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Evaluation of different Insecticides and their Spray Schedules Against Spotted Pod Borer, *Maruca vitrata* on Blackgram

G Chitti Babu, T Madhumathi, P Arjuna Rao and V Srinivasa Rao
Department of Entomology, Agricultural College, Bapatla 522 101 A P

ABSTRACT

A field experiment was conducted to evaluate the different insecticides and their spray schedules against spotted pod borer, *Maruca vitrata* (Geyer) (Pyralidae: Lepidoptera) on blackgram at Agricultural College Farm, Bapatla during *rabi* 2007-08. Among the chemical schedules (F_1), the profenofos schedule (C_3) recorded the lowest mean number of *M. vitrata* larvae (1.24) and damaged flowers/pods (1.61) per five plants and found effective. Among the spray interval schedules (F_2), the four days interval spray schedule (D_1) was found effective and has recorded the lowest number of *M. vitrata* larvae per five plants (0.80) and mean number of damaged flowers/pods per five plants (0.93). The interaction between the profenofos schedule and four days interval spray schedule *i.e.* C_3D_1 was found effective and has recorded the lowest mean number of *M. vitrata* larvae (0.73) and damaged flowers /pods (0.67) per five plants. The grain yield was highest (1.73 t/ha) in the profenofos schedule and in four days interval spray schedule (1.75 t/ha) as well as in the interaction between profenofos and four days interval spray schedule (C_3D_1, Profenofos-Chlorpyriphos+Dichlorvos- Novaluron +Dichlorvos at 4 days interval) *i.e.* 2.0 t/ha. However, the BC ratio of profenofos at ten days interval schedule (1: 3.25) was found to be cost effective with profitable returns.

Key words : Blackgram, Insecticides and Spotted pod borer.

The pulses occupy a special role in diet of human beings being a rich source of proteins with high nutritional value. Pulses contain nearly 30 per cent proteins which are nearly three times as much as cereals. Blackgram, *Vigna mungo* (L.) Hepper 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 being cultivated as rice fallow *rabi* pulse crop in Andhra Pradesh in an area of 4.27 lakh ha with a production of 2.59 mt. (Ministry of Agriculture, 2007). Blackgram is damaged by more than 64 species of insect pests (Lal, 1985) among which pod borers are important causing damage mainly at reproductive stage of the crop. Important pod borers of blackgram are spotted pod borer, *Maruca vitrata* (Geyer), tobacco caterpillar, *Spodoptera litura* (Fabricius), gram pod borer, *Helicoverpa armigera* (Hubner) and blue butterfly, *Lampides boeticus* (L.). Of these, spotted pod borer, *M. vitrata* has become a serious pest on rice fallow *rabi* blackgram and assumed the major pest status causing 20-60 per cent losses in grain yield (Singh and Allen, 1980).

MATERIAL AND METHOD

The experiment was laid in a factorial randomized block design (FRBD) with a blackgram variety, LBG-648 with ten treatments including one untreated control at Agricultural College Farm, Bapatla. The crop was sown on 10.11.2007 with a spacing of 30 x 10 cm in 3 x 4m plots. The infestation of spotted pod borer, *M. vitrata* has started 30 days after sowing *i.e.* 15.12.2007. The infestation of pest was natural and the damage symptoms observed were small holes at bases of the flowers and webbing of flowers. When the pest reached its ETL level, sprayings were given by following the schedule.

FACTOR 1 (Chemical Schedule)

Neem schedule (C_1): Neem Chlorpyriphos + Dichlorvos Novaluron + Dichlorvos
B.t schedule (C_2) : *B.t.* Chlorpyriphos + Dichlorvos Novaluron + Dichlorvos
Profenofos schedule (C_3) : Profenofo Chlorpyriphos + Dichlorvos Novaluron + Dichlorvos

FACTOR 2 (Spray Interval schedule)

4 days interval spray schedule (D_1)
7 days interval spray schedule (D_2)
10 days interval spray schedule (D_3)

In the first spray, the treatments T_1, T_2 & T_3 were sprayed with neem 1500ppm @ 2.5ml/L and the treatments T_4, T_5 & T_6 were sprayed with *Bt* @ 2.5g/L and the treatments T_7, T_8 & T_9 were sprayed with profenofos @ 2.5ml/L (Table 1). The second spray was done with chlorpyriphos @ 2.5ml/L + dichlorvos @ 1ml/L at four days after first spray in the treatments T_1, T_4 & T_7, seven days after first spray in treatments T_2, T_5 & T_8 and ten days after first spray in treatments T_3, T_6& T_9. The third spray was done with novaluron @ 2.5ml/L + dichlorvos @ 1ml/L at four days after second spray in the treatments T_1, T_4 & T_7, seven days after second spray in treatments T_2, T_5 & T_8 and ten days after second spray in treatments T_3, T_6& T_9. The fourth spray was done with chlorpyriphos @ 2.5ml/L+ dichlorvos @ 1ml/L four days after third spray in the treatments T_1, T_4& T_7, and seven days after third spray in treatments T_2, T_5 & T_8. The fifth spray was done with novaluron @ 2.5ml/L + dichlorvos @ 1ml/L at four days after fourth spray in the treatments T_1, T_4 & T_7 (Table 1)

Data on pest population was recorded at three days after spraying by counting the number of larvae of *M.vitrata* and number of damaged flowers/pods per plant on five randomly selected and tagged plants leaving border rows. After each spray one count was taken in case of four days interval schedule, two counts were taken in case of seven days interval schedule and three counts were taken in case of ten days interval schedule at three days interval. In four days interval schedule, a total of five sprays were given and five counts were taken and the mean of five counts was calculated. In seven days interval schedule, a total of four sprays were given and at each spray two counts were taken and the mean of two counts was calculated and also the mean of overall four sprays was also calculated. In ten days interval schedule, a total of three sprays were given and at each spray three counts were taken and the mean of three counts was calculated and also the mean of overall three sprays was also calculated. The means of all sprays in different spray schedules were tabulated and subjected to two factorial randomized block design (2FRBD) (Gomez and Gomez, 1994).

RESULTS AND DISCUSSION

1.Efficacy of treatments on larvae of *M. vitrata*.

Among the chemical schedules (F_1), the profenofos schedule (C_3) has recorded the lowest mean number of larvae per five plants (1.24) followed by neem schedule (C_1) (1.28) and *B.t.* schedule (1.48). Among the spray interval schedule (F_2) the lowest mean number of larvae were recorded in the four days interval spray schedule (D_1) (0.80) followed by seven days interval spray schedule (D_2) (1.36) and ten days interval spray schedule (D_3) (1.85) on blackgram (Table 2).

Srinivas (1995) reported that profenofos was effective in controlling chickpea pod borer (67.07%) which is in confromity with the present findings. Similarly, Dayakar *et al.* (1995) reported that fenvelerate 0.05% and profenofos at 0.05% were the best by recording low larval population of *M. vitrata* (1.19 and 1.73 larvae per plant). Ujagir *et al.* (1997) also revealed that profenofos 2.0 L/ha was the most effective in controlling pod borer, *Helicoverpa armigera* (Hubner) on chickpea with less per cent pod damage (6.0). Sanap and Patil (1998) also found that profenofos 50 EC at 1000 g a.i. per ha was highly effective against the pod borer, *M. vitrata* with 39.37 per cent damage in pigeonpea. Studies at RARS, Lam farm revealed that profenofos at 1ml/L recorded minimum pod borer damage of 2.67 per cent on pigeonpea (AICRP report, 2002-03). The above findings supports higher efficacy of profenofos schedule against *M. vitrata* on blackgram in the present investigation. The higher efficacy of profenofos may be due to its ovicidal action besides contact and stomach toxicity in larvae.

The interaction of the two factors, chemical schedule (F_1) and spray interval schedule (F_2) has significantly decreased the larval population of *M. vitrata* on blackgram. The interaction of profenofos schedule with four days interval spray schedule *i.e.* C_3D_1 has recorded the lowest mean number of *M. vitrata* larvae (0.73) than the other interactions. The interaction of *B.t.* schedule and four days interval spray schedule *i.e.* C_2D_1 was the next best treatment which has recorded the lowest mean number of *M. vitrata* larval population (0.80 per five plants). The highest mean number of *M. vitrata* larvae (1.95) were found in the interaction of *B.t.* with ten days interval spray schedule *i.e.* C_2D_3 (Table 2).

Among the chemical schedules, profenofos was found to be the best followed by neem and *Bt.* This order of efficacy of profenofos, neem and *Bt* schedules was supported by the findings of Krishna (2004) who revealed that profenofos (22.67%) was the best followed by neem (22.37) and *Bt* (22.14%) against *M. vitrata* on blackgram.

2.Efficacy of treatments on number of damaged flowers/pods caused by *M. vitrata.*

The profenofos schedule (C_3) was found to be the most effective among the chemical schedules (F_1), which recorded the lowest mean number of damaged flowers/pods (1.61) followed by neem schedule (C_1) and *B.t.* schedule (C_2) with 1.69 and 1.80 damaged pods per five plants, respectively (Table 3).

In the spray interval schedules (F_2), four days interval spray schedule (D_1) has recorded the lowest mean number of damaged flowers/pods (0.93) caused by *M. vitrata* which was found significant

Table1. Particulars of spray schedule

Treatments	I st spray	IInd spray	IIIrd spray	IVth spray	V th spray
$C_1 D_1 (T_1)$	Neem 1500ppm @ 0.25%	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **4** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **4** days after 2nd spray	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **4** days after 3rd spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **4** days after 4th spray
$C_1 D_2 (T_2)$	Neem 1500ppm @ 0.25%	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **7** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **7** days after 2nd spray	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **7** days after 3rd spray	——
$C_1 D_3 (T_3)$	Neem 1500ppm @ 0.25%	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **10** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **10** days after 2nd spray	——	——
$C_2 D_1 (T_4)$	*Bt* @ 0.25 %	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **4** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **4** days after 2nd spray	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **4** days after 3rd spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **4** days after 4th spray
$C_2 D_2 (T_5)$	*Bt* @ 0.25 %	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **7** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **7** days after 2nd spray	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **7** days after 3rd spray	——
$C_2 D_3 (T_6)$	*Bt* @ 0.25 %	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **10** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **10** days after 2nd spray	——	——
$C_3 D_1 (T_7)$	Profenofos 50EC @ 0.25%	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **4** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **4** days after 2nd spray	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **4** days after 3rd spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **4** days after 4th spray
$C_3 D_2 (T_8)$	Profenofos 50EC @ 0.25%	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **7** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **7** days after 2nd spray	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **7** days after 3rd spray	——
$C_3 D_3 (T_9)$	Profenofos 50EC @ 0.25%	Chlorpyriphos 20 EC @ 0.25% +Dichlorvos 76SC @ 0.1% **10** days after 1st spray	Novaluron 10 EC@ 0.25%+ Dichlorvos 76SC@ 0.1% **10** days after 2nd spray	——	——
Control (T_{10})	Water	Water	Water	Water	Water

compared to control and the other two spray intervals. The mean number of damaged flowers/pods in seven days interval spray schedule (D_2) was 1.83 followed by 2.33 in ten days interval spray schedule (D_3) (Table 3).

The interaction of the two factors was found significant in decreasing the damage to flowers and pods caused by spotted pod borer, *M. vitrata* and also the interaction was found significant over control. The interaction of profenofos schedule with four days interval spray schedule *i.e.* C_3D_1 was found to be the most effective interaction in decreasing the damage to flowers and pods caused by *M. vitrata* with the lowest mean number of damaged flowers/ pods (0.67) followed by neem schedule interaction with four days interval spray schedule *i.e.* C_1D_1 (1.07) and *B.t.* schedule and four days interval spray schedule *i.e.* C_2D_1 (1.07) which were on par with each

Table 2. Influence of spray schedules on larval population of *M. vitrata* on blackgram during *rabi* 2007-08.

Spray Interval (F_2)	Insecticde/Chemical Schedule (F_1)			
	Mean number of larvae/plant			
	Neem (C_1)	*B.t.* (C_2)	Profenofos (C_3)	Mean
4 days (D_1)	0.87	0.80	0.73	0.80
7 days (D_2)	1.21	1.68	1.17	1.36
10 days (D_3)	1.76	1.95	1.83	1.85
Mean	1.28	1.48	1.24	
Control	2.93			
	SEm±	C.D.		
Chemical	0.0756	0.1588		
Spray interval (F_2)	0.0756	0.1588		
F_1 x F_2	0.1309	0.2750		

Table 3 Influence of spray schedules on damaged flowers/pods caused by *M. vitrata* on blackgram during *rabi* 2007-08.

Spray Interval (F_2)	Insecticde/Chemical Schedule (F_1)			
	Mean number of damaged flowers/pods			
	Neem (C_1)	*B.t.* (C_2)	Profenofos (C_3)	Mean
4 days (D_1)	1.07	1.07	0.67	0.93
7 days (D_2)	1.71	1.87	1.92	1.83
10 days (D_3)	2.29	2.44	2.26	2.33
Mean	1.69	1.80	1.61	
Control	5.0			
	SEm±	C.D.		
Chemical	0.0639	0.1342		
Spray interval (F_2)	0.0639	0.1342		
F_1 x F_2	0.1107	0.2325		

Table 4. Influence of spray schedules on yield (tonnes per ha) of black gram during *rabi* 2007-08.

Spray Interval (F_2)	Insecticde/Chemical Schedule (F_1) Black gram yield (t/ha)			
	Neem (C_1)	*B.t.* (C_2)	Profenofos (C_3)	Mean
4 days (D_1)	1.53	1.71	2.0	1.75
7 days (D_2)	1.65	1.50	1.72	1.63
10 days (D_3)	1.71	1.47	1.47	1.55
Mean	1.63	1.56	1.73	
Control	0.94			
	SEm±	C.D.		
Chemical	0.0615	0.1292		
Spray interval (F_2)	0.0615	0.1292		
F_1 x F_2	0.1065	0.2238		

Table 5. Benefit-cost ratio of spray schedules against spotted pod borer, *M. vitrata* during *rabi* 2007-08.

Spray Interval (F_2)	Insecticde/Chemical Schedule (F_1) Benefit cost ratio			
	Neem(C_1)	*B.t.* (C_2)	Profenofos (C_3)	Mean
4 days (D_1)	2.08	2.31	2.58	2.32
7 days (D_2)	3.25	2.88	3.10	3.08
10 days (D_3)	4.13	3.49	3.25	3.62
Mean	3.15	2.89	2.98	
	SEm±	C.D.		
Chemical	0.0956	0.2027		
Spray interval (F_2)	0.0956	0.2027		
F_1 x F_2	0.1656	0.3511		

other. The highest mean number of damaged flowers/pods was found in the interaction of *B.t.* schedule with ten days interval spray schedule *i.e.* C_2D_3 (2.44) (Table 3).

3. **Efficacy of treatments on yield of blackgram**

Among the different chemical schedules (F_1) the highest yield (1.73 t/ha) was recorded in the profenofos schedule (C_3) which was significantly different from other schedules. The next highest yield was recorded in neem schedule (C_1) *i.e.* 1.63 t/ha and then *B.t.* schedule (C_2) with 1.56 t/ha (Table 4). Ujagir *et al.* (1997) reported that profenofos was the most effective in controlling pod borer damage caused by *M. vitrata* and increased the yield of blackgram. Krishna (2004) also reported that profenofos was found effective in controlling the pod damage caused by *M. vitrata* and increased the yields (49.72 per cent) of blackgram over control.

Among the spray interval schedules (F_2) there was significant difference with respect to yield. The highest yield was recorded in four days interval spray schedule (D_1) (1.75 t/ha) followed by seven days spray interval schedule (D_2) (1.63 t/ha) and ten days interval spray schedule (D_3) (1.55 t/ha) (Table 4). Due to more number of sprays (five) the mean number of *M. vitrata* larvae per five plants and damaged flowers were minimum (1.23 and 1.61) which ultimately resulted in the highest yield (1.75 t/ha) in four days interval spray schedule.

The interaction of these two factors (F_1 x F_2), significantly influenced the damage caused by *M. vitrata* and increased the yield. The interaction of profenofos schedule with four days interval spray schedule *i.e.* C_3D_1 was found to be the most effective interaction among all the interactions and has recorded the highest yield *i.e.* 2.0 t/ha followed by profenofos schedule interaction with seven days interval spray schedule *i.e.* C_3D_2 (1.72 t/ha). The interaction of *B.t.* schedule and ten days interval spray schedule *i.e.* C_2D_3 was found to be the least effective among all the interactions and has recorded the lowest yield of 1.47 t/ha (Table 4).

Benefit cost ratio of spray schedules against spotted pod borer, *M. vitrata*

The benefit cost ratio of all the treatments was significantly different from each other. Among the chemical schedules (F_1), neem schedule (C_1) has recorded the highest BC ratio (1:3.15) Profenofos schedule (C_3) (1: 2.97) and *B.t.* schedule (C_2) (1: 2.89) are on par with each other (Table 5). Ten days interval spray schedule has recorded the highest BC ratio (1: 3.62) among the spray interval schedules (F_2) followed by seven days interval spray schedule (1: 3.08) and four days interval spray schedule (1: 2.32). Among the interactions, the interaction of neem schedule with ten days interval spray schedule *i.e.* C_1D_3 has recorded the highest BC ratio (1: 4.13) followed by *B.t.* schedule interaction with ten days interval spray schedule *i.e.* C_2D_3 (1:3.49). The lowest BC ratio (1: 2.08) was found in the interaction, C_1D_1 (Neem schedule and four days interval spray schedule). Though the interaction between neem and ten days interval (C_1D_3) has recorded the lowest yields, the BC ratio was highest because of low cost of the formulation which is not preferable. The interaction of profenofos with ten days interval schedule (C_3D_3) has recorded profitable returns with a BC ratio of 1:3.25 with higher yields. Hence, profenofos schedule at ten days interval can be best fitted in the management of *M. vitrata* on blackgram. Reddy *et al.* (2001) have reported that three sprayings of fenvelerate 0.02 per cent at flower initiation stage, 50 per cent flowering stage and 50 per cent pod development stage were found effective against pod borer complex on pigeonpea with the lowest pod damage, grain damage and loss in grain weight with the highest returns, though the return per rupee investment was maximum in a single spray treatment at 50 per cent pod filling stage.

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