveria bassiana</i> 1×10 ⁸ @ 40 ml/10L	1.60 (1.26)	1.04 (1.02)	4.61 (2.14)	2.07 (1.44)
M3	NSE 5% fb <i>Metarhizium anisopliae</i> 1×10 ⁸ @ 40 ml/10L	1.54 (1.24)	0.98 (0.98)	4.55 (2.13)	1.68 (1.33)
M4	Flubendiamide 39.35 SC, 2 ml/10L fb Novaluron 05.25% + Indoxacarb 04.50% SC, 17.5 ml/10L	1.46 (1.20)	0.68 (0.84)	4.68 (2.16)	0.76 (0.87)
M5	Flubendiamide 39.35 SC, 2 ml/10L fb Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC 4 ml/10L	1.58 (1.26)	0.63 (0.81)	4.73 (2.17)	0.67 (0.82)
M6	Thiodicarb 75% WP, 16gm/10L fb Novaluron 05.25% + Indoxacarb 04.50% SC, 17.5 ml/10L	1.65 (1.28)	0.73 (0.87)	4.55 (2.13)	0.82 (0.90)
M7	Thiodicarb 75% WP, 16gm/10L fb Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC 4 ml/10L	1.48 (1.22)	0.64 (0.80)	4.58 (2.14)	0.72 (0.84)
M8	Monocrotophos 36 EC 12.5 ml/10L fb Chlorantraniliprole 18.5SC 2.5 ml/10L	1.59 (1.28)	0.77 (0.90)	4.79 (2.18)	0.88 (0.94)
M9	Untreated control	1.51 (1.23)	1.62 (1.47)	4.67 (2.16)	4.83 (2.20)
	'F' test	NS	Sig.	NS	Sig.
	SE (m) ±	-	0.04	-	0.09
	CD at 5%	-	0.15	-	0.28
	CV (%)	-	10.04	-	10.53

(Figures in parentheses are the corresponding square root transformed values, DBS = Days before spraying)

Effect of bio-pesticides and insecticides modules on percent pod damage due to *Helicoverpa armigera* at harvest.

The efficacy of various bio-pesticides and insecticides modules against pod damage caused by *Helicoverpa armigera* in black gram is summarized in Table 2. The results revealed that all treatment modules significantly reduced pod damage compared to the untreated control. Among the treatments, Module M5 (Flubendiamide 39.35 SC @ 2 ml/10 L followed by Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC @ 4 ml/10 L) recorded the lowest pod damage of 3.37%, emerging as the most effective module. Module M5 was followed by M7 and M4, which recorded 3.68% and 4.08% pod damage, respectively, and were statistically at par with each other. The next effective module was M6, which recorded 4.58% pod damage, followed by M8 (5.00%). Among the bio-pesticides modules, M1, M3 and M2 recorded 7.00%, 8.19% and 9.06% pod damage, respectively. The untreated control (M9) recorded the highest pod damage of 11.97%. These findings indicate that all tested modules were effective in reducing *H. armigera* pod damage, with M5 showing the highest efficacy under field conditions. Similarly, Taggar *et al.* (2021) [18] reported that chlorantraniliprole 18.5 SC was highly effective against *H. armigera*, recording 1.09% pod damage, followed by flubendiamide with 1.40%, compared with 8.62% in the untreated control.

Effect of bio-pesticides and insecticides modules on percent pod damage due to *Maruca vitrata* at harvest.

The efficacy of various bio-pesticides and insecticides modules against pod damage caused by *Maruca vitrata* in black gram is summarized in Table 2. The results revealed that pod damage ranged from 8.30 to 20.24%, and all treatment modules were significantly superior to the untreated control. Among the treatments, Module M5 (Flubendiamide 39.35 SC @ 2 ml/10 L followed by Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC @ 4 ml/10 L) recorded the lowest pod damage of 8.30%, indicating the highest efficacy against *M. vitrata*. Module M5 was followed by M7 and M4, which recorded 8.50% and 8.91% pod damage, respectively, and were statistically at par with each other. The next effective modules were M6 (9.56%) and M8 (10.00%), followed by M1 (10.55%). Among the bio-pesticides-based modules, M3 and M2 recorded 13.08% and 14.66% pod damage, respectively. In contrast, the untreated control (M9) recorded the highest pod damage of 20.24%. These findings indicated that the insecticides-based modules, particularly M5, were more effective in reducing *M. vitrata* pod damage under field conditions. Similar findings were reported by Shobharani *et al.* (2025) [13], who recorded the lowest pod damage of 2.48% with chlorantraniliprole 18.50% SC, followed by flubendiamide 20% WG (3.19%), compared with 22.68% in the untreated control. Sonune *et al.* (2010) [16] also reported lower pod damage with spinosad (7.53%) followed by

indoxacarb (7.78%) and lambda-cyhalothrin (9.21%) against *M. vitrata* in black gram. Similarly, Selvam (2018) [17] reported maximum reduction in pod damage (74.72%) with chlorpyrifos, followed by neem oil (65.99%) and azadirachtin (65.84%), supporting the present findings.

Effect of different bio-pesticides and insecticides modules on yield of black gram.

The effect of various bio-pesticides and insecticides modules on grain yield of black gram is summarized in Table 2. The results revealed that all treatment modules produced higher grain yield than the untreated control. Module M5 (Flubendiamide 39.35 SC @ 2 ml/10 L followed by Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC @ 4 ml/10 L) recorded the highest grain yield of 13.17 q/ha and was statistically at par with M7 (12.15 q/ha) and M4 (11.80 q/ha). The next effective modules were M6, M8 and M1, which recorded 11.16, 10.75 and 10.00 q/ha,

respectively, and were statistically at par with each other. Modules M3 and M2 recorded comparatively lower yields of 9.40 and 8.55 q/ha, respectively, while the untreated control (M9) recorded the lowest grain yield of 7.30 q/ha. These findings indicate that effective management of pod borer infestation resulted in higher grain yield, with M5 showing the best performance under field conditions. Similar results were reported by Anusha *et al.* (2021) [2], who recorded the highest seed yield of 412 kg/ha with spinosad, followed by Dipel (392 kg/ha), *Bacillus thuringiensis* (375 kg/ha) and *Metarhizium anisopliae* (362 kg/ha) in black gram. Sireesha and Ashwani Kumar (2022) [15] also reported higher seed yield with chlorantraniliprole 18.5 SC (16.9 q/ha), followed by spinosad (16.3 q/ha) and indoxacarb (15.7 q/ha) in greengram. Similarly, Umbarkar *et al.* (2014) [19] recorded the highest yield with indoxacarb (1516 kg/ha), followed by spinosad (1467 kg/ha) and profenophos (1385 kg/ha), supporting the present findings.

Table 2: Effect of bio-pesticides and insecticides modules on percent pod damage caused by pod borers at harvest and grain yield of black gram

Tr. No.	Treatments details	Pod damage (%)		Yield (q/ha)
		<i>Helicoverpa armigera</i>	<i>Maruca vitrata</i>	
M1	<i>Bacillus thuringiensis</i> 1Kg/ha fb <i>Bacillus thuringiensis</i> 1Kg/ha	7.00 (2.64)	10.55 (3.24)	10.00
M2	Neem oil 2% fb <i>Beauveria bassiana</i> 1×10 ⁸ @ 40 ml/10L	9.06 (3.00)	14.66 (3.82)	8.55
M3	NSE 5% fb <i>Metarhizium anisopliae</i> 1×10 ⁸ @ 40 ml/10L	8.19 (2.98)	13.08 (3.61)	9.40
M4	Flubendiamide 39.35 SC, 2 ml/10L fb Novaluron 05.25% + Indoxacarb 04.50% SC, 17.5 ml/10L	4.08 (2.01)	8.91 (2.98)	11.80
M5	Flubendiamide 39.35 SC, 2 ml/10L fb Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC 4 ml/10L	3.37 (1.83)	8.30 (2.88)	13.17
M6	Thiodicarb 75% WP, 16gm/10L fb Novaluron 05.25% + Indoxacarb 04.50% SC, 17.5 ml/10L	4.58 (2.14)	9.56 (3.09)	11.16
M7	Thiodicarb 75% WP, 16gm/10L fb Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6 ZC 4 ml/10L	3.68 (1.91)	8.50 (2.91)	12.15
M8	Monocrotophos 36 EC 12.5 ml/10L fb Chlorantraniliprole 18.5SC 2.5 ml/10L	5.00 (2.23)	10.00 (3.16)	10.75
M9	Untreated control	11.97 (3.45)	20.24 (4.49)	7.30
	SE (m)±	0.09	0.13	0.66
	CD at 5%	0.29	0.40	1.41
	CV%	7.00	7.06	7.83

(Figures in parentheses are the corresponding square root transformed values, DAS = Days after spraying)

Conclusion

Among the different bio-pesticides and insecticides modules evaluated against the pod borer complex in black gram, Module M5 was found to be the most effective, as it recorded the lowest larval population and minimum pod damage, along with the highest grain yield. Module M7 was the next best-performing module. Overall, Module M5 showed superior performance in reducing pest population and pod damage and improving grain yield, while the other effective modules also provided satisfactory pest management. Thus, Module M5 can be considered a promising option for effective management of the pod borer complex and for improving productivity in black gram.

Acknowledgment

The authors are grateful to the Pulse Research Unit and Department of Entomology, Post Graduate Institute, Dr. PDKV, Akola, MS, India, for providing all the necessary facilities for conducting the present research work.

References

- Aleem SA, Yadav U. Efficacy of bio-pesticides and chemicals against gram pod borer [*Helicoverpa armigera* (Hubner)] on greengram (*Vigna radiata* (L.) Wilczek). International Journal of Plant & Soil Science. 2023;35(17):608-614.
- Anusha N, Kumar DS, Madhumathi T, Kumari VP, Chiranjeevi C. Field evaluation of microbial control agents against spotted pod borer *Maruca vitrata* on black gram. 2021.
- Becker PC. Pest of ornamental plants. London: Ministry of Agriculture, Fisheries and Food; 1974.
- Bhushan S, Singh RP, Shanker R. Bio-efficacy of neem and Bt against pod borer, *Helicoverpa armigera* in chickpea: management of *Helicoverpa armigera* using certain biopesticides. Journal of Biopesticides. 2011;4(1):87-89.
- Bhushan S, Singh RP, Shanker R. Bio-efficacy of neem and Bt against pod borer, *Helicoverpa armigera* in chickpea: management of *Helicoverpa armigera* using certain biopesticides. Journal of Biopesticides. 2011;4(1):87-89.
- Dhuri AV, Singh KM. Pest complex succession of insect pests in black gram (*Vigna mungo* L. Hepper). Indian Journal of Entomology. 1983;45(4):396-401.
- Hamad SE, Dubey SL. Losses due to insect pests in North Bihar. Indian Journal of Entomology. 1983;1:136-146.
- Lal SS, Sachan JN. Recent advances in pest management in pulses. Indian Farming. 1987;37(7):54-58.

9. Nayar KK, Ananthakrishnan TN, David BV. General and applied entomology. New Delhi: Tata McGraw Hill; 1976. p. 589.
10. Rabindra RJ, Ballali CR, Ramanujan B. Biological options for insect pests and nematode management in pulses. In: Pulses in new perspective. New Delhi: Kalyani Publishers; 2004. p. 487.
11. Reddy NC, Singh Y, Singh VS. Pest complex and their succession on pigeon pea variety P-33. Indian Journal of Entomology. 1998;60(4):334-335.
12. Saxena HP. Losses in black gram due to insect pests. Indian Journal of Entomology. 1983;2:294-297.
13. Shobharani M, Rachappa VH. Evaluation of different insecticides against lepidopteran pests of black gram. Archives of Current Research International. 2025;25(9):1-7.
14. Singh KM, Singh RN. Succession of insect pests in green gram and black gram under dryland condition at Delhi. Indian Journal of Entomology. 1977;39(4):365-370.
15. Sireesha BS, Kumar A. Efficacy of selected insecticides against pod borer [*Helicoverpa armigera* (Hubner)] on green gram. The Pharma Innovation Journal. 2018;11(8):944-948.
16. Sonune VR, Bharodia RK. Black gram, *Maruca vitrata* (Fabricius), chemical insecticides. Legume Research. 2010;33(4):287-290.
17. Selvam K. Efficacy of botanicals and entomogenous fungi against major pod borers of black gram. Biopesticides International. 2018;14(2):109-122.
18. Taggar GK, Singh R, Randhawa HS, Cheema HK. Novel insecticides for the management of pod borer complex in pigeonpea crop. Legume Research-An International Journal. 2021;44(10):1179-1185.
19. Umbarkar PS, Parsana GJ. Field efficacy of different insecticides against spotted pod borer, *Maruca vitrata* (Geyer) infesting green gram. Journal of Industrial Pollution Control. 2014;30:227-230.
20. Verdcourt B. Studies in the Leguminosae Papilionoideae for the 'Flora of Tropical East Africa' IV. Kew Bulletin. 1970;24:507-569.