Original Research Article

Field Evaluation of Newer Insecticides against Spotted pod borer *[Maruca vitrata* (Geyer)], on Rice fallow Blackgram in North Coastal Andhra Pradesh

Abstract :

The spotted pod borer, *Maruca vitrata* (Geyer) is a serious pest of rice fallow blackgram throughout the growth period especially in flowering and pod development stages in North Coastal Andhra Pradesh and management of this pest becomes difficult due to its concealed nature of feeding inside the flowers and pods. The present study was carried out at College farm Agricultural College, Naira during *Rabi* 2017-18 with different newer insecticides were evaluated for the management of *M. vitrata* in blackgram on cultivar LBG-752 under rice fallow situations. The results revealed that among all the 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 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. The cost - benefit ratio calculated for all the treatments revealed that chlorantraniliprole 18.5 SC @ 0.0037% was highly economical with a C : B ratio of 1: 17.14 followed by spinosad 45 SC with 1: 15.28.

Keywords: chlorantraniliprole + λ cyhalothrin, chlorantraniliprole, flubendiamide, cost - benefit ratio, management, pod damage, spotted pod borer, blackgram

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Introduction:

Blackgram, *Vigna mungo* (L.) Hepper which is commonly called as urdbean is the fourth important pulse crop in India and the second most important crop in Andhra Pradesh in terms of extent of cultivation. It is a short duration, highly remunerative crop. In most parts of the country it is grown traditionally as *kharif* (wet season) crop, but in A.P it is being cultivated mostly in *rabi* (dry) season both in uplands and in rice fallow conditions. Spotted pod borer *Maruca vitrata* has emerged as a major threat in blackgram during the months of Jan- Feb in coastal region of Andhra Pradesh, India (Rangarao *et* *al*., 2007). Spotted pod borer, *Maruca vitrata* (Geyer) is a major constraint for the production of blackgram at critical stages like flowering and pod formation stages in the Southern Zone districts of Andhra Pradesh (Chandrayudu *et al*., 2008). Larvae feed the webbed mass of leaves, flowers and pods by remaining inside due to its concealed feeding habit protects the larvae from adverse conditions, natural enemies and even from insecticidal sprays. This typical nature complicates the management strategies of this pest. Chemical insecticides are the only option for the effective management of this internal feeeder. Several insecticides have been evaluated against *Maruca* on blackgram (Lakshmi *et al*. 2002, Patil *et al*. 2008, Mahalakshmi *et al*. 2012, Ramu *et al*. 2018). The repeated use of older class chemicals results in development of resistance to insecticides. Now, several novel insecticides with novel mode of action with lower doses are effective against target pests and safe to natural enemies. Keeping in view, the present study was carried out to evaluate of some newer insecticide formulations was tested against *M. vitrata* in rice faloow blackgram in north coastal Andhra Pradesh.

Materials and Methods

A Field experiment was conduced at Agricultural College farm, Naira during *Rabi* 2017-2018 with popularly growing blackgram cultivar LBG - 752 under rice fallow conditions. The experiment was laid out in randomized block design (RBD) with 10 treatments including untreated control in three replications with row spacing of 30 cm and plant to plant spacing of 10 cm in plot size of 20 m^2. The treatments (insecticide spray) were imposed at 30 and 50 days after sowing. The observations on larval population of *M. vitrata* were recorded at randomly tagged ten plants per replication at one day before the application of treatments as pre treatment count and at 1, 3, 5 and 10 days after spraying as post treatment counts. The pod damage due to *M. vitrata* was identified by presence of circular small holes (Soundararajan and Chitra, 2011). Per cent pod damage in each treatment was computed by counting the total number of damaged pods to the total number of healthy plants. The yield data were also recorded in the plots. The per cent population reduction after each treatment with reference to untreated control can be calculated by using modified Abbot's formula (Fleming and Ratnakaran, 1985).

Per cent population reduction =

$$= 1 - \left[\frac{\text{Post treatment population in treatment}}{\text{Pre treatment population in treatment}} \times \frac{\text{Pre treatment population in untreated control}}{\text{Post treatment population in untreated control}} \right] * 100$$

$$\text{Per cent pod damage} = \frac{\text{No. of damaged pods}}{\text{Total no. of pods}} \times 100$$

Cumulative efficacy of all treatments was worked out from two sprayings. Per cent pod damage was analysed in each treatment at the time of harvest. The documented data were subjected for evaluating the relative efficacy of different treatments over control and transformed into angular or square - root values as per the standard requisites (Gomez and Gomez, 1984).

Results and Discussion

The pooled data of the two sprays indicated that, all the treatments were significantly superior over untreated control in recording higher per cent reduction in mean larval population of *M. vitrata* (**Table 1 & Figure 1**). Among all evaluated insecticides at one day after spraying chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 mL L^{-1} was found to be very effective by recording 45.26 per cent reduction in mean larval population of *M. vitrata* over untreated control and was significantly superior to all other treatments followed by chlorantraniliprole 18.5 SC @ 0.0037% and flubendiamide 39.35 @ 0.00787 % which were on par with each other with 37.38 and 33.09 per cent reduction in mean larval population of *M. vitrata* over untreated control, respectively. The lowest per cent reduction over control was recorded by flonicamid 50 WG @ 0.02% (10.66%). Three days after spraying, same trend in the efficacy of insecticides was followed chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 mL L^{-1} being superior to all other insecticides with 90.68 per cent reduction in mean larval population of *M. vitrata* over untreated control and also followed by chlorantraniliprole 18.5 SC @ 0.0037 % with 88.00 per cent reduction in mean larval population of *M. vitrata* over control, while low per cent reduction was recorded in flonicamid 50 WG @ 0.02% (23.61%). Five days after spraying, chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 mL L^{-1} was significantly superior (93.76%) to rest of the treatments with respect to per cent reduction in mean larval population of *M. vitrata* over control, followed by chlorantraniliprole 18.5 SC @ 0.0037% with 91.01 per cent reduction in mean larval population of *M. vitrata* over control, whereas the low per cent reduction among all the treatments were recorded in flonicamid 50 WG @ 0.02% (31.43%). Even at 10 days after spraying, chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 mL L^{-1} (73.96%), chlorantraniliprole 18.5 SC @ 0.0037% (71.78%) and flubendiamide @ 39.35 SC 0.00787% (69.95%) were found superior and on par with each other. The minimum per cent reduction of mean larval population of *M. vitrata* over control was recored with thiacloprid 21.7 SC @ 0.0325% (23.86 %) and flonicamid 50WG @ 0.02% (20.57 %).

The overall efficacy of both the sprays resulted that all the chemical insecticides were effective against the spotted pod borer and the results were statistically significant. Chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 mL L^{-1} was found to be most effective with 75.91 per cent reduction in mean larval population of *M. vitrata* over control, 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. The lowest per cent reduction in mean larval population of *M. vitrata* over control was recorded with thiacloprid 21.7 SC @ 0.0325% was on par with flonicamid 50 WG @ 0.02% with 23.78% and 20.13% over control. The present results are in agreement with the findings of Baskaran *et al*. (2009) and Jose *et al.* (2015) against *M. vitrata* and *Helicoverpa armigera* by recording 90.21 per cent reduction over control**.** Haritha (2008), Sambathkur *et al*. (2015), Jakar *et al*. (2016) against *M. vitrata*, Babu *et al*., (2015) against *Thysanoplusia orichalcea* in blackgram and Devi and Reddy (2012) and Sachan *et al*., (2018) against stem borer in paddy. The findings of Patil *et al*. (2008), Ameta *et al*. (2011), Dey *et al*. (2012), Mahalakshmi *et al*. (2012) and Priyadarshini *et al*. (2013), Anusha *et al.* (2014) against

M. vitrata and Kumar *et al*. (2010) against *Helicoverpa armigera* in tomato conforming the outcome of the present study pertaining the efficacy of flubendiammide.

Pod damage and yield

The data on pod damage revealed that lowest pod damage (7.04%) (**Table 1**) was recorded with chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 mL L^{-1} followed by chlorantraniliprole 18.5 SC @ 0.0037 % (11.55%) . In the untreated control plot, maximum pod damage of 60.58 per cent was recorded. The data on the yield of blackgram in different treatments revealed that maximum yield of 8.31 q ha^{-1} was obtained from chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 mL L^{-1} followed by chloroantraniliprole 18.5 SC @ 0.0037 % with 7.25 q ha^{-1} (**Table 2**). In the control plot lowest yield (2.38 q ha^{-1}) was recorded. The results are in conformity with Basakaran *et al*. (2009) who reported that the maximum yield of seed cotton can be obtained with application of chlorantraniliprole + λ cyhalothrin @ 400 ml ha^{-1}. The highest yield obtained with chlorantraniliprole was also evidenced by Mohanraj *et al*. (2012) and Babu *et al* (2015).

Cost benefit ratio

It is ratio of the value of yield gain to the cost of treatment. The cost benefit ratios (CBR) among various insecticidal treatments varied between 17.14 and 0.38 (**Table 3 & Figure 2**) Maximum (1:17.14) CBR was recorded with chlorantraniliprole 18.5 SC (17.14) followed by spinosad 45 SC (15.28) and least cost benefit ratio was recorded with flonicamid 50 WG (0.03). The cost effectiveness of chlorantraniliprole might be due to their lower doses against the pod borer coupled with their low market price these treatments recorded higher cost benefit ratio which was in accordance with Kumar and Sarada (2015).

Hence, it could be concluded that pest *M. vitrata* can be effectively managed with two sparys of chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 mL L^{-1} or chlorantraniliprole 18.5 SC @ 0.0037%. The reduction in larval population is more with these chemicals than with other conventional chemicals, and chances of development of insecticide resistance in this pest might be low against these chemicals and could be recommended for farmers for the effective management of *M. vitrata* and enchanced yield of blackgram. As blackgram is short duration crop and within 65 - 75 days the crop is harvested, it is worth and best option to use such chemicals to manage the legume pod borer.

Conclusions :

The present findings conclude that the new generation insecticides like chlorantraniliprole 9.3% + λ cyhalothrin 4.6% , chlorantraniliprole were found effective against spotted pod borer *M. vitrata* along with an additional yield level in rice fallow blackgram. Further, it was observed that the cost- benefit ratio was also high with chlorantraniliprole and spinosad. Hence, it is suggested that the reduction in larval population is more with these chemicals than with other conventional chemicals, and chances of development of insecticide resistance in this pest might be low against these chemicals. As blackgram is short duration crop and within 65 - 75 days the crop is harvested, it is worth and best option to use such chemicals to manage the legume pod borer.

Table 1: Efficacy of insecticides against spotted pod borer (*Maruca vitrata*) and mean per cent pod damage on blackgram during *rabi,* 2017-18

Treatments	**PTC**	**Per cent population reduction over control**					**Mean per cent pod damage**
		1DAS	**3DAS**	**5 DAS**	**10 DAS**	**OVERALL MEAN**	
T_1 : Thiamethoxam 25WG (0.2g L^{-1})	45.83 (42.99)**	19.45 (26.21)^{e}	29.60 (33.52)^{f}	36.24 (37.17)^{f}	31.87 (34.76)^{d}	29.29 (32.27)^{f}	36.67 (37.17)^{f}
T_2 : Thiacloprid 21.7SC (1.5 mL L^{-1})	48.50 (44.14)	13.39 (21.56)^{f}	26.44 (30.98)^{g}	31.43 (34.14)^{g}	23.86 (29.00)^{e}	23.78 (29.67)^{g}	41.99 (40.11)^{g}
T_3: Flonicamid 50 WG (0.4g L^{-1})	49.66 (45.29)	10.66 (19.52)^{g}	23.61 (29.00)^{g}	25.76 (30.98)^{h}	20.57 (26.92)^{e}	20.13 (26.92)^{g}	46.20 (43.05)^{h}

T_4 : Spinosad 45 SC (0.3mL L^{-1})	46.49 (43.57)	28.62 (32.27)^{c}	69.16 (56.48)^{d}	81.83 (64.52)^{d}	62.61 (52.24)^{b}	60.55 (51.06)^{d}	16.32 (23.97)^{c}
T_5 : Flubendiamide 39.35 SC (0.2 mL L^{-1})	48.17 (44.14)	33.09 (35.37)^{b}	79.20 (63.08)^{c}	86.96 (69.30)^{c}	69.95 (56.48)^{a}	67.30 (55.24)^{c}	14.52 (22.38)^{c}
T_6 : Chlorantraniliprole 18.5 SC (0.2 mL L^{-1})	46.99 (43.57)	37.38 (37.76)^{b}	88.00 (70.18)^{b}	91.01 (73.05)^{b}	71.78 (58.37)^{a}	72.04 (58.37)^{b}	11.55 (20.70)^{b}
T_7 : Acetamiprid 4% + Fipronil 4 % (2 mL L^{-1})	49.49 (44.71)	21.03 (27.63)^{d}	25.09 (30.33)^{g}	29.62 (33.52)^{g}	27.08 (31.63)^{d}	25.77 (30.98)^{f}	33.40 (35.37)^{e}
T_8 : Flubendiamide19.9 %+ Thiachloprid 19.9 % (1 mL L^{-1})	49.99 (45.29)	26.32 (3.98)^{d}	60.70 (51.08)^{e}	71.84 (58.37)^{e}	53.40 (47.01)^{c}	52.06 (47.01)^{e}	22.82 (29.00)^{d}
T_9 : Chlorantraniliprole 9.3% + λ Cyhalothrin 4.6% (0. mL L^{-1})	48.16 (44.14)	45.26 (42.42)^{a}	90.68 (73.05)^{a}	93.76 (76.44)^{a}	73.96 (59.56)^{a}	75.91 (61.00)^{a}	7.06 (15.89)^{a}
T_{10} : Untreated check	50.33 (50.33)	0.00	0.00	0.00	0.00	0.00	60.58 (51.06)^{i}
F test	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SEm ±		1.03	0.81	1.0	1.09	0.98	1.12
CD (p= 0.05)		3.07	2.40	2.97	3.24	2.92	3.341

PTC = Pre Treatment count DAS= Day After Spraying Sign= Significant NS = Non Significant

Figures in Parentheses are ** Arc sin Transformed Values

Table 2: Influence of insecticidal sprays on blackgram yield during *rabi*, 2017-18

Treatments	**Yield**		
	Kg/Plot	**Kg/ha**	**Per cent increase over control**

T_1 : Thiamethoxam 25WG (0.2g l^{-1})	0.62	311.67	41.06
T_2 : Thiacloprid 21.7SC (1.5ml l^{-1})	0.55	273.33	23.84
T_3: Flonicamid 50 WG (0.4g l^{-1})	0.57	286.66	30.27
T_4 : Spinosad 45 SC (0.3ml l^{-1})	0.80	401.66	82.40
T_5 : Flubendiamide 39.35 SC (0.2ml l^{-1})	0.91	453.33	104.93
T_6 : Chlorantraniliprole 18.5 SC (0.2 ml l^{-1})	1.45	725.00	228.7
T_7 : Acetamiprid 4% + Fipronil 4 % (2 ml l^{-1})	0.60	300.00	36.01
T_8 : Flubendiamide19.9 %+ Thiachloprid 19.9 % (1ml l^{-1})	0.69	345.00	56.80
T_9 : Chlorantraniliprole9.3%+λ Cyhalothrin 4.6% (0.5ml l^{-1})	1.66	831.67	275.18
T_{10} : Untreated check	0.44	221.67	0.00
F test	Sig .	Sig .	Sig.
SEm ±	0.03	18.92	7.24
CD (p= 0.05)	0.11	56.21	21.52

Table 3: Influence of insecticidal sprays on blackgram yield and their Cost Benefit Ratio during *rabi*, 2017-18

Treatments	Dosage L / kg ha $^{-1}$	Cost of the insecticide Rs. /kg	Cost Rs L/kg ha $^{-1}$	Yield		Income Rs.	Labour costs Rs.	Total Cost of plant protection Rs. Ha	Net profit Rs.	C:B Ratio
				q/ha	Additional Yield/ha					
T_1 : Thiamethoxam 25WG (0.2g l^{-1})	0.1kg ha^{-1}	3000	300.00	3.11	0.80	4320	500	800.00	3520.00	4.06
T_2 : Thiacloprid 21.7SC (1.5ml l^{-1})	0.75 l ha^{-1}	2840	21,30.00	2.73	0.52	2808	500	2630.00	178.00	0.06
T_3: Flonicamid 50 WG (0.4g l^{-1})	0.2kg g	10200	2040.00	2.86	0.65	3510	500	2540.00	970.0	0.38

	ha^{-1}								0	
T_4 : Spinosad 45 SC (0.3ml l^{-1})	0.15 l ha^{-1}	2357	353.55	4.01	1.80	9720	500	853.55	8899.45	15.28
T_5 : Flubendiamide 39.35 SC (0.2ml l^{-1})	0.11 ha^{-1}	20000	2200	4.53	2.32	12,528	500	2700	9828	3.64
T_6 : Chlorantraniliprole 18.5 SC (0.2 ml l^{-1})	0.1 l ha^{-1}	10000	1000.00	7.25	5.04	27,216	500	1500.00	25716.00	17.14
T_7 : Acetamiprid 4% + Fipronil 4 % (2 ml l^{-1})	1 lha^{-1}	1660	1660.00	3.00	0.79	4266	500	2160.00	2106.00	0.975
T_8 : Flubendiamide19.9 % + Thiachloprid 19.9 % (1ml l^{-1})	0.5 l ha^{-1}	11,590	5795.00	3.45	1.24	6696	500	6295.00	401.00	0.06
T_9 : Chlorantraniliprole9.3%+λ Cyhalothrin 4.6% (0.5ml l^{-1})	0.25 l ha^{-1}	10625	2656.25	8.31	6.1	32940	500	3156.25	29783.75	9.43
T_{10} : Untreated check	-	-	-	2.21	-	-	-	-		

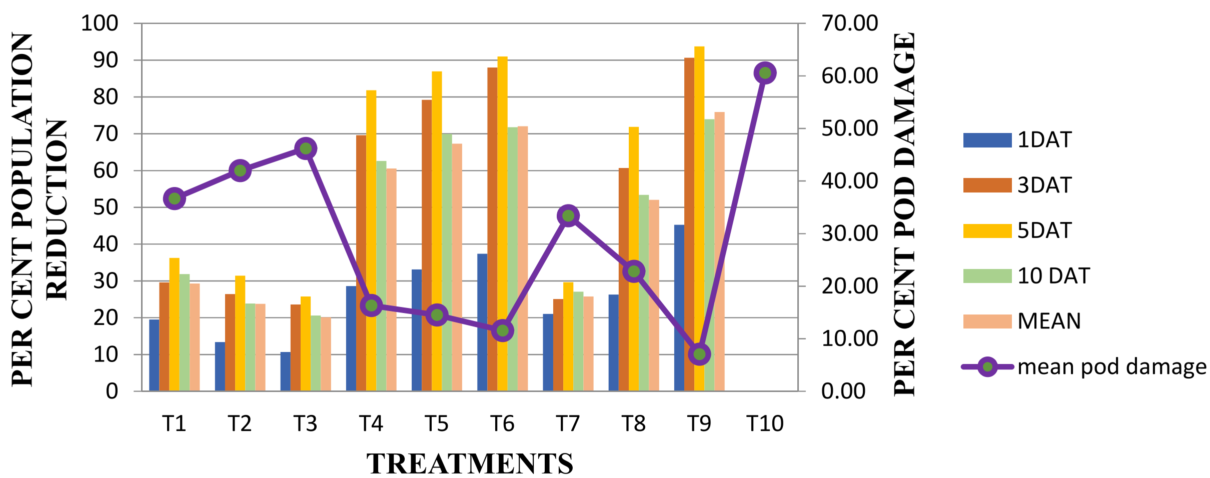

Figure 1. Cumulative efficacy of two sprays against spotted pod borer (*M. vitrata*) and per cent pod damage on blackgram during *rabi*, 2017-2018

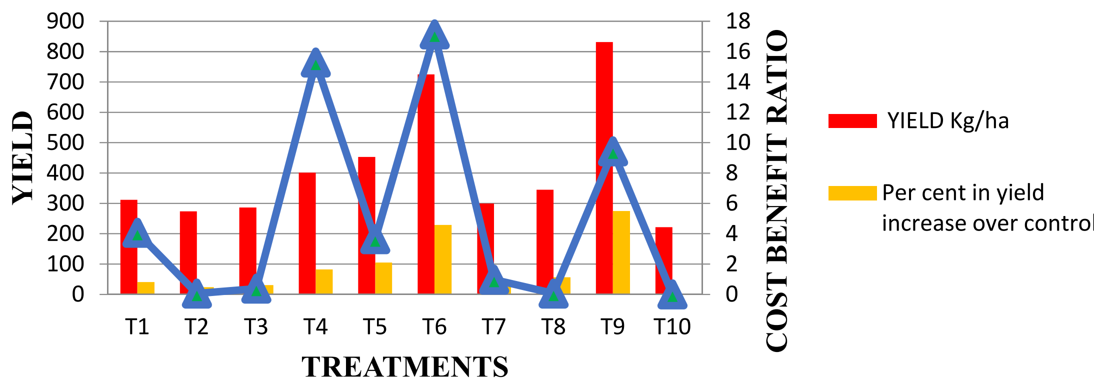

Figure 2. Effect of different insecticides in increasing the yield of blackgram and C: B ratio

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