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Evaluation of Certain Newer Insecticides against Spotted Pod Borer, *Maruca vitrata* on Greengram

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ABSTRACT

A field experiment was conducted during *rabi* 2014-15, to evaluate the efficacy of some newer insecticides along with conventional insecticides against spotted pod borer in greengram. Among eleven treatments evaluated for their efficacy against *Maruca vitrata* on greengram, novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % was numerically the best treatment with 85.67 per cent reduction in larval population over untreated control and recorded lowest per cent inflorescence and pod damage of 9.03 and 11.20 %, respectively. However, the increamental cost benefit ratio was highest from acephate 95 % SP @ 0.071 % (1: 5.36) due to its cheaper cost followed by combination insecticides *i.e.,* chlorpyriphos 20 % EC @ 0.04 % + dichlorvos 50 % EC @ 0.05 % (1: 4.33) and novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % (1: 3.78). Hence, conventional insecticides can also be used along with new insecticides for management of spotted pod borer in greengram.

Key words : Efficacy, Greengram , Insecticide, *Maruca vitrata*, Spotted pod borer.

Greengram (*Vigna radiata* (L.)) is the most important short duration and subsistence pulse crop for food and income security and sustainability of cropping systems. Around the world, the crop is cultivated in 5.0 M. ha with a production of 2.5 m. t. While in India it is grown in an area of about 26.06 lakh ha with production and productivity of 16.10 lakh tonne and 619 kg ha^{-1}, respectively (Anonymous, 2013). Andhra Pradesh is the fourth major state of India contributing 15.5 % of the national production with 351 kg ha^{-1} average productivity of greengram. Due to large vegetative canopy, more than 200 insect pests attack mungbean from its seedling to harvest stage causing serious yield losses. Among them legume pod borer, *M. vitrata* (Geyer) is predominant species in South India and is a serious pest because of its extensive host range, destructiveness and distribution (Taylor, 1967). It attacks the crop right from pre-flowering to pod maturing stage by feeding on flower buds, flowers and pods through webbing. This type of typical concealed feeding protects the larvae not only from natural enemies, but also from insecticides. Economic loss of 25 - 50 % in greengram was reported by Sandhyarani and Eswari (2008).

Hence, the present study was conducted to evaluate the field efficacy of newer insecticides with unique mode of action, beneficient to natural enemies against *M. vitrata*. Such information may be recommended to the farmers which could increase greengram productivity with an ultimate goal of self sustainability in greengram production.

MATERIAL AND METHODS

A field experiment was conducted at Regional Agricultural Research Station, Lam, Guntur during *rabi* 2014-15. The crop was grown at a spacing of 30 x 10 cm with three replications and eleven treatments including control in randomized block design. The crop received a total of two applications of insecticides, first at 50 % flowering and second at 15 days after first spray using knapsack sprayer. All the recommended practices were adopted for raising the crop. The data was recorded from five randomly selected plants from each treatment leaving border rows. The observations were recorded one day before spraying considering it as the pre-treatment count and on 3rd and 7th day after spraying for inflorescence damage, pod damage and number of larvae from five plants from each treatment. Two blanket sprays with selective insecticides was done against sucking pests to maintain the crop healthiness. The per cent population reduction in different treatments over untreated control was

$$\text{Per cent population reduction} = \left[1 - \left[\frac{\text{Post treatment population in treatment}}{\text{Pre treatment population in treatment}} \times \frac{\text{Pre treatment population in untreated check}}{\text{Post treatment population in untreated check}}\right]\right] \times 100$$

calculated by modified abbot's formula (Flemming and Retnakaran, 1985) and the data was subjected to ANOVA.

The Per cent increase in yield over control was calculated by using the following formula

$$\text{\% increase in yield} = \frac{\text{Yield in treatment - Yield in untreated control}}{\text{Yield in untreated control}} \times 100$$

RESULTS AND DISCUSSION

The data presented in Table 1, 2 and 3 shows that there was significant impact of sprayed treatments on larval population, inflorescence damage and pod damage due to spotted pod borer and grain yield at harvest.

The data showed that all the treatments were significantly effective in reducing larval population (Table 1). Among all the test insecticides novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % was numerically the best treatment

Table 1. Efficacy of insecticidal treatments against *M. vitrata* larvae in greengram during *rabi* 2014 –15.

Treatments	Pre treatment count	Mean per cent reduction in *M. vitrata* larvae over control after 1st spray			Mean per cent reduction in *M. vitrata* larvae over control after 2nd spray			Overall mean efficacy of two sprays
		3 DAT	7 DAT	Mean efficacy	3 DAT	7 DAT	Mean efficacy	
T_1: Rynaxypyr 18.5 % SC 0.005 %	13.67	77.29 (61.81)^{ab}	90.16 (72.22)^{ab}	83.73 (66.27)^{abc}	63.23 (52.8)^{a}	88.18 (70.76)^{ab}	75.71 (60.74)^{abc}	79.72 (63.38)^{abcd}
T_2: Flubendiamide 39.35 % SC 0.007 %	14.00	77.73 (61.94)^{ab}	93.83 (76.17)^{a}	85.78 (67.96)^{a}	75.46 (61.3)^{a}	88.97 (70.87)^{ab}	82.22 (65.31)^{ab}	84.00 (66.59)^{ab}
T_3: Emamectin benzoate 5 % SG 0.0145 %	20.00	77.36 (61.72)^{ab}	91.23 (73.05)^{ab}	84.30 (66.82)^{ab}	71.77 (58.6)^{a}	88.80 (70.69)^{ab}	80.29 (63.90)^{abc}	82.29 (65.30)^{abc}
T_4: Spinosad 45 % SC 0.0135 %	10.45	71.09 (57.55)^{ab}	88.97 (71.22)^{ab}	80.03 (63.55)^{abcd}	58.7 6(50.8)^{a}	85.76 (68.20)^{abc}	72.26 (58.81)^{abc}	76.15 (61.03)^{bcde}
T_5: Novaluron 5.25 % + Indoxacarb 4.5 % SC 0.005 % + 0.004 %	17.95	78.65 (62.57)^{a}	94.16 (76.29)^{a}	86.41 (68.49)^{a}	77.71 (61.9)^{a}	92.14 (73.82)^{a}	84.93 (67.23)^{a}	85.67 (67.81)^{a}
T_6: Indoxacarb 14.5 % SC 0.0145 %	11.33	65.30 (54.04)^{ab}	87.65 (69.69)^{ab}	76.48 (61.15)^{bcd}	58.07 (50.3)^{a}	82.95 (65.77)^{abc}	70.51 (57.41)^{bc}	73.49 (59.17)^{cde}
T_7: Novaluron 10 % EC 0.01 %	16.00	75.65 (61.12)^{ab}	89.66 (72.32)^{ab}	82.66 (66.20)^{abc}	61.48 (51.7)^{a}	86.14 (68.80)^{ab}	73.81 (59.28)^{abc}	78.23 (62.43)^{abcde}
T_8: Acephate 95 % SP 0.071 %	12.84	61.99 (52.44)^{bc}	82.29 (66.21)^{bc}	72.14 (58.74)^{d}	55.04 (48.3)^{ab}	76.90 (62.51)^{bc}	65.97 (55.23)^{cd}	69.05 (56.93)^{e}
T_9: Acephate 75 % SP 0.075 %	13.67	48.74 (44.24)^{c}	74.54 (59.75)^{c}	61.63 (51.80)^{e}	35.64 (35.4)^{b}	71.75 (58.47)^{c}	53.70 (47.24)^{d}	57.66 (49.53)^{f}
T_{10}: Chlorpyriphos 20 % EC + Dichlorvos 50 % EC 0.04 % + 0.05 %	11.00	64.32 (53.35)^{abc}	85.43 (68.08)^{b}	74.88 (59.99)^{cd}	56.72 (49.1)^{ab}	78.86 (63.95)^{abc}	67.80 (56.06)^{cd}	71.34 (57.93)^{de}
T_{11}: Untreated (control)	13.00	0.00 (0.00)^{d}	0.00 (0.00)^{d}	0.00 (0.00)^{f}	0.00 (0.00)^{c}	0.00 (0.00)^{d}	0.00 (0.00)^{e}	0.00 (0.00)^{g}
F – test		S	S	S	S	S	S	S
SEm±		3.25	2.33	2.15	5.06	3.47	3.03	2.12
CD (p=0.05)		9.60	6.88	6.34	14.92	10.23	8.93	6.24
CV%		10.86	6.30	6.49	18.53	9.81	9.75	6.61

Figures in parenthesis are angular transformed values DAT: Days After Treatment

Table 2. Efficacy of insecticidal treatments on per cent inflorescence and pod damagedue to *M. vitrata* in greengram during *rabi* 2014 –15.

Treatments	Pre treatment count	% inflorescence damage after 1st spray			% pod damage after 2nd spray		
		3 DAT	7 DAT	Mean	3 DAT	7 DAT	Mean
T_1: Rynaxypyr 18.5 % SC 0.005 %	28.72	17.36 (24.25)^{ab}	13.25 (21.29)^{abc}	15.30 (22.96)^{abc}	12.83 (20.90)^{ab}	10.86 (19.19)^{abcd}	11.85 (20.11)^{abcd}
T_2: Flubendiamide 39.35 % SC 0.007 %	26.42	13.68 (21.18)^{a}	11.24 (19.54)^{ab}	12.46 (20.57)^{ab}	10.79 (19.17)^{a}	8.70 (17.14)^{ab}	9.75 (18.19)^{ab}
T_3: Emamectin benzoate 5 % SG 0.0145 %	23.01	14.06 (21.86)^{a}	11.41 (19.70)^{ab}	12.73 (20.84)^{ab}	12.57 (20.66)^{ab}	9.73 (17.93)^{abc}	11.15 (19.51)^{abc}
T_4: Spinosad 45 % SC 0.0135 %	34.41	18.17 (24.98)^{ab}	14.32 (22.13)^{abc}	16.25 (23.73)^{abc}	13.51 (21.53)^{ab}	12.47 (20.46)^{abcd}	12.99 (21.04)^{bcde}
T_5: Novaluron 5.25 % + Indoxacarb 4.5 % SC 0.005 % + 0.004 %	23.53	12.27 (20.25)^{a}	10.13 (18.49)^{a}	11.20 (19.48)^{a}	10.54 (18.93)^{a}	7.53 (15.79)^{a}	9.03 (17.48)^{a}
T_6: Indoxacarb 14.5 % SC 0.0145 %	34.44	21.45 (27.42)^{ab}	14.43 (22.32)^{abc}	17.94 (25.01)^{cd}	14.49 (21.85)^{ab}	14.07 (21.91)^{bcd}	14.28 (22.00)^{cde}
T_7: Novaluron 10 % EC 0.01 %	23.87	17.53 (24.70)^{ab}	14.16 (22.05)^{abc}	15.84 (23.43)^{abc}	13.29 (21.31)^{ab}	11.01 (19.23)^{abcd}	12.15 (20.33)^{abcd}
T_8: Acephate 95 % SP 0.071 %	31.79	24.88 (29.43)^{ab}	16.82 (24.13)^{bc}	20.85 (26.91)^{cd}	15.82 (23.24)^{ab}	15.25 (22.95)^{cd}	15.54 (23.13)^{de}
T_9: Acephate 75 % SP 0.075 %	27.47	27.71 (31.46)^{bc}	18.96 (25.72)^{c}	23.34 (28.86)^{d}	16.33 (23.75)^{b}	16.73 (24.02)^{d}	16.53 (24.00)^{e}
T_{10}: Chlorpyriphos 20 % EC + Dichlorvos 50 % EC 0.04 % + 0.05 %	23.48	21.89 (26.86)^{ab}	16.19 (23.40)^{abc}	19.04 (25.81)^{cd}	15.48 (23.15)^{ab}	14.21 (21.96)^{abcd}	14.84 (22.63)^{cde}
T_{11}: Untreated (control)	30.23	42.37 (40.60)^{c}	45.22 (42.22)^{d}	43.80 (41.45)^{e}	48.18 (43.95)^{c}	50.62 (45.35)^{e}	49.40 (44.68)^{f}
F – test		S	S	S	S	S	S
SEm±		3.21	1.72	1.39	1.49	1.73	1.11
CD (p=0.05)		9.46	5.06	4.10	4.40	5.11	3.27
CV%		20.83	12.51	9.48	10.98	13.42	8.34

Figures in parenthesis are angular transformed values DAT: Days After Treatment

with 85.67 per cent reduction in larval population over untreated control followed by flubendiamide 39.35 % SC @ 0.007 % (84.00 %), emamectin benzoate 5 % SG @ 0.0145 % (82.29 %), rynaxypyr 18.5 % SC @ 0.005 % (79.72 %), novaluron 10 % EC @ 0.01 % (78.23 %) and spinosad 45 % SC @ 0.0135 % (76.15 %) which recorded more than 75 % mean reduction in larval population over untreated control. Whereas in remaining treatments the mean larval reduction was observed varying from 57.66 to 73.49 per cent. The present findings on novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % are in conformity with the findings of Das *et al*. (2012) who reported 100 per cent reduction of *Helicoverpa armigera* larval population in redgram. Similarly Dolai and Chatterjee (2012) reported lowest population of *H. armigera* and *S. litura* with novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 %.

Similarly against inflorescence and pod damge (Table 2) novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % was numerically the best treatment with 11.20 and 9.03 %, respectively followed by flubendiamide 39.35 % SC @ 0.007 % with 12.46 and 9.75 %, respectively. In the remaining treatments the mean per cent inflorescence damage varied from 12.73 to 43.80 per cent where as the mean per cent pod damage varied from 11.15 to 49.40 per cent. The literature regarding the efficacy of novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % against inflorescence damage and pod damage by *M.*

Table 3. Effect of different insecticidal treatments on seed yield and increamental cost benefit ratio during *rabi* 2014 –15 in greengram.

Treatments	Mean plot yield (kg)	Yield per ha (kg)	Per cent Increase over Control	Cost of Increased Yield (Rs)	Plant Protection Cost	Net Profit (Rs)	ICBR
T_1: Rynaxypyr 18.5 % SC 0.005 %	1.23	612.50[a]	53.13	6784	2855	3961	1.39
T_2: Flubendiamide 39.35 % SC 0.007 %	1.29	645.83[a]	61.46	8128	1900	5972	3.14
T_3: Emamectin benzoate 5 % SG 0.0145 %	1.26	629.17[a]	57.29	7328	2180	5148	2.36
T_4: Spinosad 45 % SC 0.0135 %	1.20	600.00[a]	50.00	6400	2800	3600	1.29
T_5: Novaluron 5.25 % + Indoxacarb 4.5 % SC 0.005 % + 0.004 %	1.31	654.17[a]	63.54	7872	1700	6428	3.78
T_6: Indoxacarb 14.5 % SC 0.0145 %	1.13	566.67[ab]	41.67	5344	2100	3244	1.54
T_7: Novaluron 10 % EC 0.01 %	1.22	608.33[ab]	52.08	6656	2300	4356	1.89
T_8: Acephate 95 % SP 0.071 %	1.09	545.83[ab]	36.46	5344	730	3910	5.36
T_9: Acephate 75 % SP 0.075 %	0.97	483.33[bc]	20.83	2656	710	1946	2.74
T_{10}: Chlorpyriphos 20 % EC + Dichlorvos 50 % EC 0.04 % + 0.05 %	1.13	566.67[ab]	41.67	4672	996	4316	4.33
T_{11}: Untreated (control)	0.80	400.00[c]	0.00				
F – test		S					
SEm±		39.07					
CD (p=0.05)		115.26					
CV%		11.79					

Figures in parenthesis are angular transformed values.

vitrata was scanty. The results of flubendiamide 39.35 % SC @ 0.007 % are in conformity with the Rao (2010) who reported 83.80 per cent reduction in inflorescence damage in rice fallow blackgram. The results obtained in emamectin benzoate @ 0.0145 % SG (0.0025 %) are in agreement with the findings of Rao *et al.* (2014) against *M. vitrata* recording 12.13 per cent pod damage in rice fallow blackgram and also with findings of Rekha and Mallapur (2007) against *M. testulalis* recording 11.75 per cent pod damage on dolichos bean. Regmi *et al.* (2014) reported that emamectin benzoate 5 % SG @ 0.25 g l^{-1} recorded 5.76 per cent of pod damage by *M. vitrata* on Yardlong Bean.

The results on efficacy of insecticide treatments on grain yield is presented in Table 3. It revealed that novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % was better and recorded the seed yield of 1.310 kg $plot^{-1}$ (654 kg ha^{-1}) and recorded 63.54 per cent increase over untreated control, however, it was on par with flubendiamide 39.35 % SC @ 0.007 % (1.290 kg $plot^{-1}$) and emamectin benzoate 5 % SG @ 0.0145 % (1.260 kg $plot^{-1}$) with 61.46 and 57.29 per cent increase over untreated control, respectively. The highest yield obtained in novaluron 0.005 % + indoxacarb 0.004 % treated plot was in agreement with the reports of Das *et al.* (2012) in pigeonpea. Patil *et al.* (2008) reported that flubendiamide 480 SC @ 48 g a.i. ha^{-1} was effective against pod borers of blackgram and recorded yield of 793.00 kg ha^{-1}. Among the treatments, acephate 95 % SP @ 0.071 % has recorded the highest increamental cost benefit ratio (ICBR) (1: 5.36) followed by chlorpyriphos 20 % EC @ 0.04 % + dichlorvos 50 % EC @ 0.05 % (1: 4.33), novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % (1: 3.78) and flubendiamide 39.35 % SC @ 0.007 % (1: 3.14).

CONCLUSION

Among the eleven treatments evaluated for their efficacy against *M. vitrata* on greengram, novaluron 5.25 % @ 0.005 % + indoxacarb 4.5 % SC @ 0.004 % was highly effective with 85.67 per cent reduction in larval population over untreated control and recorded lowest per cent inflorescence and pod damage of 9.03 and 11.20 % respectively.

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