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Evaluation of Different Insecticides against Lepidopteran Pests of Blackgram

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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

The annual yield loss due to insect pests has been estimated at 30 per cent in black gram. As black gram is a short-duration crop, farmers primarily rely on pesticides for the management of insect pests. Hence, the present study was undertaken to evaluate the efficacy of a novel insecticides *viz.,* chlorantraniliprole 18.50% SC, Novaluron 05.25%+ Indoxacarb 04.50% SC, Thiodicarb 75% WP, Emamectin benzoate 5% SG, Spinetoram 5.66% + Methoxyfenozide 28.3% SC, Flubendiamide 20% WG (Check) and Untreated control against lepidopteron pests in blackgram under field conditions during *kharif* - 2022 and 2023 at ARS, Bidar and ZARS, Kalaburagi, Karnataka.. Among the different insecticides evaluated, Chlorantraniliprole 18.50 % SC @ 0.2 ml/l and Novaluron 5.25% + Indoxacarb 4.5% SC @ 1.75 ml/l were proven to be the best treatments for the management of lepidopteron pests in black gram with an increase in the yields.

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Keywords: Lepidopteran pests; blackgram; chlorantraniliprole 18.50 % SC; novaluron 5.25%+indoxacarb 4.5% SC; insecticides.

1. INTRODUCTION

"Black gram, *Vigna mungo* (L.) is an important pulse crop grown throughout India. It has rich source of protein, phosphoric acid, and has established itself as a highly valuable crop with the ability to improve the soil by fixing atmospheric nitrogen. The area under black gram in India is about 3.25 million ha with production of 1.81 million tones and productivity of 463 kg /ha. Though black gram is grown in alarge area, the productivity was low due to various biotic and abiotic stresses. Among the several factors responsible for such poor yield, undoubtedly, insect infestation is considered one of the most important factors. In India, about 18 species of insect pests damage the black gram" (Singh & Singh, 1977). Among them, "whiteflies (*Bemisia tabaci*), leafhoppers (*Empoasca kerri*), Bihar hairy caterpillars (*Spilosoma obliqua*), tobacco caterpillars (*Spodoptera litura*), spotted pod borer (*Maruca vitrata*), Gram pod borer (*Helicoverpa armigera*), blue butterfly (*Lampides boeticus*), Plume moth (*Exelastis atomosa*) are known to cause considerable damage to blackgram crop, leading to reduced yields and compromised quality" (Reddy *et al*., 1998; Choudhary *et al*.,2024).

"The annual yield loss due to insect pests has been estimated at 30 per cent in urdbean and mung bean" (Hamad & Dubey, 1983). In black gram, "the avoidable loss in yield due to insect pests was recorded to be 34.7 per cent" (Saxena, 1983). Chhabra and Kooner (1985) found "54.3 per cent of losses caused by insect pests complex in urdbean". Since black gram is a short-duration crop, farmers rely mainly on pesticides for the management of insect pests in black gram. Hence, the present study was undertaken to evaluate the efficacy of a novel insecticide against lepidopteran pests in black gram under field conditions.

2. MATERIALS AND METHODS

A field experiment was conducted at two locations (Agricultural Research Station, Bidar, and Zonal Agricultural Research Station, Kalaburagi) during *kharif*-2022 and 2023 to evaluate the bio-efficacy of insecticides in black gram against lepidopteron pests. The trial was laid out in randomized block design with seven treatments replicated thrice. Black gram variety, TAU-1, was sown at 30 cm × 10 cm spacing, and all the recommended package of practices was followed to raise the crop, except for plant protection measures. The first spray was done at the initiation of pest infestation in all the experimental plots, and one more spray was given based on pest incidence. Observations on pre-treatment larval counts of lepidopterans were recorded one day before treatment imposition, and post-treatment counts were recorded at 3, 7, and 10 days after imposition of treatment on randomly selected five plants per treatment in each replication. The observations recorded were subjected to square root transformation and statistical analysis.

The percentage foliage damage was calculated on the basis of visual observations from five randomly selected plants from each plot at flowering and peak incidence of larvae by following the standard procedure (Institute of Agriculture and Natural Resources).

Per cent pod damage was worked at the time of harvest by selecting ten plants from each treatment, and per cent pod damage was calculated by using the following formula given by Jackai *et al*. (1988).

$$\text{Per cent pod damage} = \frac{Number\ of\ pods\ damaged}{Total\ number\ of\ pods} \times 100$$

Foliage and pod damage were subjected to arc sine transformation and statistical analysis.

The seed yield was recorded plot-wise at the time of harvest and converted to a hectare basis and subjected to statistical analysis.

3. RESULTS AND DISCUSSION

Management of lepidopteron insect pests infesting black gram with novel insecticides was carried out at two locations, *viz.,* Agricultural Research Station, Bidar, and ZARS, Kalaburagi, for two seasons. The results were pooled across seasons, summarized, and presented location-wise (Tables 1 and 2).

3.1 ARS, Bidar

One day before the first spray, larval population ranged from 2.33 to 2.87 larvae per five plants in all the treatments, and there was no significant

Table 1. Management of lepidopteran pests in blackgram during *Kharif,* 2022 and 2023 at ARS, Bidar (Pooled data)

Tr. No.	Treatments	Dosage per lit	lepidopteron pests (Larvae/ 5 plants)								Foliage damage (%) **	Pod damage (%) **	Yield (q/ha)
			First Spray*				Second spray*						
			1DBS	3DAS	7DAS	10 DAS	1DBS	3DAS	7DAS	10 DAS			
1	Chlorantraniliprole 18.50% SC	0.2 ml	2.87 (1.97)	0.60 (1.26)	0.37 (1.17)	0.80 (1.34)	1.30 (1.52)	0.37 (1.17)	0.10 (1.05)	0.00 (1.00)	2.86 (9.60)	2.80 (9.62)	11.29
2	Novaluron 5.25%+ Indoxacarb 4.50% SC	1.75 ml	2.80 (1.95)	0.77 (1.33)	0.50 (1.22)	1.00 (1.41)	1.37 (1.53)	0.60 (1.26)	0.30 (1.14)	0.15 (1.07)	4.00 (11.17)	3.95 (11.45)	10.71
3	Thiodicarb 75% WP	1.5 g	2.33 (1.82)	1.27 (1.50)	1.03 (1.43)	2.40 (1.84)	1.73 (1.65)	1.17 (1.47)	1.03 (1.43)	0.86 (1.36)	14.24 (22.16)	16.18 (23.69)	7.88
4	Emamectin benzoate 5% SG	0.2 g	2.80 (1.95)	1.00 (1.41)	0.73 (1.32)	1.17 (1.47)	1.53 (1.59)	0.72 (1.31)	0.60 (1.26)	0.43 (1.20)	7.17 (15.45)	6.53 (14.69)	10.13
5	Spinetoram 5.66% + Methoxyfenozide 28.3% SC	0.75 ml	2.60 (1.89)	0.97 (1.40)	0.60 (1.26)	1.03 (1.42)	1.40 (1.55)	0.63 (1.28)	0.43 (1.20)	0.17 (1.08)	4.52 (12.08)	4.12 (11.64)	10.56
6	Flubendiamide 20% WG (Check)	0.5 g	2.40 (1.84)	0.72 (1.31)	0.43 (1.20)	0.87 (1.37)	1.40 (1.55)	0.50 (1.22)	0.23 (1.11)	0.10 (1.05)	3.48 (10.55)	3.55 (10.85)	10.96
7	Untreated control	--	2.53 (1.88)	3.04 (2.00)	3.43 (2.10)	3.77 (2.17)	3.97 (2.21)	3.83 (2.19)	3.37 (2.08)	3.20 (2.04)	26.99 (31.25)	21.89 (27.85)	6.38
SEm±			0.04	0.05	0.05	0.06	0.09	0.05	0.06	0.05	0.63	0.52	0.31
CD(0.05)			NS	0.14	0.16	0.20	0.26	0.16	0.17	0.15	1.95	1.60	0.97

DAS: Days After Spray; DBS: Days Before Spray; SEM: Stand error of the mean; CD: Critical difference

** Figures in the parentheses are square root transformed values √(x+1)*

***Figures in the parentheses are arc sine transformed values*

Table 2. Management of lepidopteran pests in blackgram during *Kharif,* 2022 and 2023 at ZARS, Kalaburagi (Pooled data)

Tr. No.	Treatments	Dosage per lit	lepidopteron pests (Larvae/ 5 plants)								Foliage damage (%) **	Pod damage (%) **	Yield (q/ha)
			First Spray*				Second spray*						
			1DBS	3DAS	7DAS	10 DAS	1DBS	3DAS	7DAS	10 DAS			
1	Chlorantraniliprole 18.50% SC	0.2 ml	2.90 (1.97)	0.31 (1.14)	0.14 (1.07)	0.74 (1.97)	1.14 (1.46)	0.13 (1.06)	0.07 (1.03)	0.00 (1.03)	2.80 (9.62)	2.48 (9.05)	11.47
2	Novaluron 05.25%+ Indoxacarb 04.50% SC	1.75 ml	2.74 (1.93)	0.34 (1.16)	0.19 (1.09)	1.21 (1.89)	1.40 (1.55)	0.33 (1.15)	0.17 (1.08)	0.08 (1.54)	4.74 (12.57)	3.58 (10.74)	10.72
3	Thiodicarb 75% WP	1.5 g	2.55 (1.88)	1.16 (1.47)	0.83 (1.35)	2.88 (2.17)	2.57 (1.87)	0.93 (1.38)	0.80 (1.34)	0.77 (1.24)	12.38 (20.57)	16.78 (24.17)	7.91
4	Emamectin benzoate 5% SG	0.2 g	2.90 (1.97)	0.84 (1.35)	0.73 (1.31)	1.67 (2.14)	1.87 (1.69)	0.73 (1.29)	0.47 (1.21)	0.43 (1.13)	6.95 (15.19)	7.51 (15.89)	9.87
5	Spinetoram 5.66% + Methoxyfenozide 28.3% SC	0.75 ml	2.70 (1.92)	0.33 (1.15)	0.16 (1.08)	1.03 (1.91)	1.53 (1.59)	0.61 (1.26)	0.23 (1.11)	0.10 (1.20)	5.06 (12.98)	3.70 (11.07)	10.69
6	Flubendiamide 20% WG (Check)	0.5 g	2.58 (1.88)	0.43 (1.19)	0.17 (1.08)	1.02 (1.71)	1.27 (1.51)	0.27 (1.12)	0.13 (1.06)	0.07 (1.05)	3.78 (11.19)	3.19 (10.28)	11.02
7	Untreated control	--	2.49 (1.86)	3.33 (2.08)	3.29 (2.06)	3.80 (2.13)	3.71 (2.17)	3.80 (2.18)	3.53 (2.12)	3.24 (1.05)	30.63 (33.57)	22.68 (28.42)	6.51
SEm±			0.05	0.05	0.06	0.04	0.05	0.05	0.04	0.05	0.30	0.38	0.33
CD(0.05)			NS	0.13	0.17	0.11	0.15	0.16	0.12	0.15	0.93	1.16	1.00

DAS: Days After Spray; DBS: Days before spray; SEM: Stand error of the mean; CD: Critical difference

** Figures in the parentheses are square root transformed values √(x+1)*

***Figures in the parentheses are arc sine transformed values*

difference among the treatments. Three days after spraying Chlorantraniliprole 18.50% SC recorded the lowest larval population of 0.60 larvae/5 plants and it was on par with the standard check, Flubendiamide 20% WG, with 0.72 larvae/ 5 plants. These two treatments were followed by Novaluron 5.25%+ Indoxacarb 4.50% SC, Spinetoram 5.66% + Methoxyfenozide 28.3% SC, and Emamectin benzoate 5% SG with larval population of 0.77, 0.97, and 1 larvae/5 plants, respectively. However, the highest population was recorded in untreated control with 3.04 larvae/ 5 plants (Table 1). During seven and ten days after first spray same trend was followed concerning the efficacy of insecticides in managing the lepidopteron pests in black gram.

During one day before the second spray, all the treatments were found effective in managing the lepidopteron pests throughout the cropping period and recorded less larval population compared to the untreated check, which recorded 3.97 larvae/ 5 plants.

Three days after second spray, chlorantraniliprole 18.50% SC recorded the lowest larval population of 0.37 larvae/5 plants and was on par with the standard check flubendiamide 20% WG with 0.50 larvae/ 5 plants. These two treatments were followed by novaluron 5.25%+ indoxacarb 4.50% SC, spinetoram 5.66% + methoxyfenozide 28.3% SC, and emamectin benzoate 5% SG with larval population of 0.60, 0.63, and 0.72 larvae/5 plants, respectively. However, the highest population was recorded in the untreated control with 3.83 larvae/ 5 plants (Table 1). During seven and ten days after the second spray same trend was followed with respect to the efficacy of insecticides in managing the lepidopteran pests in black gram.

Foliage and Pod damage: The lowest percent foliage damage (2.86 %) and pod damage (2.80 %) was recorded in the plots treated with chlorantraniliprole 18.50% SC, and was on par with the standard check, Flubendiamide 20% WG, with 3.48 and 3.55 percent foliage and pod damage, respectively. The next best treatments were novaluron 5.25%+ indoxacarb 4.50% SC and spinetoram 5.66% + methoxyfenozide 28.3% SC, with 4.00, 4.52 % foliage damage and 3.95 and 4.12 % pod damage, respectively. The untreated control recorded the highest foliage (26.99 %) and pod damage (21.89 %).

Seed Yield: The seed yield levels varied from 6.38 to 11.29 q/ha. The treatment comprising of chlorantraniliprole 18.50% SC has recorded significantly highest seed yield (11.29 q/ha), which was on par with standard check flubendiamide 20% WG with 10.96 q/ha. The plots treated with novaluron 5.25%+ indoxacarb 4.50% SC, spinetoram 5.66% + methoxyfenozide 28.3% SC, and emamectin benzoate 5% SG recorded seed yield of 10.71, 10.56 and 10.13 q/ha, respectively. The untreated control recorded the lowest seed yield of 6.38 q/ha.

3.2 ZARS, Kalaburagi

One day before the first spray, larval population ranged from 2.49 to 2.90 larvae per five plants in all the treatments, and there was no significant difference among the treatments. Three days after spraying chlorantraniliprole 18.50% SC recorded the lowest larval population of 0.31 larvae/5 plants and it was on par with spinetoram 5.66% + methoxyfenozide 28.3% SC with 0.33 larvae/5 plants. These two treatments were followed by novaluron 5.25%+ indoxacarb 4.50% SC, flubendiamide 20% WG and emamectin benzoate 5% SG with larval populations of 0.34, 0.43, and 0.84 larvae/5 plants, respectively. Seven days after spraying chlorantraniliprole 18.50% SC, spinetoram 5.66% + methoxyfenozide 28.3% SC, flubendiamide 20% WG, Novaluron 5.25%+ Indoxacarb 4.50% SC recorded 0.16,0.17,0.19,0.73 larvae/ 5 plants respectively and found on par with each other. The untreated control recorded 3.29 larvae/ 5 plants. At 10 days after first spray same trend was observed.

During one day before the second spray, all the treatments were found effective in managing the lepidopteran pests throughout the cropping period and recorded less larval population compared to the untreated check, which recorded 3.71 larvae/ 5 plants. Three days after second spray, chlorantraniliprole 18.50% SC recorded the lowest larval population of 0.13 larvae/5 plants and was on par with the standard check flubendiamide 20% WG with 0.27 larvae/ 5 plants. These two treatments were followed by novaluron 5.25%+ indoxacarb 4.50% SC, spinetoram 5.66% + methoxyfenozide 28.3% SC and emamectin benzoate 5% SG with larval population of 0.33, 0.61, and 0.73 larvae/5 plants, respectively. However, the highest population was recorded in the untreated control with 3.80 larvae/ 5 plants (Table 1). During seven and ten days after the second spray same trend

was followed in managing the lepidopteran pests in black gram.

Foliage and Pod damage: The lowest percent foliage damage (2.80 %) and pod damage (2.48 %) was recorded in the plots treated with chlorantraniliprole 18.50% SC, and was on par with the standard check flubendiamide 20% WG with 3.78 and 3.19 percent foliage and pod damage, respectively. The next best treatments were novaluron 5.25%+ indoxacarb 4.50% SC and spinetoram 5.66% + methoxyfenozide 28.3% SC with 4.74, 5.06 % foliage damage and 3.58 and 3.70 % pod damage, respectively. The untreated control recorded the highest foliage (30.63 %) and pod damage (22.68 %).

Seed Yield: The seed yield levels varied between 6.51 to 11.47 q/ha. The treatment comprising chlorantraniliprole 18.50% SC has recorded significantly highest yield (11.47 q/ha), which was on par with standard check flubendiamide 20% WG with 11.02 q/ha. The plots treated with novaluron 5.25%+ indoxacarb 4.50% SC, spinetoram 5.66% + methoxyfenozide 28.3% SC, emamectin benzoate 5% SG recorded grain yield of 10.72, 10.69, 9.87 q/ha respectively. The untreated control recorded the lowest grain yield of 6.51 q/ha.

In the present study, chlorantraniliprole 18.50% SC, flubendiamide 20% WG, novaluron 5.25%+ indoxacarb 4.50% SC, spinetoram 5.66% + methoxyfenozide 28.3% SC, and emamectin benzoate 5% SG were found effective in managing the lepidopteron pests on black gram throughout the cropping period, and all of them were found on par with each other. The present results are in line with Swathi *et. al*., (2019), who reported that Chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5ml/l was found to be very effective by recording 75.91 per cent overall mean reduction in *M. vitrata* larval population with lowest pod damage (7.04%) over control (60.58%) and also recorded highest grain yield (8.31 q ha-1) followed by chlorantraniliprole 18.5 SC @ 0.0037% and flubendiamide @ 39.35 SC 0.00787% with 72.04 and 67.30 per cent overall reduction in mean larval population of *M. vitrata* over untreated control. Further, Girish *et al*. (2018) reported that Chlorantraniliprole 18.5% SC was found most effective against Bihar Hairy Caterpillar infesting black gram and recorded the highest yield of 1012.3 kg/ha. Further, spraying of Flubendiamide 3.5% + Hexaconazole5% WG @ 1250 g/ha was proved to be ideal for the management of *Spodoptera litura*, Helicoverpa *armigera and* powdery mildew disease in black gram with increase in the yield (Shobharani *et. al*., 2020). Shobharani *et. al*., 2019 reported “that Novaluron 5.25% + Indoxacarb 4.5% SC @ 875 ml/ha and 825 ml/ha were proven superior by recording the lowest larval population of lepidopteron pests and recorded the highest grain yield in soybean crop”.

“Two sprays of spinetoram 6% w/v + methoxyfenozide 30% w/v SC @ 144 g a.i/ha and flubendiamide 34.35 SC @ 48 g a.i/ ha from 45 DAS at 15 days interval proved to be most effective and superior in reducing the lepidopteran pod borers like *M. vitrata and L. boeticus on* green gram” (Srinivasan *et. al*., 2023). Thilagam *et al.,* 2025 found Spinetoram 5.66% + Methoxyfenozide 28.3% SC was effective in managing the pod borers in red gram and also enhanced the yield of red gram. Manjunath *et. al., (*2019) found emamectin benzoate 5 SG + DDVP 76 EC effective in managing the spotted pod borer, *Maruca vitrata* (Geyer) infesting black gram and found next best treatment to profenophos 50 EC + DDVP 76 EC.

4. CONCLUSION

All the insecticides *viz*., Chlorantraniliprole 18.50% SC, Flubendiamide 20% WG, Novaluron 5.25%+ Indoxacarb 4.50% SC, Spinetoram 5.66% + Methoxyfenozide 28.3% SC, and Emamectin benzoate 5% SG were found effective in managing the lepidopteron pests on black gram throughout the cropping period, and all of them were found on par with each other. Hence, any of these insecticides can be effectively used for managing the lepidopteran insect pests on black gram.

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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