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The Field Efficacy of Newer Insecticide Molecules against Major Pod Borers of Black Gram

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Abstract

The purpose of this study is to observe newer insecticide molecules against pod borer complex such as *Maruca vitrata, Euchrysops cnejus*. Field experiments were conducted during 2017-2018 to study black gram under rainfed condition 6.20. Flubendiamide 480 SC recorded the lowest larval population of *Maruca vitrata* (2.40 larvae/plant) under field condition followed by thiodicarb (3.33 larvae/plant) whereas untreated check recorded (9.04 larvae/plant). Among the newer insecticide molecules, lowest gram blue butterfly larval population was recorded in thiodicarb 75 % WP (1.64 larvae/plant) followed by flubendiamide 480 (1.83). The standard check registered (11.75). Lowest *Maruca vitrata* pod damage was recorded in flubendiamide 480 SC (5.25 %) followed by thodicarb 75 % WP (5.55 %). Thiodicarb 75% recorded lowest percentage (3.8) of *Euchrysops cnejus* pod damage among newer insecticides molecules.

Keywords: Black Gram, *Euchrysops cnejus*, *Maruca vitrata,* Newer Insecticide Molecules

1. Introduction

The variety of legume crop, namely *Vigna mungo* (L.) Hepper [Synonyms: *Phaseolus mungo* L. (1753)] which is a major legume crop in India. Black gram occupies an area of about 13.10 lakh hectares with a total production of about 38.14 lakh tonnes[1].

Black gram is grown in low annual rainfall areas and named as dry land crop. It is adapted to deficiency soil due to its root nodules symbiotic association with bacteria called *Mycorrhiza*[2] and also cultivated as relay crop, playing an important role in environmental conservation and food security, respectively. It is an important source of human food mainly due to its high level of protein content (26.2 %). In addition, it contains 350 calories /100 grams with vitamins *viz.,* B_1, B_2 and Miyacin (0.42, 0.37 and 2.0 mg/100g). Being source of protein, it is a rich source of minerals namely calcium, iron and phosphorus (185, 8.7 and 345 mg/100g). It also contains 56.6 per cent carbohydrates and 1.2 per cent fat.

Rich in protein and phosphoric acid, it plays an important role in our diet and animal feed. It helps in maintaining soil fertility by improving the physical properties of the soil[3]. It is also a drought-resistant crop suitable for dry land agriculture .Of the many factors responsible for low yield, insect infestation is undoubtedly considered one of the most important factors. On average, two to three million tonnes are lost each year[4]. In India preventable yield losses in the range of 7 to 35 % due to pest infestation in black and green grams were recorded. The annual yield loss due to insect pests has been estimated at 30 % in black grams (Hamad and Dubey, 1983).

The species diversity or the population level of natural enemies may be influenced by the complex environment of the crops. Properly planned cropping system such as non-host crops are cost effective component of IPM.

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Hence keeping all the above aspects in view, the present investigation a study on impact of different intercrops along with blackgram was tested against pod borers in black gram.

2. Newer Insecticide Molecules against Pod Borers of Black Gram

The experiment was conducted in Randomized Block Design at farmer's field Kovilankulam, Aruppukkottai nearby during *rabi* season of 2018. Seeds of black gram (Cultivar: VBN 6) were sown on 25th December 2017 for *rabi* season with four replication and treatments having plot size of 5.0 × 3.6 m^2 with an inter plot and inter block distance of 1.5 m. Spacing of row to row and plant to plant was 30 cm and 10 cm, respectively. The crop was grown under irrigated condition.

Treatments	Newer insecticides	Dose
T1	Spinosad 45 SC	0.3 ml/l
T2	Emamectin Benzoate 5% SG	0.4 g/l
T3	Flubendiamide 480 SC	0.3 ml/l
T4	Indoxacarb 14.5 % SC	0.4 ml/l
T5	Thiodicarb 75 % WP	1g/l
T6	Control untreated	-

3. Assessment of Pod Borer

Data on the number of larvae per plant one day before and 3rd and 7th DAS (day after spraying) were recorded from ten randomly selected plants per plot.

4. Assessment of Pod Damage

Numbers of healthy and infested pods were calculated. Presence of damaged hole on the pods along with webbing was counted as symptom of damage for spotted pod borer and presence of small hole on the pod for blue butterfly[5].

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

5. Evaluation of Newer Insecticides Against Major Pod Borers

5.1 Evaluation of Newer Insecticides on Spotted Pod Borer, *Maruca vitrata*

From the Table 1 it is observed that the population of black gram spotted pod borer was non-significant, thereby indicating the population of to be uniformly distributed in the experimental plot prior to the application of treatments. The average population of *M. vitrata* per ten plants prior to the application of newer insecticides ranged from 4.67 to 8.22. The results revealed that at flower initiation stage, first spray with flubendiamide 480 SC spray was found to be the most effective and significantly superior over all the other treatments by recording lowest mean number of larvae (2.10 larvae/plant) and showed prolonged residual efficacy up to flowering stage compared to others. The next better treatment was thiodicarb 75 WP % spray with mean number of larvae of 3.20 larvae/plant. Indoxicarb 14.5 % SC spray with mean number of 4.60 larva per plant.

The results further revealed that at pod initiation stage, a second spray with flubendiamide 480 SC spray was consistently found to be the most effective and significantly superior over all the other treatments by recording lowest mean number of larvae (2.70 larvae/plant) and showed prolonged residual efficacy up to pod initiation stage compared to others. The next better treatment was thiodicarb 75 % WP spray spray with 2.60 larvae/plant followed by Indoxicarb 14.5 % SC spray with 2.40 larva per plant. Spinosad 45 SC, emamectin benzoate 5% SC were found to be 5.85 and 6.15 larva per plant.

The data on overall efficacy of various treatments against *M. vitrata* presented in Table 1 indicated that the various treatments were significantly superior over untreated control. The survival larval population ranged from larva/plant as against untreated control (9.04 larva/plant). Accordingly, flubendiamide 480 SC had registered with survival larval population of 2.40 larvae/plant was followed by thiodicarb 75 % (3.33 larvae/plant). While,

emamectin benzoate 5% SC found to be less effective by registering 5.83 larvae/plant.

The per cent reduction over control due to the application of flubendiamide 480 SC was recorded as 73.46 % followed by thiodicarb 75 % WP (63.23 %) and Indoxicarb 14.5 % SC (57.15 %).

5.2 Newer Insecticides on the Population of Gram Butterfly, *Euchrysops cnejus*

Data on the effect of newer insecticides on the population of gram butterfly, *Euchrysops cnejus* are presented in Table 2. The average population of *Euchrysops cnejus* per ten plants prior to the application of newer insecticides ranged from 4.20 to 9 larvae/plant. These observations were statistically non-significant, thereby indicating the population of black gram spotted pod borer to be uniformly distributed in the experimental plot prior to the application of treatments.

The results revealed that at flower initiation stage, first spray with thiodicarb 75 % WP was found to be the most effective and significantly superior over all the other treatments by recording lowest mean number of larvae (1.10 larvae/plant) and showed prolonged residual efficacy up to flowering stage compared to others. The next better treatment was flubendiamide 480 SC spray with mean number of larvae of 1.70 larvae/plant followed by Indoxicarb 14.5 % SC spray with mean number of 4.80 larva per plant.

The results further revealed that at pod initiation stage, a second spray with with thiodicarb 75 % WP spray was consistently found to be the most effective and significantly superior over all the other treatments by recording lowest mean number of larvae (1.98 larvae/plant) and showed prolonged residual efficacy up to pod initiation stage compared to others. The next better treatment was flubendiamide 480 SC spray with 1.95 larvae/plant followed by Indoxicarb 14.5 % SC spray with 6.90 larva per plant., emamectin benzoate 5% SC, Spinosad 45 SC were found to be 7.65 and 8.70 larva per plant.

The data on overall efficacy of various treatments against *Euchrysops cnejus* presented in Table 2 indicated that the various treatments were significantly superior over untreated control. The survival larval population ranged from larva/plant as against untreated control (11.75 larva/plant). Accordingly thiodicarb 75 % WP had registered with survival larval population of 1.64 larvae/plant was followed by flubendiamide 480 (1.83 larvae/plant). While, Spinosad 45 SC found to be less effective by registering 7.45 larvae/plant.

The per cent reduction over control due to the application of thiodicarb 75 % was recorded as 86.06 % followed by flubendiamide 480 (84.47 %) and Indoxicarb 14.5 % SC (50.21 %).

6. Newer insecticides on the incidence of pod damage due to *Maruca vitrata* and *Euchrysops cnejus*

Maruca vitrata

From Table 3 it was observed that flubendiamide 480 SC treatment recorded a minimum pod damage of 5.25 per cent which was on par with thiodicarb 75 % WP (5.55 %). The highest pod damage was recorded in the treatment of Spinosad 45 SC emamectin benzoate 5% SC, (12.80 %) and (13.80 %) respectively.

The per cent reduction of pod damage was maximum (83.06 %) in treatment flubendiamide 480 SC on pod maturing stage. This was followed by thiodicarb 75 % (82.10 %) and Indoxicarb 14.5 % SC (69.35 %). The treatment with emamectin benzoate 5% SC showed a lower per cent reduction (55.48 %) over untreated control.

Euchrysops cnejus

Among the various newer insecticides spray thiodicarb 75 % WP treatment recorded a minimum pod damage of 3.8 per cent followed by flubendiamide 480 SC (4.30 %). The highest pod damage was recorded in the treatment of Spinosad 45 SC, emamectin benzoate 5% SC, (13.00%) and (13.45 %) respectively.

The per cent reduction of pod damage was maximum (78.88 %) in thiodicarb 75 % WP on pod maturing stage. This was followed by flubendiamide 480 SC (76.11%) and Indoxicarb 14.5 % SC (47.85%). The treatment with emamectin benzoate 5% SC showed a lower per cent reduction (25.27 %) over untreated control.

Table 1. Evaluation of newer insecticides on Spotted pod borer, *Maruca vitrata*

S. No	Treatments	PTC	Mean number of larvae/ plant							Pooled Mean	% reduction over control
			I spray			PTC	II spray				
			3 DAS	7 DAS	Mean		3 DAS	7 DAS	Mean		
1	Spinosod (Tracer) 45 SC	6.90 (2.62)	5.80 (2.40)^{c}	4.60 (2.14)^{d}	5.20 (2.27)^{d}	7.40 (2.72)	6.80 (2.60)^{c}	4.90 (2.21)^{d}	5.85 (2.41)^{d}	5.53 (2.12)^{d}	38.89
2	Emamectin Benzoate 5% SG	7.50 (2.73)	6.40 (2.52)^{d}	4.60 (2.14)^{d}	5.50 (2.33)^{e}	7.60 (2.75)	6.60 (2.56)^{c}	5.70 (2.38)^{e}	6.15 (2.47)^{e}	5.83 (2.18)^{e}	35.58
3	Flubendamide 480 SC	5.40 (2.32)	3.00 (1.73)^{a}	1.20 (1.09)^{a}	2.10 (1.41)^{a}	4.10 (2.02)	3.80 (1.94)^{a}	1.60 (1.26)^{a}	2.70 (1.60)^{a}	2.40 (1.39)^{a}	73.46
4	Indoxicarb 14.5 % SC	4.67 (2.16)	5.70 (2.38)^{c}	3.50 (1.87)^{c}	4.60 (2.12)^{c}	5.20 (2.28)	3.90 (1.97)^{a}	2.40 (1.54)^{b}	3.15 (1.76)^{b}	3.88 (1.79)^{b}	57.15
5	Thiodicarb 75 % WP	6.43 (2.53)	3.80 (1.94)^{b}	2.60 (1.61)^{b}	3.20 (1.78)^{b}	6.40 (2.52)	4.30 (2.07)^{b}	2.60 (1.61)^{c}	3.45 (1.84)^{c}	3.33 (1.65)^{c}	63.23
6	Untreated Control	8.22 (2.86)	6.84 (2.61)^{e}	10.33 (3.21)^{e}	8.59 (2.91)^{f}	11.00 (3.31)	10.00 (3.16)^{d}	9.00 (2.99)^{f}	9.50 (3.08)^{f}	9.04 (2.71)^{f}	-
SEd		**NS**	**0.0295**	**0.0246**	**0.0293**	**NS**	**0.0210**	**0.0271**	**0.0175**	**0.0199**	-
CD(P=0.05%)			**0.0657**	**0.0549**	**0.0652**		**0.0468**	**0.0604**	**0.0389**	**0.0442**	-

DAS- Days After Spraying. PTC- Pre Treatment Count. * Grand mean formed by making average values of 3rd, 7th days after treatment through the means of four replications of two rounds of spray. Figures in parentheses are square root transformed values. In a column, means followed by common letter are not significantly different by LSD (P = 0.05)

Table 2. Newer insecticides on gram butterfly, *Euchrysops cnejus*

S. No	Treatments	PTC	Mean number of larvae/ plant							Pooled Mean	% reduction over control
			I spray			PTC	II spray				
			3 DAS	7 DAS	Mean		3 DAS	7 DAS	Mean		
1	Spinosod (Tracer) 45 SC	8.70 (2.94)	7.20 (2.68)^{f}	5.20 (2.28)^{d}	6.20 (2.48)^{e}	12.00 (3.46)	10.30 (3.20)^{d}	7.10 (2.66)^{d}	8.70 (2.93)^{e}	7.45 (2.44)^{e}	36.60
2	Emamectin Benzoate 5% SG	8.20 (2.86)	6.50 (2.54)^{d}	4.10 (2.02)^{c}	5.30 (2.28)^{d}	9.20 (3.03)	8.00 (2.82)^{c}	7.30 (2.70)^{d}	7.65 (2.76)^{d}	6.48 (2.28)^{d}	44.89
3	Flubendamide 480 SC	5.40 (2.32)	2.40 (1.54)^{b}	1.00 (0.99)^{a}	1.70 (1.27)^{b}	6.50 (2.54)	2.40 (1.54)^{a}	1.50 (1.22)^{b}	1.95 (1.38)^{b}	1.83 (1.22)^{b}	84.47
4	Indoxicarb 14.5 % SC	4.20 (2.04)	6.30 (2.50)^{c}	3.30 (1.81)^{b}	4.80 (2.16)^{c}	9.50 (3.08)	8.00 (2.82)^{c}	5.80 (2.40)^{c}	6.90 (2.61)^{c}	5.85 (2.16)^{c}	50.21

5	Thiodicarb 75 % WP	4.80 (2.19)	1.20 (1.09)[a]	1.00 (0.99)[a]	1.10 (1.04)[a]	7.10 (2.66)	2.70 (1.64)[b]	1.25 (1.11)[a]	1.98 (1.38)[a]	1.64 (1.09)[a]	86.06
6	Untreated Control	9.00 (2.99)	7.00 (2.64)[e]	6.00 (2.44)[e]	6.50 (2.54)[f]	16.00 (3.99)	18.00 (4.24)[e]	16.00 (3.99)[e]	17.00 (4.12)[f]	11.75 (2.98)[f]	-
SEd		**NS**	**0.0153**	**0.0285**	**0.0244**	**NS**	**0.0228**	**0.0310**	**0.0146**	**0.0262**	-
CD (P=0.05%)			**0.0341**	**0.0635**	**0.0545**		**0.0509**	**0.0690**	**0.0325**	**0.0583**	-

DAS- Days After Spraying. PTC- Pre Treatment Count. * Grand mean formed by making average values of 3rd, 7th days after treatment through the means of four replications of two rounds of spray. Figures in parentheses are square root transformed values. In a column, means followed by common letter are not significantly different by LSD (P = 0.05).

Table 3. Effect of Newer insecticides on the incidence of pod damage due to *Maruca vitrata* and *Euchrysops cnejus*

Sl. No.	Treatments	Pod Damage Percentage									
			Maruca vitrata					Euchrysops cnejus			
		PTC	3 DAS	7DAS	Mean	% reduction over control	PTC	3 DAS	7 DAS	Mean	% reduction over control
1	Spinosod (Tracer) 45 SC	14.20 (20.94)	13.60 (21.64)[c]	12.00 (20.26)[d]	12.80 (20.95)[c]	58.71	16.50 (22.77)	14.00 (21.97)[d]	12.00 (20.26)[d]	13.00 (21.11)[d]	27.77
2	Emamectin Benzoate 5% SG	16.40 (23.58)	15.00 (22.78)[d]	12.60 (20.79)[e]	13.80 (21.79)[d]	55.48	17.20 (23.06)	14.00 (21.97)[d]	12.9 (21.05)[e]	13.45 (21.51)[e]	25.27
3	Flubendamide 480 SC	8.40 (20.89)	6.50 (14.77)[a]	4.00 (11.53)[a]	5.25 (13.15)[a]	83.06	12.40 (22.97)	4.90 (12.78)[b]	3.70 (11.09)[b]	4.3 (11.93)[b]	76.11
4	Indoxicarb 14.5 % SC	12.40 (23.48)	10.00 (18.43)[b]	9.00 (17.45)[c]	9.50 (17.94)[b]	69.35	13.40 (22.80)	10.80 (19.18)[c]	7.10 (15.45)[c]	8.95 (17.31)[c]	50.27
5	Thiodicarb 75 % WP	9.40 (21.03)	6.00 (14.17)[a]	5.10 (13.05)[b]	5.55 (13.61)[a]	82.10	11.40 (23.32)	4.50 (12.24)[a]	3.10 (10.14)[a]	3.8 (11.19)[a]	78.88
6	Untreated Control	28.40 (23.60)	31.00 (33.83)[e]	31.00 (33.83)[f]	31.00 (33.83)[e]	--	21.00 (22.60)	18.00 (25.10)[e]	18.00 (25.10)[f]	18 (25.10)[f]	--
	SEd	**NS**	**0.3456**	**0.1392**	**0.2373**	--	**NS**	**0.1657**	**0.2123**	**0.1466**	--
	CD(P=0.05%)		**0.7701**	**0.3101**	**0.5288**	--		**0.3692**	**0.4730**	**0.3266**	--

DAS- Days After Spraying. Values in the parentheses are arc sine transformed
*Each value is the mean of four replication. In a column, means followed by common letter are not significantly different by LSD (P= 0.05).

7. Discussion

7.1 Newer Insecticides against the Population of Spotted Pod Borer *Maruca vitrata* on Black Gram

The present findings are in agreement with findings of Bhoyar *et al.*[6], Meena *et al.*[7] and Muthukrishna *et al.*[8] who reported the higher efficacy of these molecules.

7.2 Newer Insecticides against the Population of Gram Butterfly *Euchrysops cnejus* on Black Gram

Work on efficacy of different insecticides against pod borers has been reported by different researchers in last 10 years. Flubendiamide[9,10], spinosad[11–13] (Singh and Yadav, 2007) Emamectin benzoate[12–14].

8. References

1. Anonymous. Directorate of Pulses Development- Annual Web Report. New Delhi; 2016-17. p. 45–6.
2. Kasiamdari R, Smith S, Smith F, Scott E. Influence of the mycorrhizal fungus, *Glomus coronatum,* and soil phosphorus on infection and disease caused by binucleate *Rhizoctonia* and *Rhizoctonia solani* on mung bean (*Vigna radiata*). Plant and Soil. 2002; 238(2):235–44. https://doi.org/10.1023/A:1014400701819
3. Parmar S, Naik M, Pandya H, Rathod N, Patel S, Dave P, Saiyad M. Bio-efficacy of some insecticides against pest complex of blackgram [*Vigna mungo* (L.) Hepper]. International Journal of Plant Protection. 2015; 8(1):162–8. https://doi.org/10.15740/HAS/IJPP/8.1/162-168
4. Rabindra R, Ballali C, Ramanujan B. Biological options for insect pests and nematode management in pulses. Masood Ali, Singh, BB, Shivkumar and Vishwadhar (eds.), Pulses in New Perspective. Indian Society of Pulses Research and Development, Kanpur, India; 2004. p. 400–25.
5. Soundararajan R, Chitra N. Effect of bioinoculants on sucking pests and pod borer complex in urdbean. Journal of Biopesticides. 2011; 4(1):7–11.
6. Bhoyar AS, et al. Studies on seasonal incidence and biointensive management of pigeonpea pod borer complex. Pestology 28.9. 2004:32–7.
7. Meena RS, Srivastava CP, Joshi N. Bioefficacy of some insecticides against the major insect pests of short duration pigeonpea. Pestology. 2006; 30:13–16.
8. Muthukrishna N, Palaniswamy S, Rajagam J, Manoharan T, Thangaraj T. Evaluation of IPM strategies and new insecticides molecules against tomato pests.International Conference of Vegetables. 2002 Nov 11–14, Bangalore, Karnataka, India; 2002. p. 254.
9. Anonymous. Bio-efficacy of NNI 0001 (Flubendiamide) 480 SC against Lepidopteran pod borers and defoliators (*Maruca vitrata, Helicoverpa armigera* and *Spodoptera litura*) in Black gram. Final report: M/s. Bayer Crop Science Limited, Mumbai sponsored project, Department of Entomology, AAU, Anand, Gujarat; 2008b.
10. Patil SK, Deshmukh GP, Patil JV. Efficacy of Flubendiamide 480 SC against pod borers in black gram. Pestology. 2008; 32(9):20–2.
11. Ahmed S, Zia K, Shah Nu. Validation of chemical control of gram pod borer, *Helicoverpa armigera* (Hub.) with new insecticides. International Journal of Agriculture and Biology. 2004; 6(6):978–80.
12. Singh V, Verma PC. Management of pod borer, *Helicoverpa armigera* (Hubner) in chickpea with newer chemicals. Pestology. 2006; 30(6):36–8.
13. Patil SK, Ingle MB, Jamadagni BM. Bio-efficacy and economics of insecticides for management of *Helicoverpa armigera* (Hubner) in chick pea. Annals of Plant Protection Sciences. 2007; 15(2):307–11.
14. Raghwani BR, Poshiya VK. Field efficacy of newer molecules of insecticides against pod borer, H. armigera in chickpea. Pestology. 2006; 30(4):18–20.
15. Hameed S, Durbey S. Losses due to insect pests in North Bihar. Crop losses due to insect pests. Special issue V. Indian Journal of Entomology. 1983; 45:136–46.
16. Yadav JB, Verma RA. Efficacy of certain synthetic insecticides and biopesticides used as foliar application against the gram pod borer (*Helicoverpa armigera* Hubner). Journal of Entomological Research. 2007; 31(4):327–9.