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Field evaluation of biocontrol agents and biopesticides against spotted pod borer, *Maruca vitrata* (Geyer) on lablab

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ABSTRACT

Microplot field trial was conducted from March to May 2017 to assess the efficacy of various biopesticides, pathogen, predator and parasitoid against *M. vitrata* on lablab (var. Co Gb 14). The experiments were carried out in a randomized block design (RBD) with nine treatments and three replications. Results revealed that spinosad 45% SC @ 75 ml ha^{-1} was significantly superior to all other treatments by recording a cumulative mean population reduction of 72.58 per cent. The next in the order of efficacy were emamectin benzoate 5% SG @ 200 ml ha^{-1} (65.16 %) > sequential application of emamectin benzoate (200 ml ha^{-1}) + *Bracon brevicornis* (2000 adults ha^{-1} released after fortnight) (63.70%) > emamectin benzoate (100 ml ha^{-1}) + *B. brevicornis* (1000 adults ha^{-1}) @ half the dose each (62.06 %) > azadirachtin 0.03% @ 2.5 L ha^{-1} (39.33 %) > *B. brevicornis* @ 2000 adults ha^{-1}(32.77 %) > Crude suspension of *B. bassiana* (Bb 112) @ 10^8 Spores ml^{-1} (25.95 %) > *Xylocoris flavipes* @ 40,000 adults ha^{-1} (20.22 %).

Key words: Biointensive management, Emamectin benzoate, *M. vitrata*, Spinosad.

INTRODUCTION

India is the major pulse growing country in the world, sharing 35 to 36 per cent area with 27 to 28 per cent pulse production. It is producing 12 to 14 million tonnes of pulses from 22 to 24 million ha of land (Mahalakshmi *et al.*, 2016). The commonly grown major pulse crops in India are pigeonpea, mungbean, urdbean, chickpea, horsegram, cowpea and some of the minor pulse crops are drybean, mothbean, lathyrus, lentil and peas. *Maruca vitrata* (Geyer) is one among the pod borers causing serious damage to grain legumes in the tropics apart from *Helicoverpa armigera* (Hubner). The larvae damage the flower buds, flowers and immature pods by webbing and contaminate with their excreta (Rekha and Mallapur, 2007). The grain yield loss due to legume pod borer was estimated to be 10.0 to 80.0 per cent in various crops (Singh and Allen, 1980; Sharma, 1998). Webbings of flowers and pods during feeding makes the pest hard to reach and hence makes the management difficult (Sharma, 1998). However, the pest is still being managed by means of insecticides only (Jakhar *et al.*, 2016). Preference of insecticides depends on their easy availability and applicability, but their excessive and indiscriminate use resulted in the development of insecticidal resistance in most of the pests and environmental pollution (Phokela *et al.*, 1990; Sharma *et al.*, 2002). The increasing concern about pesticide hazards evoked worldwide interest on alternate pest management practices that are ecofriendly in nature. Biologically derived insecticides or microbial insecticides, natural enemies and entomopathogenic fungi provide an alternative, more environmentally friendly option to control this insect pest. In view of the above facts, the present study was aimed to evaluate the efficacy of biopesticides, predators, parasitoids, entomopathogens and their combination against *M. vitrata* infesting pulses.

MATERIALS AND METHODS

Microplot field trial was conducted from March to May 2017 at TNAU- Orchard during flowering to pod formation stages to assess the efficacy of various biopesticides, pathogen, predator and parasitoid on lablab (var. Co Gb 14) with a plot size of 2.5 m x 2.5 m. The experiments were carried out in a randomized block design (RBD) with nine treatments and three replications.

Spinosad was used as a positive control to compare with other treatments, since it was widely recommended for pulses. Two rounds of treatments were imposed at fortnight intervals. Observations on the number of larvae were recorded in ten randomly selected plants on 0, 3, 5, 7 and 14 days after treatment and the per cent reduction over control was worked out. During harvest, the pods were categorized as damaged or undamaged and the per cent pod damage was calculated (Yule and Srinivasan, 2014).

RESULTS AND DISCUSSION

Population of *M. vitrata* ranged from 24.60 to 26.00 numbers per ten plants before imposing the treatment. The data on post treatment population of the *M. vitrata* are presented in Table 1 and 2. After the first round of spraying / release, spinosad 45% SC was found to be significantly

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Table 1: Effect of biorational management practices against *M. vitrata* on lablab (var. Co Gb 14) – microplot.

Treatments	PTC (no. of larvae / 10 plants)	Number of larvae / 10 plants (Days after 1st spraying)				Mean no. of larvae / 10 plants	Per cent reduction over control
		3	5	7	14		
B. brevicornis @ 2000 adults ha^{-1}	25.40	24.50(4.95)^{f}	23.60(4.86)^{e}	22.40(4.73)^{e}	21.80(4.67)^{e}	23.07(4.80)^{e}	19.95
X. flavipes @ 40,000 adults ha^{-1}	25.70	25.30(5.03)^{f}	24.90(4.99)^{f}	25.20(5.02)^{f}	25.60(5.06)^{g}	25.25(5.02)^{g}	11.45
Sequential application / release of emamectin benzoate (200 ml ha^{-1}) +*B. brevicornis* (2000 adults ha^{-1} after fortnight)	24.60	15.40(3.92)^{b}	14.80(3.85)^{b}	10.60(3.26)^{b}	9.20(3.03)^{b}	12.50(3.54)^{b}	54.75
Emamectin benzoate (100 ml ha^{-1}) + *B. brevicornis* (1000 adults ha^{-1}) @ half the dose each	24.90	18.50(4.30)^{d}	16.30(4.04)^{c}	15.90(3.99)^{c}	13.60(3.69)^{c}	16.07(4.01)^{c}	44.24
Spinosad 45% SC @ 75 ml ha^{-1}	25.20	14.20(3.77)^{a}	12.30(3.51)^{a}	9.00(3.02)^{a}	7.50(2.74)^{a}	10.75(3.28)^{a}	62.70
Emamectin Benzoate 5% SG @ 200 ml ha^{-1}	25.60	16.80(4.10)^{c}	15.20(3.90)^{b}	11.40(3.38)^{b}	9.70(3.11)^{b}	13.27(3.64)^{b}	53.94
Azadirachtin 0.03% @ 2.5 L ha^{-1}	26.00	22.50(4.74)^{e}	20.80(4.56)^{d}	18.90(4.35)^{d}	18.50(4.30)^{d}	20.17(4.49)^{d}	30.01
Crude suspension of *B. bassiana* (Bb 112) @10^{8} spores ml^{-1}	25.20	24.30(4.93)^{f}	23.90(4.89)^{e}	24.20(4.92)^{f}	24.50(4.95)^{f}	24.22(4.92)^{f}	14.17
Untreated check	25.00	28.30(5.32)^{g}	29.70(5.45)^{g}	27.30(5.22)^{g}	30.00(5.48)^{h}	28.82(5.37)^{h}	-
SEd	-	0.49	0.44	0.47	0.35	0.45	-
CD (0.05)	-	1.06	0.95	1.01	0.75	0.96	-

PTC- Pretreatment Count

Figures in the parentheses are $\sqrt{X + 0.5}$ transformed values.

In a column mean(s) followed by a common letter are not significantly different at 5 % in LSD.

Table 2: Effect of biorational management practices against *M. vitrata* on lablab (var. Co Gb 14) – microplot.

Treatments	Number of larvae / 10 plants (Days after 2nd spraying) 3	5	7	14	Mean no. of larvae/ 10 plants	Per cent reduction over control	Pooled mean (no. of larvae / 10 plants)	Cumulative per cent reduction over control
B. brevicornis @ 2000 adults ha^{-1}	20.90(4.57)^{e}	19.40(4.40)^{f}	18.80(4.34)^{e}	18.30(4.28)^{f}	19.35(4.40)^{e}	43.55	21.21	32.77
X. flavipes @ 40,000 adults ha^{-1}	25.20(5.02)^{g}	24.70(4.97)^{h}	24.90(4.99)^{g}	25.60(5.06)^{h}	25.10(5.01)^{g}	26.77	25.17	20.22
Sequential application / release of emamectin benzoate (200 ml ha^{-1}) + *B. brevicornis* (2000 adults ha^{-1} after fortnight)	9.00(3.02)^{b}	9.50(3.08)^{c}	10.30(3.21)^{c}	12.80(3.58)^{d}	10.40(3.22)^{c}	69.66	11.45	63.70
Emamectin benzoate (100 ml ha^{-1}) + *B. brevicornis* (1000 adults ha^{-1}) @ half the dose each	11.80(3.44)^{c}	10.40(3.22)^{d}	9.70(3.11)^{c}	9.50(3.08)^{c}	10.35(3.22)^{c}	69.80	11.97	62.06
Spinosad 45% SC @ 75 ml ha^{-1}	7.20(2.68)^{a}	6.80(2.61)^{a}	6.30(2.51)^{a}	5.90(2.43)^{a}	6.55(2.56)^{a}	80.89	8.65	72.58
Emamectin Benzoate 5% SG @ 200 ml ha^{-1}	9.40(3.07)^{b}	8.90(2.98)^{b}	8.40(2.90)^{b}	8.10(2.85)^{b}	8.70(2.95)^{b}	74.61	10.99	65.16
Azadirachtin 0.03% @ 2.5 L ha^{-1}	18.10(4.25)^{d}	17.60(4.20)^{e}	17.40(4.17)^{d}	16.80(4.10)^{e}	17.48(4.18)^{d}	49.01	19.13	39.33
Crude suspension of *B. bassiana* (Bb 112) @10^{8} spores ml^{-1}	23.20(4.82)^{f}	22.70(4.76)^{g}	22.30(4.72)^{f}	21.8(4.67)^{g}	22.50(4.74)^{f}	34.36	23.36	25.95
Untreated check	31.50(5.61)^{h}	33.60(5.80)^{i}	35.20(5.93)^{h}	36.80(6.07)^{i}	34.28(5.85)^{h}	-	31.55	-
SEd	0.31	0.25	0.39	0.35	0.241	-	-	-
CD (0.05)	0.66	0.55	0.84	0.74	0.51	-	-	-

PTC- Pretreatment Count. Figures in the parentheses are $\sqrt{X + 0.5}$ transformed values.
In a column mean(s) followed by a common letter are not significantly different at 5 % in LSD.

superior among all the treatments and recorded lowest larval population of 14.20, 12.30, 9.00 and 7.50 larvae per ten plant on 3, 5, 7 and 14 days after treatment, respectively with the highest reduction of 62.70 per cent. This was followed by the sequential application / release of emamectin benzoate (200 ml ha^{-1}) + *B. brevicornis* (2000 adults ha^{-1} released after fortnight) and emamectin benzoate 5 % SG @ 200 ml ha^{-1} with a population reduction of 54.75 and 53.94 per cent, respectively.

Similar trend was also observed after the second round of treatment. The cumulative mean per cent reduction of *M. vitrata* larvae after two rounds of spraying indicated that spinosad 45 % SC @ 75 ml ha^{-1} was significantly superior to all other treatments by recording a population reduction of 72.58 per cent. The next in the order of efficacy were emamectin benzoate 5% SG @ 200 ml ha^{-1} (65.16 %) > sequential application of emamectin benzoate (200 ml ha^{-1}) + *B. brevicornis* (2000 adults ha^{-1} released after fortnight) (63.70%) > emamectin benzoate (100 ml ha^{-1}) + *B. brevicornis* (1000 adults ha^{-1}) @ half the dose each (62.06 %) > azadirachtin 0.03% @ 2.5 L ha^{-1} (39.33 %) > *B. brevicornis* @ 2000 adults ha^{-1} (32.77 %) > Crude suspension of *B. bassiana* (Bb 112) @ 10^8 spores ml^{-1} (25.95 %) > *X. flavipes* @ 40,000 adults ha^{-1} (20.22 %).

Observations on pod damage revealed lowest pod damage in spinosad 45 SC @ 75 ml ha^{-1} treated plots with 79.26 per cent reduction over control followed by emamectin benzoate 5 % SG @ 200 ml ha^{-1} (72.82 %) and sequential application of emamectin benzoate (200 ml ha^{-1}) + *B. brevicornis* (2000 adults ha^{-1} released after fortnight) (67.96 %) (Table 3). Naik *et al.* (2009) found that spinosad 0.015 per cent individually and in combination with novaluron was most effective in reducing pod borer infestation on pigeonpea. Spinosad was reported to be effective against *M. vitrata* at 0.005 per cent on urdbean (Lakshmi *et al.*, 2002), 0.009 per cent on pigeonpea (Mittal and Ujagir, 2005) and 0.015 per cent on dolichos bean (Rekha and Mallapur, 2007).

In the present investigations, observations on the pod damage revealed lowest pod damage in spinosad 45 SC @ 75 ml ha^{-1} treated plots with 79.26 per cent reduction over control followed by emamectin benzoate 5 SG @ 200 ml ha^{-1} (72.82 %) and sequential application of emamectin benzoate (200 ml ha^{-1}) + *B. brevicornis* (2000 adults ha^{-1} released after fortnight) (67.96 %) in lablab. The results were in line with Sonune *et al.* (2010) who reported that spinosad 0.009%, indoxacarb 0.008%, profenophos 0.05% and lambda cyhalothrin 0.005% were the most effective treatments in reducing the larval population and pod damage on black gram. The efficacy of spinosad is supported by the findings of Sidde Gowda *et al.* (2003) who reported the lowest pod damage in pigeonpea treated with spinosad. Rao *et al.* (2007) also reported that the pod damage due to legume pod borer, *M. vitrata* was lowest in plants sprayed with spinosad. The results were also in accordance with Patel *et al.* (2012) who reported least spotted pod borer damage on cowpea treated with emamectin benzoate 5 SG (3.18 %) and spinosad 45 SC (3.78 %).

However, sequential application of emamectin benzoate (200 ml ha^{-1}) + *B. brevicornis* (2000 adults ha^{-1}) (released after fortnight interval) and emamectin benzoate (100 ml ha^{-1}) + *B. brevicornis* (1000 adults ha^{-1}) @ half the dose each were found to be next in the order of efficacy against the spotted pod borer on both lablab and green gram. This was in line with the findings of Ravi *et al.* (2008) who reported that the sequential application of spinosad with *Bacillus thuringiensis* or nuclear polyhydrosis virus (NPV) or neem was equally as effective as chemical pesticides alone in reducing the fruit borer (*H. armigera*) damage in tomato.

Table 3: Effect of biorational management practices against *M. vitrata* on lablab pods during harvest.

Treatments	Pod damage (%)	Per cent reduction over control
B. brevicornis @ 2000 adults ha^{-1}	18.53(25.48)^{f}	43.20
X. flavipes @ 40,000 adults ha^{-1}	29.97(33.18)^{h}	8.17
Sequential application / release of emamectin benzoate (200 ml ha^{-1}) + *B. brevicornis* (2000 adults ha^{-1} after fortnight)	10.77(19.15)^{c}	67.96
Emamectin benzoate (100 ml ha^{-1}) + *B. brevicornis* (1000 adults ha^{-1}) @ half the dose each	11.43(19.76)^{d}	67.00
Spinosad 45% SC @ 75 ml ha^{-1}	6.77(15.07)^{a}	79.26
Emamectin Benzoate 5% SG @ 200 ml ha^{-1}	8.87(17.31)^{b}	72.82
Azadirachtin 0.03% @ 2.5 L ha^{-1}	14.38(22.28)^{e}	55.92
Crude suspension of *B. bassiana* (Bb 112) @10^8 spores ml^{-1}	23.32(28.86)^{g}	28.54
Untreated check	32.63(34.83)^{i}	-
SEd	0.09	-
CD (0.05)	0.19	-

PTC- Pretreatment Count. Figures in the parentheses are $\sqrt{X + 0.5}$ transformed values.
In a column mean (s) followed by a common letter are not significantly different at 5 % in LSD.

Similarly, Thanavendan *et al.* (2017) also reported that the combined release of *Trichogramma chilonis* + *Chelonus blackburni* + *Bracon brevicornis* were more effective to lower larval population of *E. vittella* and *H. armigera* which was next to endosulfan 35 EC on okra.

CONCLUSION

Though spinosad treated plots recorded the highest per cent reduction in the pod borer damage, it may not have long term benefits in terms of environmental safety. Hence, sequential application of emamectin benzoate (200 ml ha^{-1}) + *B. brevicornis* (2000 adults ha^{-1}) (released after fortnight interval) or emamectin benzoate (100 ml ha^{-1}) + *B. brevicornis* (1000 adults ha^{-1}) @ half the dose each twice at fortnight interval starting from flowering to pod formation stage may have long term effects in terms of pest suppression and environmental safety.

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