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Research Article

Efficacy of *Bacillus thuringiensis* against *Maruca vitrata* (Geyer) on cowpea

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ABSTRACT: Spotted pod borer, *Maruca vitrata* (Geyer) is a major constraint in the production of grain cowpea. The pest causes losses in grain yield of cowpea ranging from 20 to 60 per cent. In order to manage the pest, field experiments were conducted at four farmers fields during rabi 2010-2011. The study revealed that the pest can be managed effectively by spraying profenophos @ 1ml/litre at the time of flowering, *Bacillus thuringiensis* @ 1g/litre one at the time of flowering and next one was at 15 days later, *Beauveria bassiana* @ 20 g/litre at the time of flowering and other one was at 15 days interval and carbaryl @ 4 g/litre at the time of flowering. At harvest, the treatments recorded the per cent pod borer incidence of 6.99, 7.40, 7.86 and 8.96, respectively. Significantly higher grain yield was recorded in profenophos (817.18 kg/ha), *Bacillus thuringiensis* (754.89 kg/ha) and *Beauveria bassiana* (748.66 kg/ha) and carbaryl (669.31 kg/ha) treated plots.

KEY WORDS: Spotted pod borer, *Maruca vitrata*, *Bacillus thrungiensis*, cowpea.

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INTRODUCTION

The spotted pod borer, *Maruca vitrata* (Geyer) is an important pest infesting 40 host plants including cowpea, pigeonpea and common bean all over the world. In cowpea, the larvae infest terminal shoots, flower buds, flowers and pods of the cowpea and web inflorescence/ pods together and feed within (Sharma, 1988). The webbing behaviour and inaccessibility of larvae makes the pest difficult to control. Moths prefer to oviposit at the flower bud stage. Eggs hatch in 3-6.5 days and the larvae move from one flower to another and each may consume 4-6 flowers before larval development is completed. Third - fifth instar larvae are capable of boring into the pods and occasionally into peduncle and stems. Larval development is completed in 8-16.3 days and prepupal period lasts for 1-2 days. Puation occurs in the soil in a pupal cell and lasts for 6.4-11 days. Life cycle is completed in 18-35 days. Losses to grain yield have been estimated to range from 20 to 60 per cent (Singh and Allen,1980). Farmers use indiscriminate quantity of various combinations of insecticides to reduce the impact of spotted pod borer on different pulse crops so as to obtain grain yield (Ganapathy and Durairaj, 2000). In the present study, *Bacillus thurungiensis* and *Beauveria bassiana* formulations were evaluated against *M. vitrata* at different locations at farmers field to select a viable, eco-friendly technology to manage the pest.

MATERIALS AND METHODS

Farm trials were laid out during rabi 2010-11 at three locations of Palakkad district and one location in Malappuram district of Kerala State. Five treatments along with control were included. The treatments tested were *Bacillus thuringensis* at 1 g/litre at the time of flowering (T1). *B. thuringiensis* at 1 g/litre at the time of flowering and second one at 15 days later (T2). *Beauveria bassiana* at 20 g/litre at the time of flowering and second one at 15 days later (T3). profenophos at1ml/ litre at the time of flowering (T4). carbaryl at 4 g/litre at the time of flowering (T5) and control (T6). Three seeds of cowpea variety Kanakamony were sown per hole. The cowpea seeds were sown in 2x2 m^2 beds with a spacing of 30 cm x 15 cm. Three weeks later, the plants were thinned to two seedlings per stand. The experiment was conducted in a randomized block design with four replications at each location. The fertilizers *viz.*, N at 20 kg/ha, P_2O_5 at 30 kg/ha and K^2O at 10 kg/ha were applied to the crop as per the package of practices recommendation of Kerala Agricultural University. Half the quantity of nitrogen, the whole of phosphorus and potash were applied at the time of sowing. The remaining 10 kg nitrogen was applied on 15th day after sowing. Mancozeb at 0.20% was applied at the time of fungal disease incidence. Hand hoeing was done at ten days after sowing to remove the weeds. The application of *B. thuringiensis* and *B. bassiana*, carbaryl and profenophos was done during evening hours to get the good effect of microbial pesticides as well as chemical insecticides. The pest damage was recoded at the time of picking of cowpea pods in five randomly selected plants and expressed as per cent pod borer damage.

$$\text{Per cent pod damage} = \frac{\text{Total No. of pods} - \text{No. of undamaged pods x 100}}{\text{Total No. of pods}}$$

Data on pod borer damage were analyzed after arcsine transformation. Yield was recorded from each plot and expressed as kg/ha. Pooled analysis was done by taking each location as one replication.

RESULTS AND DISCUSSION

First location conducted at Edathody, Agallur, Palakkad showed that pod borer damage was less in the plots treated with profenophos @1ml/litre (4.68%) and *B. thuringiensis* at 1g/litre twice (5.67%) followed by *B. bassiana* at 20 g/litre (9.29%) and carbaryl 4 g/litre (9.32%). Higher yield was recorded in treatments with profenophos at 1 ml/litre (625.83kg/ha) followed by *B. thuringiensis* at 1g/litre twice (583.33 kg/ha), *B. bassiana* at 20 g/litre twice (583.17 kg/ha) and carbaryl at 4 g/litre treated plots (508.33 kg/ha).

The second location conducted at Kannanur, Kuzhalmannam, Palakkad showed that pod borer damage was less in the plots treated with *B. thuringiensis* at 1g/litre twice (6.92%), *B. bassiana* at 20 g/litre twice (7.14%), profenophos @1ml/litre (7.24%) followed by carbaryl at 4 g/litre (8.05). Higher yield was recorded in treatments with profenophos (875 kg/ha), *B. thuringiensis* (842.50 kg/ha), carbaryl at 4 g/litre treated plots (750 kg/ha) and *B. bassiana* at 20 g/litre twice treated plots (737.50 kg/ha).

The third location conducted at Mangalachery, Kailiyad, Edappal, Vattankulam, Malappuram showed that pod borer damage was less in the treatments with *B. bassiana* at 20 g/litre twice treated plots (6.46%), profenophos at 1ml/litre treated plots (8.02%), *B. thuringiensis* at 1g/litre twice treated plots (8.73%) and carbaryl at 4 g/litre treated plots (9.52%). Higher yield was recorded in plots treated with *B. bassiana* @20 g/litre twice treated plots (1020.60), profenophos @1ml/litre treated plots (906.67 kg/ha), *B. thuringiensis* at 1g/litre twice treated plots (866.67 kg/ha) and carbaryl at 4 g/litre treated plots (800 kg/ha).

The fourth location conducted at Varamangalathu Vedu, Kondurkara, Palakkad, the efficacy of treatments were in the order of showed that pod borer damage was less in the profenophos@ 1ml/litre treated plots (8.03%), *B. thuringiensis* @ 1g/litre twice treated plots (8.29%), *B. bassiana* @20 g/litre twice treated plots (8.55%) and carbaryl @ 4 g/litre treated plots (8.96%). Higher yield was recorded in profenophos at 1ml/litre treated plots (906.67 kg/ha), *B. thuringiensis* at 1g/litre twice treated plots (727.22 kg/ha), *B. bassiana* @ 20 g/litre twice treated plots (653.22 kg/ha) and carbaryl @4 g/litre treated plots (618.92 kg/ha).

Pooled analysis of data over four locations showed that significantly less pod borer damage was recorded in with profenophos at 1 ml/litre (6.99%), *B. thuringiensis* at 1g/litre twice treated plots (7.40%), *B. bassiana* at 20 g/litre twice treated plots (7.86%) and carbaryl at 4 g/litre treated plots (8.96%). Significantly higher yield was recorded in profenophos at 1m l/litre treated plots (817.18 kg/ha), followed by *B. thuringiensis* @1g/litre twice treated plots (754.89 kg/ha) and *B. bassiana* @20 g/litre twice treated plots (748.66 kg/ha) followed by and carbaryl at 4 g/litre treated plots ((669.31 kg/ha). The results are presented in Table1.

Effective management of cowpea pod borer by *B. thuringiensis* was reported by Karel and Schoonhoven, 1986; Supriyatin, 1990; Otieno and Karikuri, 1991. Chandrayudu *et al.* (2008) reported that *B. thuringiensis* (0.0025%) and fipronil (0.016%) exhibited superior control efficacy at 2 (54.13 and 48.73%), 5 (59.53 and 56.94%), 9 (62.60 and 60.93%) and 14 (88.90 and 84.64%) days after spraying. At harvest, pod damage was significantly lower with *B. thuringiensis* (0.0025%), fipronil (0.016%), chlorpyrifos (0.05%) + DDVP (0.07%) and azadirachtin (1500 ppm) treated plots with the pod borer damage of 15.80%, 18.43%, 22.83% and 24.74% respectively. Profenophos treated plots recorded the pod borer damage of 28.11% and offered moderate control to *M. vitrata. B. thuringiensis* and fipronil also resulted in high pod yields (927.70 and 658.30 kg/ha) and favourable cost: benefit ratios (1:25.6 and 1:24.4). Azadirachtin 1500 ppm recorded the cost benefit ratio of 1:7.98, chlorpyrifos (0.05%) + DDVP (0.07%) offered the cost benefit ratio of 1:1.6 whereas profenophos (0.05%) recorded the cost benefit ratio of 1:06 only. Profenophos 50EC at 2.0 ml/liter of water in combination with DDVP at 0.5 ml/liter of water at the time of flowering was found most effective in combating the pest and

Table 1. Percentage incidence of Pod borer and yield (kg/ha)

	Incidence (%)					Yield (kg/ha)				
Treatments	Loc. 1	Loc. 2	Loc. 3	Loc. 4	Mean	Loc. 1	Loc. 2	Loc. 3	Loc. 4	Mean
T1	12.97 (21.07)	12.38 (20.54)	12.97 (19.82)	12.59 (20.79)	12.73 (20.55)	416.67	750.00	733.33	584.16	621.04
T2	5.67 (13.74)	6.92 (15.21)	8.73 (17.16)	8.29 (16.47)	7.40 (15.64)	583.33	842.50	866.67	727.22	754.89
T3	9.29 (17.69)	7.14 (15.44)	6.46 (14.66)	8.55 (16.91)	7.86 (16.17)	583.17	737.50	1020.60	653.22	748.66
T4	4.68 (12.32)	7.24 (14.63)	8.02 (16.44)	8.03 (16.33)	6.99 (14.93)	625.83	875.00	906.67	861.25	817.18
T5	9.32 (17.79)	8.05 (16.48)	9.52 (17.88)	8.96 (17.42)	8.96 (17.39)	508.33	750.00	800.00	618.92	669.31
T6	26.68 (30.95)	23.80 (29.17)	17.34 (24.62)	18.36 (25.22)	21.54 (27.49)	341.67	375.00	547.12	479.08	435.72
	CV = 10.04% CD 5% = 2.67					CV = 10.08% CD 5% = 97.09				

Figures in the parentheses are arcsine transformed values

registered lowest pod damage (6.23%), highest grain yield (10.20 q/ha) with highest cost benefit ration (1:5.30) as compared to individual insecticides. This treatment was followed by monocrotophos 36SL at 2.0 ml + DDVP at 0.5 ml/litre and methomyl 40SP at 1.0 g DDVP @ 0.5 ml/litre. (Gopali *et al*., 2010).

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