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Efficancy of newer insecticide molecules againist spotted pod borer, Maruca vitrata (Geyer) on rice fallow blackgram

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ABSTRACT

Field efficacy of nine newer insecticidal treatments consisting of chlorantraniliprole 18.50 % SC (T_1), flubendiamide 480 SC (T_2), lufenuron 5.4 % EC(T_3), spinetoram 11.7 % SC(T_4), spinosad 45 % SC(T_5), indoxacarb 14.5 % SC (T_6), pyridalyl 10 % EC(T_7), emamectin benzoate 5 % SG(T_8), novaluran 10 % EC(T_9) were evaluated against *Maruca vitrata* (Geyer) infesting blackgram during *rabi* season of 2024-25. The results revealed that spotted pod borer per cent reduction in larval population was highest in chlorantraniliprole 18.5% SC followed by flubendamide 480 SC and emamectin benzoate 5% SG. The maximum yield was observed in the treatment chlorantraniliprole 18.5% SC (10.85q/ha) followed by flubendamide 480 SC (10.12 q/ha) followed by emamectin benzoate 5% SG (9.70 q/ha), spinosad 45 % SC (9.37 q/ha) and untreated control registered the lowest yield of 4.48 q/ha. Highest BC ratio was recorded in treatment with chlorantraniliprole 18.5 % SC (1.60), followed by emamectin benzoate 5 % SG (1.36), followed by flubendamide 480 SC (1.34) and spinosad 45 % SC (1.04). The lowest BC ratio was recorded in the untreated control (0.11). Thus two rounds of insecticidal spray, at the time of bud initiation, flowering and pod development stages were found efficacious on the field management of *M. vitrata* on blackgram with higher yields.

Keywords: *Cost benefit area, Efficacy, Insecticides, Maruca vitrata and Yield*

Blackgram [*Vigna mungo* (L.) Hepper; 2n = 22] is a highly nutritious grain legume crop mainly grown in South and Southeast Asian countries including Afghanistan, Bangladesh, India, Myanmar, Pakistan, Sri Lanka, Thailand, and Vietnam (Kaewwongwal *et al.*, 2015). Blackgram is also locally known as Urdbean, Urid, Mash, and Biri in India; as Mashkalai in Bangladesh; as Maas in Nepal; as Matpe in Myanmar. It plays an important role in vegetarian diets in South Asia due to its high nutritive value. Mature dry seeds of black gram possess approximately 24%–26% protein, 60% carbohydrates, 1.3% fats, phosphorus (345 mg/100 g), potassium, iron (8.7 mg/100 g), and calcium (185 mg/100 g) along with several essential amino acids (arginine, phenylalanine, leucine, lysine, valine, and isoleucine, etc.), vitamins such as vitamin B3 (niacin; 2 mg/100 g), vitamin A (23 IU/100 g), vitamin B1 (thiamine; 0.42 mg/100 g), and vitamin B2 (riboflavin; 0.37 mg/100 g) (USDA National Nutrient Database, 2018). It is widely consumed as dry whole grain or split grain known as *daal* and as unfermented and fermented flour (Khan *et al.*, 2021). Popular Indian dishes like *idli*, *dosa* and *vada* are prepared using blackgram flour. It is also used as a major ingredient in several food items such as cakes, biscuits, snacks, and cookies. Its seed may be used in the food industry as functional food and nutraceutical as well as in the cosmetic and pharmaceutical industries (Pandey, 2019; Khan *et al.*, 2021). In Thailand and Japan, blackgram sprouts are preferred to mungbean sprouts because of their longer shelf life (Kaewwongwal *et al.*, 2015).

The crop is a potential component of various cropping systems, especially in rice and wheat fallows owing to its short life cycle (70–90 days), capacity to fix atmospheric nitrogen, and relative drought tolerance. Blackgram is generally intercropped with maize, sorghum, cotton, millets, and pigeon pea or rotated with cereal crops such as rice to increase soil fertility, minimize pest and disease incidence, and enhance dry matter yield of main crops. India is the world's largest producer of blackgram, contributing 70% of the global production, followed by Myanmar and Pakistan. India produces approximately 2.7 million tonnes from an approximately 4.4 m ha area with an average yield of 598 kg/ha (Directorate of Economics and Statistics, 2021). Approximately 60% of the crop area is cultivated during the *Kharif* season; however, the *rabi* season cultivation is increasing due to the adoption of early maturing (75–80 days) varieties in rice fallows. Blackgram contributes approximately 10% of the total pulse production in India with more than 90% of its production coming from 10 states, *viz*., Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Uttar Pradesh, Jharkhand, Telangana, Odisha, Andhra Pradesh, and Tamil Nadu (Directorate of Economics and Statistics, 2021).

In India, the major *rabi* blackgram growing states are Andhra Pradesh 2.75 lakh ha (6.80 lakh acres), Tamil Nadu 2.44 lakh ha (6.03 lakh acres), Assam 0.58 lakh ha (1.43 lakh acres) and Telangana 0.23 lakh ha (0.57 lakh acres). According to the 2nd advance estimates 2024-25, Government of India blackgram crop is estimated at 17.99 lakh tonnes as compared to 23.19 lakh tonnes in 2023-24. Among the states, Andhra Pradesh is leading in blackgram production with 3.53 lakh tonnes followed by Maharashtra (2.45 lakh tonnes), Uttar Pradesh 2.38 lakh tonnes, Madhya Pradesh (2.37 lakh tonnes), Rajasthan (1.83 lakh tonnes) and Telangana 0.36 lakh tonnes.(Anonymous, 2025)

Approximately 198 insect species are reported to feed on pulse crops around the world, of which 115 are reported in India (Kooner *et al.,* 2006). Out of these 115 species, 45 insect species have been reported on mungbean and black gram. The insect species composition and their infestation vary across geography, seasons, plant phenology and the prevailing environmental conditions such as temperature, humidity, and rainfall. The pest spectrum of blackgram could be divided based on their feeding habit and plant parts as a) defoliators, *viz*., Bihar hairy caterpillar *Spilosoma obliqua* Walker, red hairy caterpillar *Amsacta moorei* Butler, tobacco cutworm *Spodoptera litura* Fabricius, and blue butterfly *Lampides boeticus* (Linnaeus); b) sucking pests, *viz.,* leafhopper *Empoasca kerri* (Pruthi), whitefly *Bemisia tabaci* Gennadius, cowpea aphids (*Aphis craccivora* Koch), and thrips (*Megalurothrips distalis* Kany and *Caliothrips indicus* (Bagnall); c) internal feeders, viz., stem fly *Ophiomyia phaseoli* (Tryon) and Galerucid Beetles *Madurasia obscurella* (Jacoby); d) pod borers/pod sucking bugs, *viz.,* plant bugs (*Riptortus pedestris* (Fabricius), *Nezara viridula* (Linnaeus), and *Clavigralla gibbosa (*Spinola), spotted pod borer *Maruca vitrata (*Fabricius*),* field bean pod borer *Adisura atkinsoni* Moore), and bruchids *Callosobruchus chinesis* Linnaeus and *Callosobruchus maculatus* (Fabricius) (Yadav *et al*., 2015).

MATERIAL AND METHODS

The studies were carried out at Agricultural Research Station, Ragolu, Srikakulam. Ragolu is a research station in North coastal zone situated at 18.3493° North Latitude, 83.8937° East Latitude and at an altitude of 20 m above mean sea level (MSL).

Application of spray fluids

Foliar application of selected insecticides was done based on Economic Threshold Level (ETL) and two sprayings were done. Spraying was done during the morning hours using a knapsack sprayer and proper care was taken for thorough coverage of entire experimental plot by using the spray fluid @ 500 l/ha. The sprayer and the container used for preparing the spray fluid were thoroughly cleaned with water after each treatment.

Observations

The data on pest population was recorded one day before spraying as pre- treatment count and at one, six, ten and fourteen days after spraying as post-treatment count. The observations were recorded from ten randomly selected plants in each plot leaving the border rows.

The larval population of spotted pod borer, population was recorded from ten randomly selected plants at one day prior to spraying and at 2, 6, 10 and 14 days after spraying on whole plant basis.

Grain yield

The data on grain yield were recorded from the net plot of each treatment separately and converted to per hectare basis.

Cost of plant protection

Based on the prevailing market prices of produce, cost of insecticides, cost of labourers and cost of other inputs, the net profit was worked out.

Net return

Net return (Rs/ ha) was calculated by subtracting the cost of plant protection (Rs/ ha) from the gross return.

Benefit Cost ratio

The BC ratio was obtained by taking the ratio of net profit to the cost of plant protection.

$$\text{BC ratio} = \frac{\text{Net profit (Rs/ha)}}{\text{Cost of plant protection (Rs/ha)}}$$

Statistical analysis

The data on management studies was subjected to ANOVA and treatment means were compared with Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

In the experiment, nine different treatments, consisting of chlorantraniliprole 18.50 % SC (T_1), flubendiamide 480 SC (T_2), lufenuron 5.4 % EC(T_3), spinetoram 11.7 % SC(T_4), spinosad 45 % SC(T_5), indoxacarb 14.5 % SC (T_6), pyridalyl 10 % EC(T_7), emamectin benzoate 5 % SG(T_8), novaluran 10 % EC(T_9) were tested to compare the efficacy against *Maruca vitrata* and the influences on the yield of blackgram.

The data on the mean (2, 6, 10 and 14 days after spraying) larval population on first spray (Table.1) revealed that all the treatments except untreated control are effective and at par. Among all the treatments highest per cent reduction of spotted pod borer was recorded in chlorantraniliprole 18.5% SC (65.85%), followed by flubendamide 480 SC (61.22%) and emamectin benzoate 5% SG (55.12%), spinosad 45 SC (50.73), novaluran 10% EC (47.07), indoxacarb 14.5% SC (41.71)%, lufenuron 5.4% EC (38.05%), pyridalyl 10% EC (35.12%) and spinetoram 11.7% SC (28.78%) as compared to control plot was found to be least effective but comparatively superior over the control.

The data on larval population on second spray after spray (Table. 2) revealed that all the treatment are significantly superior over control. Among all the treatments chlorantraniliprole 18.5% SC (77.69%), followed by flubendamide 480 SC (71.07%) and emamectin benzoate 5% SG (66.67%), spinosad 45 SC (62.53%), novaluran 10 EC (57.30%), indoxacarb 14.5 SC (53.99%), pyridalyl 10 EC (48.48%), lufenuron 5.4 EC (41.87%) and spinetoram 11.7 SC (34.71) as compared to control plot was found to be least effective but comparatively superior over the control.The present findings are in conformation with Swathi *et al*., (2019) who reported that insecticidal treatments chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 ml l^{-1} 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 flubendamide @ 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.

Banerjee and Sabysachi (2022) reported that among the treatments, seed treatment with imidacloprid 600 FS @ 5 g ai kg^{-1} seed followed by spraying with chlorantraniliprole 18.5 SC @ 20.0 g ai ha^{-1} was the most effective treatment against spotted pod borer (*Maruca vitrata*) . The present findings are in confirmation with Srinivasan *et al.* (2023) who reported that two sprays of flubendamide 34.35 SC @ 48 g a.i/ha from 45 DAS at 15 days interval proved to be effective in reducing the lepidopteran pod borers like spotted pod borer. These results agree with the findings of Sesha Mahalakshmi *et al.,* (2012) who noticed that emamectin benzoate 5 SG (0.4g/l), flubendamide 480 SC (0.2 ml/l) and thiodicarb 75 WP (1.5 g/l) were found effective in reducing the pod borer damage in blackgram. Similar findings made by Sreekanth *et al*., 2015 who reported 2.08 per cent pod damage by pod borer. Emamectin Benzoate 5SG (1.266) was found to be the next best treatment which is in line with the findings of Kumar and Sarada (2015) and Ahmed *et al*., 2020 [1] they reported that emamectin Benzoate 5SG was found most effective in reducing per cent population reduction of greengram spotted pod borer as well as increasing the yield with 79.1 per cent reduction over control and 68.37 pod infestation respectively. Flubendiamide 20SG (1.344) is found to be the next best treatment which is in line with the findings of Meena *et al.,* 2006 which proved to be the best for reducing the pod damage (9.2%) and Singh *et al*., 2020 (4.79%) was observed significantly higher, in reducing the damage caused by the spotted pod borer in cowpea. Spinosad 45 SC (1.555) is found to be next best treatments is found to be the next effective treatment which is in

Table 1. Efficacy of insecticides against spotted pod borer, *M. vitrata* in blackgram during *rabi*, 2024-25 (first spray)

S. No.	Treatment	Mean larval population per plant after first spray							
		Dose (ml/L) Or (g/L)	1DBS	2DAS	6DAS	10DAS	14DAS	Mean	MPROC
T_1	Chlorantraniliprole 18.5 % SC	0.3	2.83	1.55	1.15	1.4	1.72	1.4	65.85
			-1.66	(1.24)f	(1.07)e	(1.18)e	(1.31)e	(1.18)f	
T_2	Flubendiamide 480 SC	0.2	2.63	1.85	1.29	1.58	1.83	1.59	61.22
			-1.62	(1.36)ef	(1.14)de	(1.25)de	(1.34)ef	(1.26)ef	
T_3	Lufenuron 5.4 % EC	1.2	2.95	2.58	2.35	2.57	2.73	2.54	38.05
			-1.71	(1.61)b	(1.53)bc	(1.60)bc	(1.65)bc	(1.59)bc	
T_4	Spinetoram 11.70 % SC	0.8	2.79	2.73	2.63	2.95	3.27	2.92	28.78
			-1.67	(1.65)b	(1.62)b	(1.72)b	(1.81)b	(1.71)b	
T5	Spinosad 45 % SC	0.3	3	2.15	1.76	2.05	2.33	2.02	50.73
			-1.73	(1.47)cde	(1.33)d	(1.43)de	(1.53)cd	(1.42)cdef	
T_6	indoxacarb 14.5 % SC	1	2.89	2.47	2.14	2.39	2.55	2.39	41.71
			-1.7	(1.57)bc	(1.46)c	(1.55)bc	(1.60)bcd	(1.54)bcd	
T_7	Pyridalyl 10 % EC	1.5	3	2.65	2.64	2.75	2.83	2.66	35.12
			-1.73	(1.63)b	(1.62)bc	(1.66)bc	(1.68)bc	(1.63)bc	
T_8	Emamectin benzoate 5 % SG	0.4	2.67	1.98	1.37	1.84	2.16	1.84	55.12
			-1.62	(1.41)de	(1.17)d	(1.36)de	(1.47)cde	(1.36)def	
T_9	Novaluran 10 % EC	1	2.92	2.35	1.9	2.18	2.42	2.17	47.07
			-1.7	(1.53)bcd	(1.38)d	(1.47)b	(1.56)bcd	(1.47)bcde	
T10	Check		2.75	3.47	3.98	4.3	4.6	4.1	-
			-1.66	(1.86)a	(2.00)a	(2.07)a	(2.14)a	(2.02)a	
	F-Test		NS	Sig.	Sig.	Sig.	Sig.	Sig.	
	CD (p=0.05)		0.23	0.2191	0.16	0.18	0.24	0.21	
	CV (%)		7.33	7.1495	5.58	6.85	8.02	7.32	
	SEm±		0.07	0.07	0.05	0.06	0.07	0.07	

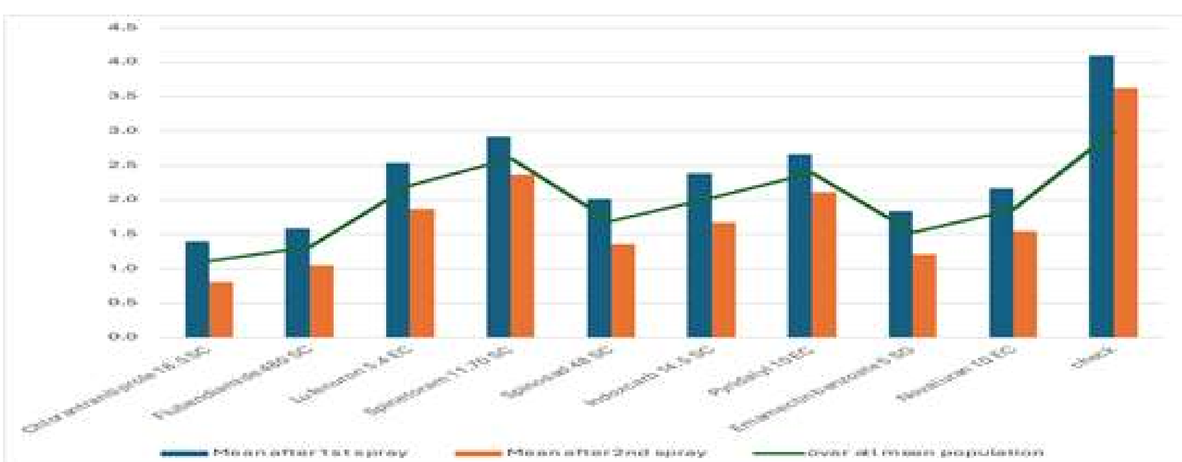

Fig.1 Overall efficacy of insecticides against spotted pod borer in blackgram during *rabi*, 2024-25

Table. 2 Efficacy of insecticides against spotted pod borer, *M. vitrata* in blackgram during *rabi*, 2024-25 (second spray)

S. No.	Treatment	Mean larval population per plant after second spray							
		Dose (ml/L) Or (g/L)	1DBS	2DAS	6DAS	10DAS	14DAS	Mean	MPROC
T_1	Chlorantraniliprole 18.5 % SC	0.3	1.72 (1.31)^{e}	0.81 (0.90)^{e}	0.57 (0.76)^{f}	0.79 (0.89)^{g}	1.24 (1.11)^{g}	0.81 (0.90)^{g}	77.69
T_2	Flubendiamide 480 SC	0.2	1.83 (1.34)^{de}	1.13 (1.07)^{de}	0.73 (0.86)^{ef}	1.02 (1.01)^{fg}	1.46 (1.21)^{fg}	1.05 (1.02)^{fg}	71.07
T_3	Lufenuron 5.4 % EC	1.2	2.83 (1.68)^{bc}	1.84 (1.36)^{bc}	1.86 (1.37)^{bcd}	1.89 (1.37)^{cd}	2.27 (1.51)^{bcd}	1.87 (1.37)^{cd}	41.87
T_4	Spinetoram 11.70 % SC	0.8	2.42 (1.56)^{b}	2.46 (1.57)^{b}	2.52 (1.59)^{b}	2.32 (1.52)^{b}	2.48 (1.57)^{b}	2.37 (1.54)^{b}	34.71
T5	Spinosad 45 % SC	0.3	3.27 (1.81)^{def}	1.39 (1.18)^{cd}	1.12 (1.06)^{def}	1.37 (1.17)^{ef}	1.73 (1.31)^{de}	1.36 (1.17)^{efg}	62.53
T_6	indoxacarb 14.5 % SC	1	2.55 (1.60)^{bcd}	1.68 (1.30)^{bcd}	1.52 (1.23)^{cde}	1.66 (1.29)^{de}	2.12 (1.46)^{bcd}	1.67 (1.29)^{de}	53.99
T_7	Pyridalyl 10 % EC	1.5	2.16 (1.47)^{bc}	2.12 (1.46)^{bc}	2.15 (1.47)^{bc}	2.11 (1.45)^{bc}	2.34 (1.53)^{bc}	2.11 (1.45)^{bc}	48.48
T_8	Emamectin benzoate 5 % SG	0.4	2.73 (1.65)^{def}	1.28 (1.13)^{cde}	0.92 (0.96)^{def}	1.18 (1.09)^{f}	1.68 (1.29)^{ef}	1.21 (1.10)^{efg}	66.67
T_9	Novaluran 10 % EC	1	2.33 (1.53)^{cde}	1.52 (1.23)^{bcd}	1.36 (1.17)^{cde}	1.57 (1.25)^{e}	1.92 (1.39)^{cde}	1.55 (1.25)^{e}	57.3
T10	Check		4.6 (2.14)^{a}	4.2 (2.05)^{a}	4.05 (2.01)^{a}	3.35 (1.83)^{a}	2.6 (1.61)^{a}	3.63 (1.91)^{a}	-
	F-Test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	
	CD (p=0.05)		0.24	0.27	0.2	0.18	0.17	0.23	
	CV (%)		8.02	11	8.7	7.84	7.26	8.74	
	SEm±		0.07	0.08	0.06	0.05	0.05	0.07	

Values in parenthesis are square root transformations; NS= Non-significant; Sig. - Significant; Means with the same letter are not significantly different following DMRT

line with the findings of Koushik et *al.,* 2016 proved that spinosad 45 SC caused highest mortality (68 to 71%) mortality of *Maruca vitrata* over control and Swamy et *al.,* 2010 . Lakshmi *et al.* (2002) opined that the spinosad 45 SC @ 0.005 per cent was significantly superior over all other treatments with higher pod yield of blackgram which was also in conformity with the present results.

F) Pod yield

The impact of different treatments on grain yield revealed that all the treatments were found significantly superior over the untreated check in reducing the pest population leading to increased grain yield.

The maximum yield was observed in the treatment chlorantraniliprole 18.5 SC (10.85q/ha) which was superior to other treatments followed by flubendamide 480 SC (10.12q/ha), followed by emamectin benzoate (9.70 q/ha) and spinosad 45 SC (9.37q/ha) and untreated control registered the lowest yield of 4.48 q/ha(Table.3).

G) Cost economics

The results obtained from the experiment indicated that maximum net return were obtained from

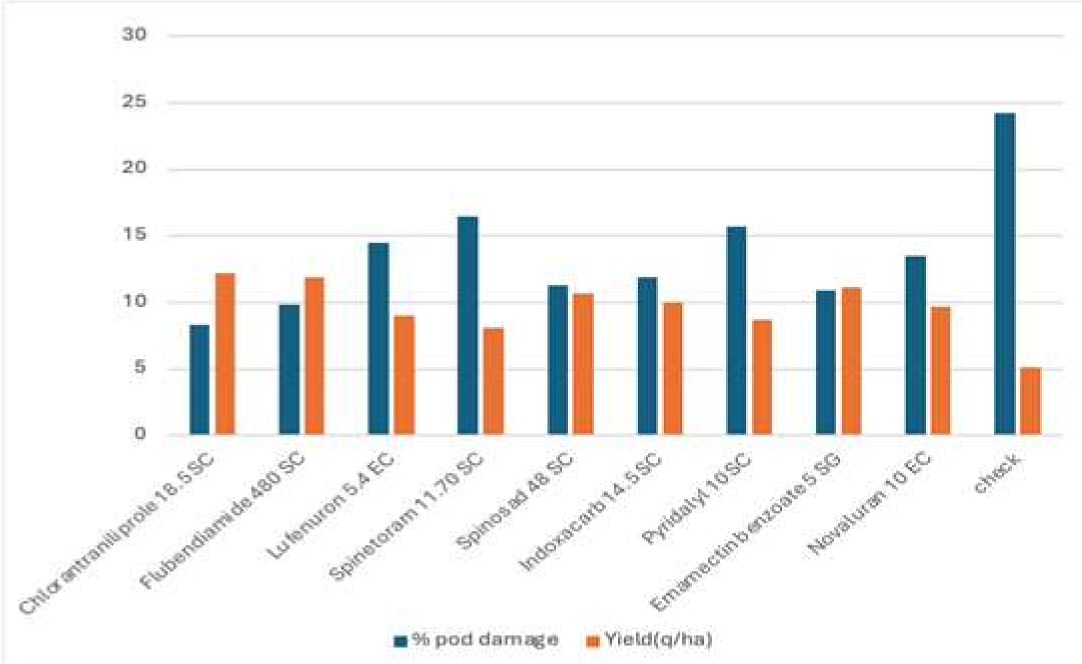

Fig 2. Efficacy of insecticides on pod damage due to spotted pod borer, *M. vitrata* and on grain yield on blackgram

chlorantraniliprole 18.5 SC (Rs.49,419/ha) followed by flubendamide 480 SC (RS.42,888/ha) and emamectin benzoate 5 SG (Rs.41,320/ha). Similarly highest BC ratio was recorded in the treatment with chlorantraniliprole 18.5 SC (1.60), followed by emamectin benzoate 5 SG (1.36), followed by flubendamide 480 SC (1.34) followed and spinosad 45 SC (1.04). The lowest BC ratio was recorded in the untreated control (0.11)(Table.4). Sambathkumar *et al.* (2014) reported that flubendamide @ 24g a.i./ ha showed the maximum per cent yield increase over control (72.6) and it was 71.3 per cent in chlorantraniliprole @ 30g a.i./ha and 69.9 per cent in indoxacarb @ 75g a.i./ha. Highest seed yield was registered in chlorantraniliprole @ 30g a.i./ha (579.2 kg/ha) and flubendamide @ 24g a.i./ha (312.5 kg/ ha) during *kharif* and *rabi* seasons of 2012, respectively. Yadav *et al.* (2023) reported that the treatments of emamectin benzoate 5% WG and indoxacarb 14.5% SC were found the most effective in reducing the pod borer damage with high grain yield of blackgram. According to Sonune *et al.* (2010) maximum per cent increase in seed yield (79.37%) was recorded in the treatment spinosad 45 SC (0.009%). Meena *et al.* (2006) recorded higher grain yield in pigeonpea using emamectin benzoate 5 SG @ 11 g a.i./ha sprayed twice at 15 days interval. Similarly, Patil *et al.* (2007) reported that emamectin benzoate 5 SG @ 11 g a.i./ha application enhanced maximum grain yield followed by spinosad 45 SC @ 60 g a.i./ha. The reason for chlorantraniliprole 18.5 SC showing more efficacy against spotted pod borer might be because it is an insecticide with novel mode of action (Diamides – Ryanodine receptor modulators) which exhibits larvicidal activity as an orally ingested toxicant. It targets and disrupts the Ca^{2+} balance, which triggers muscle contraction, cessation of feeding, followed by paralysis and eventual death of the larvae (Wadaskar *et al*., 2013)

Singh *et al.* (2020) reported that among the new generation insecticides tested, flubendamide 20 WG @ 1.0 g/L (4.79%) was observed significantly higher, in reducing the damage caused by the spotted pod borer in cowpea. Further, the findings are also in conformity with Shivaraju *et al.* (2011) who revealed that flubendamide 480 SC 24% + thiacloprid 48% SC recorded comparatively high larval reduction followed by emamectin benzoate 5 SG and indoxacarb against *M. testulalis* on blackgram. Rao (2000) also reported that profenophos 50 EC @ 0.01 per cent alone and in combination with lufenuron (0.05%) (profenophos 50 EC 0.05% + lufenuron 0.005%) proved effective in controlling *M. vitrata* in pigeonpea and recorded maximum larval reduction. However, Mallikarjuna (2009) recorded highest larval reduction of pod borers with flubendamide 480 SC

Table 3. Effect of insecticides on the yield of blackgram during *rabi*, 2024-25

S. No.	Treatment	Dose (ml/L) or(g/L)	Yield (q ha-1)	Cost of yield (Rs/kg)	Returns (Rs /ha)	Common cost (Rs/ha)	Treatment cost (Rs.)	Total cost (Rs.)	Net Returns	B:C ratio
T_1	Chlorantraniliprole 18.5% SC	0.3	10.85	74	80290	30000	875	30875	49419	1.6
T_2	Flubendiamide 480 SC	0.2	10.12	74	74888	30000	2000	32000	42888	1.34
T_3	Lufenuron 5.4 % EC	1.2	7.38	74	54612	30000	2400	32400	22212	0.69
T_4	Spinetoram 11.70 % SC	0.8	6.36	74	47064	30000	4000	34000	13064	0.38
T_5	Spinosad 45% SC	0.3	9.37	74	69338	30000	4060	34060	35278	1.04
T_6	Indoxacarb 14.5 % SC	1	7.92	74	58608	30000	2000	32000	26608	0.83
T_7	Pyridalyl 10 % EC	1.5	6.85	74	50690	30000	2070	32070	18620	0.58
T_8	Emamectin benzoate 5 % sg	0.4	9.7	74	71780	30000	460	30460	41320	1.36
T_9	Novaluran 10 % EC	1	8.55	74	63270	30000	1950	31950	31320	0.98
T_{10}	Check		4.48	74	33152	30000	0	30000	3152	0.11
	F-test	-	S	-		-	-	-		-
	SEm±	-	0.1	-		-	-	-		-
	CD (p=0.05)	-	0.3	-		-	-	-		-
	CV (%)	-	7.18	-		-	-	-		-

Values in parenthesis are square root transformations; NS= Non-significant; Sig. - Significant; Means with the same letter are not significantly different following DMR

Table.4 Effect of insecticides on the yield of blackgram during *rabi*, 2024-25

S. No.	Treatment	Dose (ml/L) or(g/L)	Yield (q ha-1)	Cost of yield (Rs/kg)	Returns (Rs /ha)	Common cost (Rs/ha)	Treatment cost (Rs.)	Total cost (Rs.)	Net Returns	B:C ratio
T_1	Chlorantraniliprole 18.5% SC	0.3	10.85	74	80290	30000	875	30875	49419	1.6
T_2	Flubendiamide 480 SC	0.2	10.12	74	74888	30000	2000	32000	42888	1.34
T_3	Lufenuron 5.4 % EC	1.2	7.38	74	54612	30000	2400	32400	22212	0.69
T_4	Spinetoram 11.70 % SC	0.8	6.36	74	47064	30000	4000	34000	13064	0.38
T_5	Spinosad 45% SC	0.3	9.37	74	69338	30000	4060	34060	35278	1.04
T_6	Indoxacarb 14.5 % SC	1	7.92	74	58608	30000	2000	32000	26608	0.83
T_7	Pyridalyl 10 % EC	1.5	6.85	74	50690	30000	2070	32070	18620	0.58
T_8	Emamectin benzoate 5 % sg	0.4	9.7	74	71780	30000	460	30460	41320	1.36
T_9	Novaluran 10 % EC	1	8.55	74	63270	30000	1950	31950	31320	0.98
T_{10}	Check		4.48	74	33152	30000	0	30000	3152	0.11
	F-test	-	S	-		-	-	-		-
	SEm±	-	0.1	-		-	-	-		-
	CD (p=0.05)	-	0.3	-		-	-	-		-
	CV (%)	-	7.18	-		-	-	-		-

thiacloprid followed by emamectin benzoate 5 SG and indoxacarb 14.5 SC at 0.3 ml/l. Mahalle *et al.* (2018) reported that chlorantraniliprole 18.5 SC has been found to be significantly superior to all other treatments in controlling *Maruca vitrata*. At 30 g a.i. ha^{-1}, it recorded significantly low pest infestation of 9.55 webs per plant after 10 days of the second spray as compared to 22.55 webs per plant in the untreated control.

CONCLUSION

In case of spotted pod borer per cent reduction in larval population was highest in chlorantraniliprole 18.5% SC (65.85%), followed by flubendamide 480 SC (61.22%) and emamectin benzoate 5% SG (55.12%) after first spray and after second spray per cent reduction in larval population was highest in chlorantraniliprole 18.5 % SC (77.69%), followed by flubendamide 480 SC (71.07%) and emamectin benzoate 5% SG (66.67%). The maximum yield was observed in the treatment chlorantraniliprole 18.5% SC (10.85q/ha) followed by flubendamide 480 SC (10.12q/ha) followed by emamectin benzoate 5% SG (9.70 q/ha) spinosad 45 % SC (9.37q/ha) and untreated control registered the lowest yield of 4.48 q/ha. The results obtained from the experiment indicated that maximum net return were obtained from chlorantraniliprole 18.5 % SC (Rs.49,419/ha) followed by flubendamide 480 SC (RS.42,888/ha) and emamectin benzoate 5 SG (Rs.41,320/ha). Similarly, highest BC ratio was recorded in treatment with chlorantraniliprole 18.5 % SC (1.60), followed by emamectin benzoate 5 % SG (1.36), followed by flubendamide 480 SC (1.34) and spinosad 45 % SC (1.04). The lowest BC ratio was recorded in the untreated control (0.11).

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