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Bioefficacy of some novel insecticides and biopesticides for managing bean pod borer, *Maruca vitrata* Geyer

Salma Aktar, Mohammad Mahir Uddin✉, Kazi Shahanara Ahmed

Department of Entomology, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

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Correspondence:
Mohammad Mahir Uddin
✉: mahir@bau.edu.bd

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ABSTRACT

Bean pod borer, *Maruca vitrata* Geyer is a key pest of bean causing up to 80 percent yield loss. The present study was conducted at the Entomology Field Laboratory of Bangladesh Agricultural University, Mymensingh, Bangladesh during October 2017 to March 2018 to evaluate the bioefficacy of some novel insecticides and biopesticides for managing bean pod borer on BARI Shim-2. Treatments were evaluated based on different parameters viz. no of healthy and infested pod, percent pod infestation, and marketable pod yield (t/ha). The experiment was laid out in RCBD with 3 replications of each treatment. Eight treatments viz. T_1: Cartap (Suntap 50 SP), T_2: Flubendiamide, (Belt 24 WG), T_3: Lufenuron (Heron 5EC), T_4: *B. bassiana*, T_5: Cypermethrin, T_6: Spinosad (Libsen 45Sc), T_7: Emamectin benzoate (Suspend 5SG) and T_8: Untreated control. Treatments were applied at seven days interval and data were also collected seven days of each spraying. All the treatments significantly reduced bean pod borer infestation in the field. The best result was found in case of Emamectin benzoate treated plots which showed the highest cumulative mean number of healthy pod (46.00) and the highest increase of healthy pod (63.29%) over control by number, the lowest cumulative mean number of infested pod plot^{-1} (2.88) and the highest reduction of infested pod over control (69.215%) by number. The highest cumulative mean weight of healthy pods plot^{-1} (240.66g), the highest percent increase of healthy pod over control (34.03%) by weight, the lowest cumulative mean weight of infested pods plot^{-1} (6.44g) and the highest (%) reduction of infested pod weight over control (65.02%) were also obtained from Emamectin treated plots. Among the treatments the highest yield (7.1 ton ha^{-1}) and yield increase over control (32.58%) were also found from Emamectin. Cartap (Suntap 50 SP) showed the second best performance regarding the above parameters including the second highest yield (6.4 ton ha^{-1}). The lowest performance was always obtained from untreated control in case of all parameters studied. Though Cartap was very effective but considering the environmental issue Emamectin benzoate (Suspend 5 SG) would be recommended for sustainable management of bean pod borer in the field.

Introduction

Vegetables are important part of healthy food and provide important nutrients including potassium, fiber, folate (folic acid) and vitamins A, E and C. Potassium may help to maintain blood pressure. Bean commonly known as 'seem' and commercially cultivated in Jessore, Kustia, Khulna, Rangpur, Dinajpur, Barisal, Pabna, Bogra and Patuakhali (BBS, 2011). In Bangladesh total land area under bean cultivation is near about 49192 acres and the production is about 122091 MT during 2014-2015 (BBS, 2015). In Chittagong the farmers follow intensive practices of country bean production as a commercial crop both in ails (border) of the plots or main plots (Rashid, 1983). Recently, due to high demand and high profit farmers are cultivating country bean in large scale. In spite of being a prospective crop, high incidence of insect pests results low yield and poor quality of country bean. The yield loss of country bean due to insect pests is reported about 12-30% (Hossain, 1990). Country bean is attacked by nine different insect species and one species of mite (Alam, 1969). Four of these species have been

considered as major pests and the rest of them as minor pest. The pod borer (*Maruca vitrata* Fab) is the most serious pest causing economic losses in the field (Gowda and Kaul, 1982). The pod borers found to cause 38.0% yield loss through flower and pod damage of pigeon pea in Bangladesh. Bean pod borer is considered as a major pest of legumes in Africa, Asia, South and Central America and Australia causing yield loss ranging between 20 and 60% (Rahman *et al.* 1981). There are three different species of pod borers, out of which *Maruca vitrata* Geyer is a common one on country bean. It can cause losses of 20-80% on the harvests of country bean. Its feeding sites on plants are flower buds, flowers and young pods. *M. vitrata* larval feeding has been documented on over 50 alternative host plants and most often found on cultivated and wild host plants from the family, Fabaceae (Sharma, 1998). The early instar larvae feed mainly on flowers (Karel, 1985) and a single larva can consume four to six flowers by the time it reaches to

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pupal stage and up to 80% flowers are infested by *M. vitrata* larvae in the field (Gblagada, 1982; Karel, 1985; Afun *et al*. 1991). Basically, *Maruca* is a hidden pest and completes its larval development inside the web formed by rolling and tying leaves, flowers, buds and pods. This pest is a voracious feeder and attack pods, stems, petioles of bean and eventually damage inflorescences. The larvae make holes in the pod and damage the seed. About 52.3% larvae are found on flowers, 37.8% on pods and 9.9% on leaves. Up to 31% of flowers are damaged by feeding activity of the larvae (Karel, 1985).

Bean is a commercial vegetable crop and farmers of Bangladesh have a high tendency to use insecticides indiscriminately to control bean pod borer. Farmers of our country usually use various chemical insecticides to control *Maruca vitrata.* It also creates some problems like pest resistance, resurgence, removal of natural enemies and insecticide residues in pods. But the residual effects are not environmentally safe. *M. vitrata* has also developed resistance towards many synthetic insecticides. Novel insecticides which are very much specific and easily biodegradable biopesticides might be the alternative of toxic chemical insecticides for managing bean pod borer. Farmers of our country are not so much aware to use them. In Bangladesh research work with novel insecticides and biopesticides against bean pod borer is also scanty. So present study has been carried out to evaluate the bioefficacy of certain novel insecticides and biopesticides for managing bean pod borer in the field.

Materials and Methods

The study was conducted at the Entomology Field Laboratory of Bangladesh Agricultural University, Mymensingh from October 2017 to March 2018 to evaluate the bioefficacy of certain novel insecticides and some biopesticides for managing bean pod borer in Rabi season. BARI Shim-2 developed by Olericulture division, Horticulture Research Centre, Gazipur and released by Bangladesh Agricultural Research Institute was used in this experiment. Seeds were collected from Natunbazar, Mymensingh. At first the experimental plot was ploughed with a country plough. Then the land was ploughed and cross-ploughed several times with a power tiller to obtain final tilth that was followed by laddering and spading. The stubbles of the crops and uprooted weeds were removed from the field and the land was then leveled prior to seed sowing. The entire experimental field was divided into three blocks. Each block was divided into 8 plots and total of 24 plots were made in the specified area for conducting the experiments. The plots were raised by 10 cm from the soil surface keeping the drain around the plots. Individual plots were prepared with basal dose of chemical fertilizers with the help of spade. At the same time before sowing final weeding was done to facilitate seed germination and to minimize crop weed competition. Two adjacent unit plots and blocks both were separated by 1 foot apart. After final preparation of pit, seeds were sown followed by a light irrigation to ensure soil moisture for germination. Five seeds were sown in each pit of experimental plot. Recommended fertilizer doses of 10 ton cowdung, 25 kg urea, 90 kg TSP, 60 kg MoP, Gypsum 5 kg and 5 kg Boric acid were adopted for one ha land. Half of the dose of urea and the total phosphorus were applied as basal dose and the rest of the urea was applied at 30 days after sowing. Well decomposed cowdung, gypsum, boric acid were also applied at the time of final land preparation. Mustard oil cake was also applied at the vegetative stage. After sowing a light irrigation was applied. All the agronomic practices were done to develop the healthy plants for conducting experiment. Bamboo stalking was made for propping, allowing easy standing and preventing the plant from lodging. Each experimental plot was tagged properly considering the treatments and replications. The experiment was conducted with 8 treatments (T_1= Cartap (Suntap 50 SP, @ 1g/L), T_2=Flubendiamide [Belt 24 WG @ 1 ml/L], T_3= Lufenuron [Heron 5 EC @ 1 ml/L], T_4=*Beauveria bassiana* @ 5g/L, T_5= Cypermethrin @1 ml/L, T_6= Spinosad [Libsen 45 SC @ 0.5ml/L], T_7= Emamectin benzoate [Suspend 5 SG @ 1g/L] and T_8= untreated control. Each of the treatment was replicated for three times. The experiment was laid out in a Randomized Complete Block Design (RCBD). The treatments were evaluated based on some parameters viz. no of healthy pods plot^{-1}, no of infested pods plot^{-1}, weight of healthy pods plot^{-1} and weight of infested pods plot^{-1}. Percent pod infestation by number and weight, percent protection of pod over control by number and weight were calculated from the collected data. Data were recorded at 7 days interval after each spray.

All treatments were applied with the aid of knapsack sprayer at seven days intervals. Mature pod were collected separately from each plot. Number and weight of damaged and healthy pods were recorded for each plot separately. Number of healthy pods was harvested and counted from each replication from the randomly selected five plants and then converted into number of healthy fruits plot^{-1}. Number of infested pods was recorded before spray and during harvest from the randomly selected five plants and then converted into infested fruits plot^{-1}. Finally yield (ton ha^{-1}) of healthy pod was calculated from data found from experiment. Data were analysed using MSTAT-C and means were separated by DMRT.

Results and Discussion

Efficacy of selected novel insecticides and biopesticides on the mean no. of healthy pod plot^{-1}

From the data it was revealed that novel insecticides and biopesticides reduced pod borer infestation significantly in compared to control (Table 1). The maximum number of healthy pod plot^{-1} from first harvest (38.00) was observed in Emamectin benzoate sprayed plots followed by Cartap (35.00), Cypermethrin (29.00) and Spinosad (28.00) (Table 1). The lowest number of healthy pod plot^{-1} was recorded from control (16.33). In second harvest Emamectin benzoate produced the highest pod plot^{-1} (43.00) followed by Cartap (38.00), Spinosad (33.00) and Cypermethrin (31.00). The lowest number of healthy pod was obtained from control (16.33). In third harvest Emamectin benzoate provided the highest pod plot^{-1} (57.00) followed by Cartap (43.30), Spinosad (37.70) and Cypermethrin (35.30). The lowest number of healthy pod plot^{-1} was found from control (18.00). Similar findings were also obtained by Patel *et al.* (2012) who evaluated the effect of some biopesticides against spotted pod borer where they found that Emamectin benzoate 5 SG (2.70%) showed good performance in this case. These findings are also more or less similar with Gaikwad *et al*. (2009).

Table 1. Effect of novel insecticides and some biopesticides against bean pod borer based on number of healthy pod plot^{-1}

Treatments	Mean no of healthy pod plot^{-1}			Cumulative mean no. of healthy pod plot^{-1}
	1st harvest	2nd harvest	3rd harvest	
Cartap	35.00 b	38.00 b	43.3 b	38.77
Flubendiamide	23.67 d	27.33 d	30.3 d	27.1
Cypermethrin	29.00 c	31.67 c	35.3 c	31.99
B. bassiana	19.67 e	22.00 e	24.6 e	22.30
Spinosad	28.00 c	33.67 c	37.7 c	33.12
Emamectin benzoate	38.00 a	43.00 a	57.0 a	46.00
Lufenuron	21.00 e	24.33 e	27.3 e	24.21
Control	16.33 f	16.33 f	18.0 f	16.89
Level of Significant	**	**	**	-
CV (%)	5.166	5.48	4.69	-

In column, means followed by different letters are significantly different. **means significant at 1% level of probability

The highest cumulative mean number of healthy pods plot^{-1} was obtained from Emamectin benzoate (Suspend 5 SG) (46.00) treated plots followed by Cartap (38.77). The lowest number was recorded in control (16.88) (Table 1). Among the treatments the highest percentage increase of healthy pod over control by number was observed from Emamectin benzoate (63.29%) treated plots and the lowest was from *Beauveria bassiana* (22.30%) treated plots (Fig. 1). The efficacy rank of the treatments based on (%) increase of healthy pod over control by number was as follows- Emamectin benzoate (Suspend 5 SG) > Cartap (Suntap 50 SP) > Spinosad (Libsen 45 SC) > Cypermethrin > Flubendiamide (Belt 24 WG) > Lufenuron (Heron 5 EC) > *Beauveria bassiana* (Fig. 1).

Efficacy of selected novel insecticides and biopesticides on the mean no. of infested pod plot^{-1}

Biopesticidal treatments to manage the bean pod borer showed highly significant effects during first harvest of infested pod plot^{-1}. In case of first harvest, the lowest number of infested pod was obtained from plots treated with Emamectin benzoate (Suspend 5 SG) (4.36). Spinosad (Libsen 45 SC) showed more or less similar result with Emamectin benzoate and the highest value of infested pods derived from control (9.33) which showed statistical similarity with *Beauveria bassiana* (9.00).

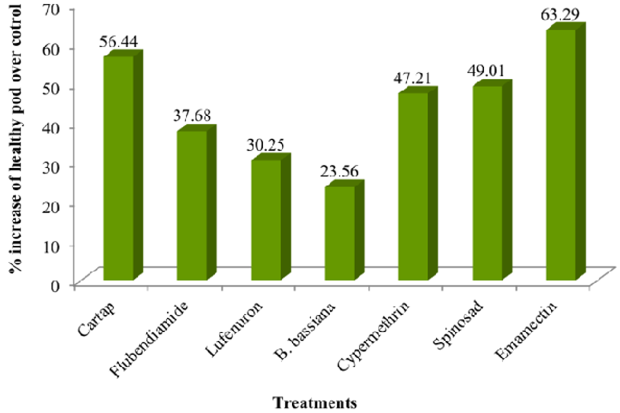

Fig.1. Effect of novel insecticides and biopesticides on percentage increase of healthy pod over control by number

Cypermethrin, Flubendiamide (Belt 24 WG), Lufenuron (Heron 5 EC) gave the moderate result. In case of second harvest the lowest number of infested pod was obtained from Emamectin benzoate (2.67), followed by Cartap (3.33). The highest number of infested pod plot^{-1} was obtained from control (9.00). In third harvest again the lowest number of infested pod was obtained from Emamectin benzoate (1.6) treated plot. The highest number of infested pod was obtained from control (9.6). The present findings are in agreement with the following reports. Anil and Sharma (2011) stated that the minimum (18.79%) fruit infestation was recorded in Emamectin benzoate whereas in Spinosad and Novaluron treated plots moderate (25.01 and 25.22%, respectively) fruit infestation was recorded in brinjal. Similarly, Haripriya *et al.* (2019) reported that due to sequential application of Emamectin benzoate only 8.87% pod was infested by *M. vitrata* on lablab. Kolarath *et al*. (2015) found Emamectin benzoate very effective with 7.90% pod damage in field bean. Shinde *et al.* (2015) stated that Emamectin benzoate was very effective and recorded 9.1% pod damage whereas 22.2% pod damage was in untreated control.

Table 2. Effect of novel insecticides and some biopesticides against bean pod borer based on number of infested pod plot^{-1}

Treatments	Mean no. of infested pod plot^{-1}			Cumulative mean no. of infested pod plot^{-1}
	1st harvest	2nd harvest	3rd harvest	
Cartap	5.66 cd	3.33 ef	3.3 e	4.10
Flubendiamide	7.00 bc	5.33 cd	4.7 cd	5.68
Cypermethrin	5.66 cd	4.66 d	4.0 de	4.77
B. bassiana	9.00 a	7.333b	6.0 b	7.44
Spinosad	4.66 d	4.333 de	3.7 e	4.23
Emamectin benzoate	4.36 d	2.67 f	1.6 f	2.88
Lufenuron	7.33 b	6.33 bc	5.3bc	6.32
Control	9.33 a	9.00 a	9.6 a	9.31
Level of Significant	**	**	**	-
CV (%)	1.046	1.83	5.05	-

In column, means followed by different letters are significantly different. **means significant at 1% level of probability

The highest percentage reduction of infested pods over control was observed from the plots treated with Emamectin benzoate (Suspend 5 SG) (69.21%). However, *Beauveria bassiana* (20.05%) provided the least percentage reduction of infested pods affected by bean pod borer (Fig. 2). Similar effect of Emamecting benzoate against legume pod borer was reported by Ahmed *et al.* (2020), where they found 68.37% reduction of pod damage over control. Birah and Raghuraman (2011) revealed that Emamectin benzoate was found effective in suppressing the incidence of bhendi fruit and shoot borer at 14 and 18 g a.i. ha^{-1} followed by Spinosad at 50 g a.i. ha^{-1} at New Delhi. The efficacy rank of the tested treatments based on % decrease of infested pod over control by number was as follows- Emamectin benzoate (Suspend 5 SG)>Cartap (Suntap 50 SP) > Spinosad (Libsen 45 SC) > Cypermethrin > Flubendiamide (Belt 24 WG) > Lufenuron (Heron 5 EC) > *B. bassiana* (Fig. 2).

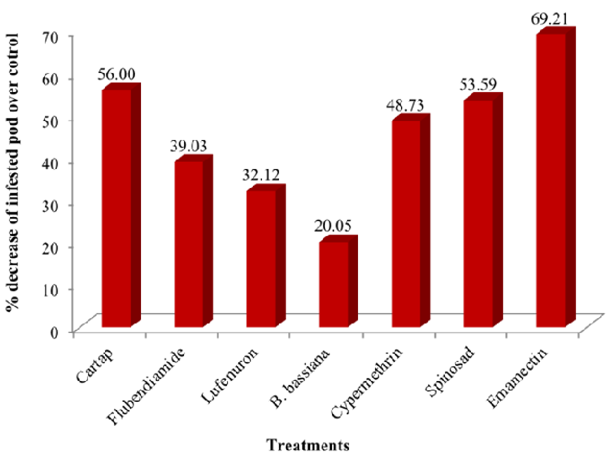

Fig. 2. Effect of novel insecticides and biopesticides on percentage decrease of infested pod over control by number

Efficacy of selected novel insecticides and biopesticides on the mean wt. of healthy pod $plot^{-1}$

Data on total mean weight of pods $plot^{-1}$ showed significant different under the various treatments. The highest weight of healthy pod $plot^{-1}$ was found 223.66, 242.33 and 256.0g from first, second and third harvest respectively when the plants were treated with Emamectin benzoate (Table 3). The lowest weight of healthy pod $plot^{-1}$ was observed from control 176.66, 179.00 and 183.0g from first, second and third harvest respectively. The cumulative mean weight of healthy pods was 240.66 g $plot^{-1}$ was found best from Emamectin benzoate (Suspend 5 SG) treated plot followed by Cartap 231.33g $plot^{-1}$. On the other hand the lowest cumulative mean weight of healthy pods $plot^{-1}$ (179.55g) was found from control plots (Table 3). This result is similar with the report of Regmi *et al.* (2014), where they found the highest mean weight of healthy pods $plot^{-1}$ from the Emamectin treated plants.

Percentage increase of healthy fruit over control based on weight is presented by Fig. 3. The highest percent increase (34.03%) of healthy pod weight over control was provided by Emamectin benzoate (Suspend 5 SG) (Fig. 3). The lowest percentage increase of healthy pod weight was obtained from Flubendiamide (16.46%) followed by *Beauveria basssiana* (19.06%). This result is similar to the findings of Regmi *et al.* (2014) who reported that Emamectin benzoate 5 SG (@ 0.25 g/L) increased 63.42% pod yield over control of yard long bean. The present result is in the line of report of Haripriya *et al.* (2019), where they stated that sequential application of Emamectin benzoate with *Bracon brevicornis* increased the 72.82% pod yield over control in case of lablab. The efficacy rank of the tested insecticides based on % increase of healthy pod over control by weight was as follows- Emamectin benzoate (Suspend 5 SG)>Cartap (Suntap 50 SP)>Cypermethrin >Spinosad (Libsen 45 SC)>Lufenuron (Heron 5 EC) >*Beauveria bassiana*. >Flubendiamide (Belt 24 WG) (Fig, 3).

Table 3. Effect of novel insecticides and some biopesticides against bean pod borer based on weight of healthy pod $plot^{-1}$

Treatments	Mean weight (g) of healthy pod $plot^{-1}$			Cumulative mean weight (g) of healthy pod $plot^{-1}$
	1st harvest	2nd harvest	3rd harvest	
Cartap	211.00 ab	237.00 a	246.0 b	231.33
Flubendiamide	183.33 c	218.00 c	226.0 de	209.11
Cypermethrin	223.33 a	229.00 b	230.3 cd	227.54
B. bassiana	209.67 ab	215.67 c	216.0 f	213.78
Spinosad	203.33 b	228.33 b	233.3 c	221.65
Emamectin benzoate	223.66 a	242.33 a	256.0 a	240.66
Lufenuron	215.67 ab	217.00 c	223.0 e	218.56
Control	176.66 c	179.00 d	183.0 g	179.55
Level of Significant	**	**	**	-
CV (%)	4.41	2.017	1.45	-

In column, means followed by different letters are significantly different. **means significant at 1% level of probability

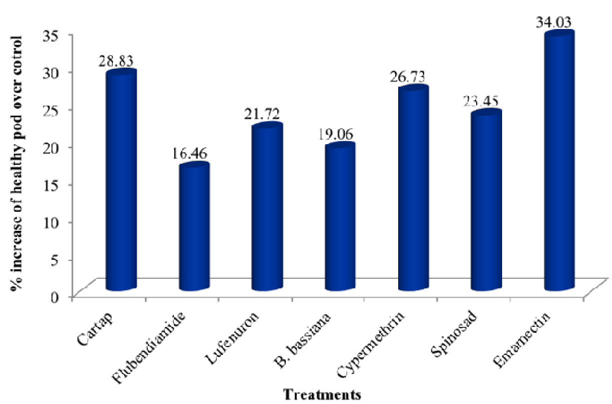

Fig. 3. Effect of novel insecticides and biopesticides on percentage increase of healthy pod over control by weight

Efficacy of selected novel insecticides and biopesticides on the mean wt. of infested pod plot^{-1}

Biopesticides as well as the novel insecticides showed their significant effect in reducing the infested pods than the control (Table 4). Weight of infested pods plot^{-1} varied significantly (at 1% level) under various treatments at first harvest (Table 4). In first harvest the highest weight of infested pod (20.33g) plot^{-1} was obtained from control plot which was statistically different from all other treatments. The lowest weight of infested pod plot^{-1}(9.33g) was found from Emamectin benzoate followed by Spinosad (11.33g), Cypermethrin (11.66g) and Cartap (12.0g). In second harvest the highest weight of infested pod (16.6g) was obtained from control plot and the lowest infested pod weight per plot was observed from Emamectin benzoate (7.00g) followed by Cypermethrin (9.00g). In case of third harvest the highest weight of infested pod plot^{-1}(18.33g) was obtained from control plot and the lowest was provided by Emamectin benzoate (3.00g plot^{-1}) followed by Cartap (3.47g plot^{-1}) and Spinosad (4.60g plot^{-1}) (Table 4). It was mentioned that Emamectin benzoate always showed the best performance in reducing the weight of infested pod among all other treatments.

Table 4. Effect of novel insecticides and some biopesticides against bean pod borer based on weight of infested pod plot^{-1}

Treatments	Mean weight (g) of infested pod plot $^{-1}$			Cumulative mean weight (g) of infested pod plot^{-1}
	1st harvest	2nd harvest	3rd harvest	
Cartap	12.00 cd	9.60 d	3.47 cd	8.36
Flubendiamide	14.00 bc	10.30 cd	9.33 b	11.21
Cypermethrin	11.66 cd	9.00 de	8.66 b	9.77
B. bassiana	16.00 b	13.00 b	5.00 c	11.33
Spinosad	11.33 cd	9.70 d	4.60 cd	8.54
Emamectin benzoate	9.333 d	7.00 e	3.00 d	6.44
Lufenuron	14.00 bc	12.30 bc	10.00 b	12.10
Control	20.33 a	16.6 a	18.33 a	18.42
Level of Significant	**	**	**	-
CV (%)	1.98	3.99	3.14	-

In column, means followed by different letters are significantly different. **means significant at 1% level of probability

The lowest cumulative mean weight of infested pod (6.44g plot^{-1}) was obtained from Emamectin benzoate (Suspend 5 SG) treated plots. On the other hand the highest cumulative mean weight of infested pod (18.42g plot^{-1}) was found from untreated control plot. In case of overall situation it was also mentionable that Emamectin benzoate showed the best performance among all the treatments used in the experiment.

In case of percentage reduction of infested pod weight over control it was observed that the highest reduction was determined from Emamectin benzoate (Suspend 5 SG) (65.02%) treated plots while the lowest percentage reduction was obtained by *Beauveria bassiana* (38.47%) among all the tested treatments in the present research (Fig. 4). The efficacy rank of the treatments based on percentage decrease of infested pod over control by weight was as follows- Emamectin benzoate (Suspend 5 SG) > Cartap (Suntap 50 SP) > Spinosad (Libsen 45 SC) > Lufenuron (Heron 5 EC) > Cypermethrin > Flubendiamide (Belt 24 WG) >*B. bassiana* (Fig. 4).

Efficacy of selected novel insecticides and biopesticides on the mean yield of marketable pod

The results revealed that all treatments could increase marketable pod yield (ton ha^{-1}) of country bean significantly as compared to control. Statistically significant variation was observed in respect of total yield at different treatments in the present study. Emamectin benzoate (Suspend 5 SG) showed highest (7.1 ton ha^{-1}) yield which was significantly different from other treatments used in the experiment whereas the lowest yield was recorded from untreated control plot (4.80 ton ha^{-1}) (Table 5). Similar result was found by Ahmed *et al.* (2020), where they reported that the highest pod yield (16.98 ton ha^{-1}) of yard long bean was found from Emamectin benzoate (1g/L of water) treated plots. Kolarath *et al.* (2015) found 20.66 qha^{-1} pod yield of field bean from the treatment of Emamectin benzoate.

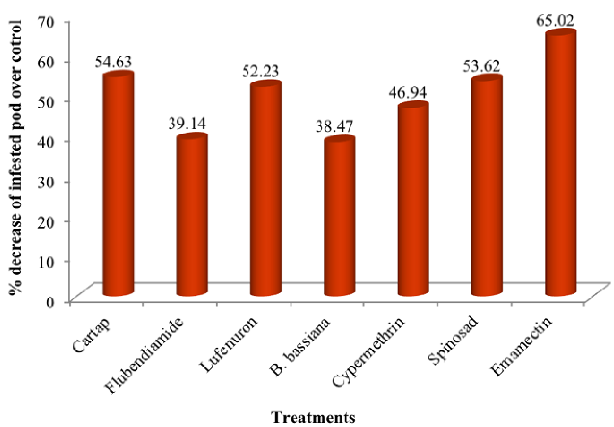

Fig.4. Effect of novel insecticides and biopesticides on percentage decrease of infested pod over control by weight

Table 5. Effect of novel insecticides and some biopesticides on the yield of marketable pod

Treatments	Yield (ton ha^{-1})	Increased yield over control (%)
Cartap	6.41 b	25.18
Flubendiamide	5.60 f	14.29
Lufenuron	5.80 de	17.24
B. bassiana	5.71 ef	15.94
Cypermethrin	6.10 c	21.31
Spinosad	5.90 d	18.64
Emamectin benzoate	7.12 a	32.58
Control	4.80 g	-
Level of significance	**	-
CV (%)	1.469	-

In column, means followed by different letters are significantly different. **means significant at 1% level of probability

The percent increase of pod yield over control is showed in Table 5. The highest percent increase of pod yield over control was observed from Emamectin benzoate (Suspend 5 SG) (32.58%) among all the treatments. But the lowest percent increase of pod yield over control was recorded from Flubendiamide (14.29%) followed by *B. bassiana* (15.94%) (Table 5). The present result is also in accordance with the finding of Ahmed *et al.* (2020), where Emamectin benzoate (1 g/L of water) increased 47.90% healthy pod yield over untreated control. The efficacy rank of the insecticides based on the percent increase of pod yield over control was as follows- Emamectin benzoate (Suspend 5 SG) > Cartap (Suntap 50 SP) > Cypermethrin > Spinosad > Lufenuron > *B. bassiana* > Flubendiamide.

Conclusion

In the present study data showed that all the treatments were significantly effective against the bean pod borer in comparison to control. The lowest healthy pod plot^{-1}, the highest infested pod plot^{-1} and the lowest yield ha^{-1} were obtained from untreated control plots. Among the treatments the highest percentage increase of healthy pod and decrease of pod infestation were found in Emamectin benzoate treated plot which was followed by Cartap and Spinosad. Similarly, the highest yield was obtained from Emamectin benzoate treated plots. Considering the efficacy against the pod infestation by *M. vitrata* and on the yield of pod it could be concluded that Emamectin benzoate might be incorporated as a component of IPM for sustainable management of bean pod borer.

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