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RESEARCH PAPER

Effectiveness of some insecticides on spotted pod borer, *Maruca vitrata* geyer (Lepidoptera: Pyralidae) in greengram

Ram Kishor Meena*, Ravindra Kumar Meena[1], Uadal Singh **and** Manohari Lal Meena
Department of Entomology, College of Agriculture (S.K.N.A.U.), Lalsot, Dausa (Rajasthan) India
(Email: rkmeena.ento@sknau.ac.in)

Abstract : The effect of commercially available insecticides formulations, emmamection benzoate 0.5 per cent SG (0.5 g/ litre of water), quinalphos per cent 25 EC (2.0 ml/ lit.), novaluron 10 per cent EC (1.0 ml/ lit.), *Neem* oil 2 per cent (20 ml/lit.), karanj oil 2 per cent (20 ml/lit.) against the spotted pod borer, *Maruca vitrata* in greengram were evaluated. The most effective insecticide were emmamection benzoate > quinalphos > novaluron the maximum population reduction over control was found after 7 days of application of second spray at 15 days of interval *viz.*, 72.66 and 68.20 per cent due to emmamection benzoate, quinalphos, respectively during 2015. A similar trend was found in 2016 and 2017. Thus, emmamection benzoate was found most effective against the spotted pod borer, *Maruca vitrata* Geyer (Lepidoptera: Pyralidae).

Key Words : Greengram, Emmamection Benzoate, Novaluron, *Maruca vitrata*

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INTRODUCTION

Pulses provide high quality protein to substantial vegetarian population of the country. India is the largest pulse crop cultivating country in the World, India's production of pulses is relatively were in comparison to total cereal crops productions. Pulses give better returns with a minimum use of resources and provide vegetable for human being and nutritious fodder for animals. Per cent share of pulses to total food-grain of India in terms of area and production was 19.62 and 16.55 per cent, respectively during 1950-51. This trend continued till 1960-61 and started declaration after green revolution from 1970-71 due to no breakthrough in production technology of pulses in comparison to cereals.

The share of pulses to food grains in India is 23, 8, and 36 per cent, respectively in terms of area, production and productivity. The ever highest production of pulses was recorded (23 million tones) in India and occupies an area of about 29.28 m.ha with a production of 22.40 m.t and 765 kg ha^{-1} productivity during 2016-17. [*Vigna radiata* (L.) Wilczek], is an important legume crop widely grown in many Asian countries. In India, greengram occupies fourth place after chickpea, pigeonpea and blackgram. Greengram is a short duration pulse crop grown in India and occupies an area of about 4.30 m.ha with a production of 2.07 m.t and 481 kg ha^{-1} productivity and the percentage share to total pulses in terms of area

*** Author for correspondence:**
[1]Department of Plant Breeding and Genetics, Sardarkrushinagar Dantiwada Agricultural University, Dantiwada (Gujarat) India

15.4, production 9.7 and productivity is 63 kg ha^{-1} during 2016-17.

During twelfth plan (2012-2017) the total area covered under greengram in India was 34.50 lakh hectares with a total production of 15.91 lakh tonnes. Rajasthan having maximum coverage of area and its production (32.76% and 30.61%) followed by Maharashtra (11.95 % and 10.58%) of the total area and production of India. Karnataka stand third in area (8.81%) and Tamil Nadu ranked third position for production (7.63%). The highest productivity was recorded by the state of Punjab (845 kg/ha) followed by Jharkhand (704 kg/ha) and Andhra Pradesh (696 kg/ha). The lowest productivity was observed in the state of Karnataka (227 kg/ha) followed by C.G. (326 kg/ha) and Odisha (327 kg/ha) amid National yield average was 461 kg/ha (Ananymous, 2017).

Acharya (1985) has highlighted the neglected aspect of plant protection in pulse cultivation and found that only 5 to 6 per cent of the growers use plant protection measures. In view of the above facts, for the control of various pests in green gram, only certain insecticides have been recommended by several workers. Green gram is native to India and Central Asia and known by various names as *Vigna radiata* (L.) Wilczek Synonyms: *Phaseolus radiatus* L. (1753), *Phaseolus aureus* Roxb. (1832). Since prehistoric times it has been grown as an important legume crop in India throughout the year (Vavilov, 1926). There is no single variety of green gram that might offer resistance to the major insect pests (Devasthali and Joshi, 1994 Devasthali and Saran, 1998). The annual yield loss is estimated to be 30 per cent in black gram and green gram and on an average 2.5 to 3.0 million tonnes of pulses are lost annually due to pests infestation (Ali, 1998).

Insect pest of green gram can be managed through integrated pest management strategies *i.e.* use of disease free seeds, the use of resistant varieties, management of vectors, manipulation of cultural practices and biological and chemical control methods (Raguchandar *et al.*, 1995; Vidhyasekaran and Muthamilan, 1995). Due to its high vegetative growth, large number of insects attack from seedling to harvesting stage which is detrimental factor for production and causing severe yield losses (Lal and Sachan, 1987). It is important to avoid the incidence of the sucking pests rather than control to escape from the viral diseases and to obtain higher seed yield (Mahalaxmi *et al.*, 2015). Timing of insecticidal application as foliar sprays is the most important basic requirement for effective control of insect pests in greengram (Khaliq *et al.*, 2017). Hence, in the present study, insecticidal schedule was evaluated for scheduling the foliar sprays against major insect pests in greengram.

MATERIAL AND METHODS

The present study field trials on evaluation of insecticides schedule were conducted at the Experimental Farm of Agricultural Research Station, Navgaon, Alwar (Rajasthan) three consecutive seasons, *i.e.* during *Kharif* 2015, 2016 and 2017. The variety RMG 344 was selected as test variety and the seed was sown at 30 x 10 cm spacing in plots each measuring 12 sq.m. The crop was sown during first fortnight of july and harvested at maturity during September in all the three years. A total of 5 insecticide schedule treatments were evaluated including untreated control and each treatment was replicated three times. Five insecticides *i.e.* emmamection benzoate 0.5 per cent SG (0.5 g/ litre of water), quinalphos per cent 25 EC (2.0 ml/ lit.), novaluron 10 per cent EC (1.0 ml/lit.), *Neem* oil 2 per cent (20 ml/lit.), karanj oil 2 per cent (20 ml/lit.) with different modes of action were selected against spotted pod borer for the present study. The conventional insecticide such as quinalphos per cent 25 EC was selected as standard insecticide checks against spotted pod borer along with one untreated check. First spray was given at 30 days after sowing (DAS) followed by second spray at 45 DAS against spotted pod borer using water volume of 500 litre per hectare.

The larval population counts of spotted pod borer were recorded on one day before spraying was considered as pre-treatments counts for first spraying and the post-treatment counts were recorded from ten randomly selected plants per plot after one, three, seven and fourteen days of each spray. Fourteenth day larval population counts formed the pre-treatment counts for the second spray. The larvae of Spotted pod borer were counted on whole plant basis (Fleming and Retnakaran, 1985). From these data the mean population per ten plants was estimated and after transformation, it was subjected to statistical analysis. Per cent reduction in population were analysed using a formula given by Henderson and Tilton (1955) as under:

$$\text{Per cent reduction in population} = 100\,(1 - \frac{Ta \times Cb}{Tb \times Ca})$$

where,

Ta= Number of insects after treatment

Tb = Number of insects before treat ment

Ca = Number of insects in untreated check after treatment

Cb = Number of insects in untreated check before treatment

The data thus, obtained were analyzed statistically by ANOVA after converting it to suitable transformed values. The primary mode of action of Novaluron 10 EC is by disrupting cuticle formation and deposition occurring when insect change from one developmental stage to another and resulting at moulting.

RESULTS AND DISCUSSION

Emmamection benzoate 0.5 per cent SG reduced the population of *Maruca vitrata* by 44.89, 42.41 and 40.49 per cent after one day of first spraying during 2015, 2016 and 2017, respectively. The efficacy of emmamection benzoate 0.5 per cent SG went upto 66.50, 61.86 and 61.17 per cent during 2015, 2016 and 2017, respectively after seven days of first spraying. The emmamection benzoate 0.5 per cent SG found most effective at 7 days of II spraying and reduced the population of *Maruca vitrata* by 72.66, 67.64 and 66.02 per cent during 2015, 2016 and 2017, respectively. Effectiveness of emmamection benzoate 0.5 per cent SG was followed by quinalphos per cent 25 EC against *Maruca vitrata* in per cent reduction of population over control at 1, 7, 14 days after I and II spraying during all the three years (Table 1, 2 and 3).

Effectiveness of quinalphos per cent 25 EC against *Maruca vitrata* in per cent reduction in population over control after one day of first spraying was 40.02, 39.21 and 37.32 per cent during 2015, 2016 and 2017, respectively. After seven days of first spraying the efficacy of quinalphos per cent 25 EC went upto 63.02, 59.49 and 60.00 per cent during 2015, 2016 and 2017, respectively and after 7 days of II spraying population reduced over control by 68.20, 63.37 and 63.68 per cent during 2015, 2016 and 2017, respectively. Least effective treatment was was Karanj oil 2 per cent against *Maruca vitrata* and reduced the larval population at 1 day after I spraying by 13.79, 27.92 and 26.62 per cent during 2015, 2016 and 2017, respectively (Table 1, 2 and 3).

Emmamection benzoate 0.5 % SG @ 0.5 g/lit. of water controls *Maruca vitrata* and gave highest mean reduction (%) in population over control by 72.66, 67.64 and 66.02 per cent during 2015, 2016 and 2017, respectively at 7 days after II spray of 14 days interval in greengram. The effectiveness of emmamection benzoate 0.5 per cent SG was followed by quinalphos per cent 25 EC@ 2.0 ml/ litre of water and novaluron 10 per cent SL @1.0 ml/ litre of water. Emmamection benzoate 0.5 per cent SG (0.5 g/ lit.) and quinalphos per cent 25 EC (2.0 ml/ lit.) proved better in reducing the incidence of the spotted pod borer (Table 1, 2 and 3).

Present findings are in conformity with the findings of Kaushik *et al.* (2016); Yadav and Singh (2014) and Umbarkar and Parsana (2014) reported that emamectin

Table 1: Efficacy of some insecticides against spotted pod borer, *Maruca vitrata* in greengram during *Kharif* 2015

Sr. No.	Treatments g.a.i./ha	Formulation dose (g/ml)	PTP/ plants	Mean reduction (%) in population days after							
				First spray				Second spray			
				1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS
1.	*Neem* oil 2%	20.0 ml/ litre of water	4.00	19.59	28.76	39.04	22.55	26.66	35.15	44.19	44.19
				(26.17)	(32.37)	(38.62)	(28.31)	(31.03)	(36.29)	(41.65)	(33.00)
2.	Novaluron 10 %	1.0 ml/ litre of water	5.00	35.56	45.75	55.29	36.81	40.42	49.32	59.89	59.89
	EC			(36.56)	(42.55)	(48.02)	(37.32)	(39.45)	(44.58)	(50.70)	(41.29)
3.	Quinalphos % 25	2.00 ml/ litre	4.33	40.02	50.69	63.02	42.35	45.44	54.45	68.20	68.20
	EC			(39.21)	(45.36)	(52.52)	(40.57)	(42.36)	(47.52)	(55.25)	(42.52)
4.	Emmamection	0.5 g/ litre of water	4.43	44.89	56.64	66.50	46.21	50.16	59.77	72.66	72.66
	Benzoate 0.5% SG			(42.05)	(48.79)	(54.62)	(42.80)	(45.08)	(50.60)	(58.46)	(44.96)
5.	Karanj oil 2 %	20.0 ml/ litre of water	3.97	13.79	23.78	33.51	16.60	18.70	30.13	38.40	38.40
				(21.71)	(29.14)	(35.33)	(23.99)	(25.56)	(33.17)	(38.26)	(28.97)
6.	Untreated control		4.27	-	-	-	-	-	-	-	-
	S.E.±			0.656	0.620	0.842	0.599	0.782	0.801	0.956	0.956
	C.D. (P=0.05)			1.984	1.877	2.547	1.812	2.367	2.423	2.894	2.894

PTP: Pre-treatment population, Transformed values in parenthesis, DAS- Days After spraying benzoate 8g a.i./ha (0.62 larvae/plant) was the most effective treatment in reducing *M. Vitrata* population. and in T_8-*V. lecanii* (1×10^8 Spores/g) 5g/L (2.18 larvae/ plant) it was the least effective one.

Treatments against pod borer and in reducing the pod damage. The next best treatments were indoxacarb 14.5 SC @ 1.0 ml/lt, spinosad 45 SC @ 0.3 ml/lt and novaluron 10 EC @ 1.0 ml/lt with more than 60 per cent reduction in larval poplation of spotted pod borer (Deshmukh *et al.*, 2010; Mallikarjuna *et al.*, 2009 and Ashok Kumar and Shivaraju, 2009). Lal (1984) suggested control measures on increasing pulse production through spraying the crop with quinalphos 0.05 per cent at the time of pod formation was effective against pod borer complex. The maximum number of spotted pod borer larvae (2.35) was recorded in control. In studies with lepidopteran pests, Ishaaya *et al.* (1996; 1998 and 2003) revealed that novaluron was highly active against

Table 2: Efficacy of some insecticides against spotted pod borer, *Maruca vitrata* in greengram during *Kharif* 2016

Sr. No.	Treatments g.a.i./ha	Formulation Dose (g/ml)	PTP/ Plants	Mean reduction (%) in population days after							
				First spray				Second spray			
				1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS
1.	*Neem* oil 2%	20.0 ml/ litre of water	6.23	35.08 (36.28)	40.57 (39.54)	50.00 (44.98)	36.41 (37.06)	39.33 (38.81)	44.67 (41.53)	53.56 (47.03)	42.76 (40.82)
2.	Novaluron 10 % EC	1.0 ml/ litre of water	5.87	27.56 (31.58)	36.26 (36.99)	57.25 (49.12)	28.13 (31.94)	30.98 (33.79)	39.49 (38.92)	61.53 (57.67)	36.17 (36.94)
3.	Quinalphos % 25 EC	2.00 ml/ litre	5.97	39.21 (38.71)	47.08 (43.49)	59.49 (50.45)	40.75 (39.81)	42.62 (40.72)	49.89 (44.90)	63.37 (52.72)	44.66 (41.88)
4.	Emmamection Benzoate 0.5% SG	0.5 g/ litre of water	6.00	42.41 (40.60)	51.15 (45.82)	61.86 (51.85)	43.23 (41.08)	45.65 (42.46)	53.41 (46.94)	67.64 (54.30)	47.38 (43.47)
5.	Karanj oil 2 %	20.0 ml/ litre of water	6.17	27.92 (31.86)	33.61 (35.37)	39.19 (41.36)	29.16 (32.61)	30.16 (33.20)	38.68 (38.43)	47.55 (43.18)	35.99 (36.80)
6.	Untreated control		6.30	-	-	-	-	-	-	-	-
	S.E.±			1.098	0.935	0.864	1.216	1.302	0.799	1.198	1.023
	C.D. (P=0.05)			3.322	2.830	2.616	3.681	3.941	2.418	3.625	3.096

PTP: Pre- treatment population, Transformed values in parenthesis, DAS- Days after spraying

Table 3: Efficacy of some insecticides against spotted pod borer, *Maruca vitrata* in greengram during *Kharif* 2017

Sr. No.	Treatments g.a.i./ha	Formulation dose (g/ml)	PTP/ plants	Mean reduction (%) in population days after							
				First spray				Second spray			
				1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS
1.	*Neem* oil 2%	20.0 ml/ litre of water	6.63	33.46 (35.31)	39.84 (39.13)	48.76 (44.29)	34.18 (35.73)	37.53 (37.76)	42.66 (40.78)	52.62 (46.50)	39.73 (39.07)
2.	Novaluron 10 % EC	1.0 ml/ litre of water	6.27	26.26 (30.72)	35.24 (36.40)	57.80 (49.49)	26.17 (30.66)	29.54 (32.88)	37.65 (37.84)	62.50 (52.25)	44.09 (41.60)
3.	Quinalphos % 25 EC	2.00 ml/ litre	6.37	37.32 (37.60)	45.40 (42.35)	60.00 (50.77)	38.32 (38.21)	40.60 (39.56)	47.53 (43.58)	63.68 (52.94)	45.48 (42.41)
4.	Emmamection Benzoate 0.5% SG	0.5 g/ litre of water	6.40	40.49 (39.51)	49.37 (44.64)	61.17 (51.46)	40.82 (39.70)	43.60 (41.31)	47.53 (43.58)	66.02 (54.35)	47.97 (43.83)
5.	Karanj oil 2 %	20.0 ml/ litre of water	6.57	26.62 (31.00)	32.67 (34.78)	45.66 (42.50)	27.16 (31.33)	28.71 (32.27)	36.42 (37.12)	46.87 (43.20)	34.25 (35.76)
6.	Untreated control		6.80	-	-	-	-	-	-	-	-
	S.E.±			1.109	0.960	1.034	1.182	1.315	0.761	0.702	0.725
	C.D. (P=0.05)			3.356	2.905	3.129	3.578	3.979	2.302	2.126	2.193

PTP: Pre-treatment population, Transformed values in parenthesis, DAS- Days after spraying

Spodoptera littoralis (Boisduval) and *Helicoverpa armigera* (Hübner) larvae by ingestion, with persistent biological activity. Cotton leaves were treated with novaluron after 8 days in the field approximately 100 per cent of exposed larvae died, while 30-60 per cent of larvae died when exposed to foliage treated 15 days previous (Ishaaya *et al*., 1996). Hadapad *et al.* (2001) also showed *H. armigera* larvae were susceptible to novaluron, although lufenuron was more effective in laboratory experiments. *Spodoptera exigua* (Hübner) larvae are highly susceptible to novaluron (Ishaaya *et al.*, 1996, 1998, 2001, 2002 and 2003).

Among all the treatments, emmamection benzoate 0.5 per cent SG (0.5 g/lit.) was found most effective against spotted pod borer. The remaining treatments were found to be moderately effective against as compared to untreated control in reducing the incidence of spotted pod borer in greengram.

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