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Field evaluation of microbial derivatives for management of legume pod borer, *Maruca vitrata* F. in yard long bean

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Abstract
Globally, legume pod borer, *Maruca vitrata* F. is one of the major constraints in increasing the production of grain legumes including Yard-long bean (*Vigna unguiculata* subspecies *sesquipedalis*). The present research was conducted to evaluate the efficacy of two microbial derivatives *viz.* emamectin benzoate and spinosad along with a widely used chemical insecticide Nitro 505 EC for the management of legume pod borer *M. vitrata* in the field laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh during *kharif* season 2016. The experiment was done following RCBD with three replications of each treatment along with an untreated control. Microbial derivative, emamectin benzoate @ 1.0 g/L showed a significant better performance in comparison to spinosad and widely used chemical insecticide Nitro 505 EC in respect of benefit cost ratio and bio-efficacy on *M. vitrata* which reduced 55.52 and 68.37% flower and pod infestation, respectively subsequently resulting 47.90% increasing pod yield.

Keywords: Microbial, management, pod borer, *Maruca vitrata*, yard long bean

Introduction
Legumes are important sources of low-fat dietary protein, fiber, and micronutrients in the human diet [1] and therefore, considered as the `meat of the poor' [2]. In the farming system, legumes are planted in crop rotations to improve soil fertility by fixing atmospheric nitrogen, breaking pest cycles, controlling soil erosion, and producing livestock fodder [3]. Amongst food legume, yard long bean (*Vigna unguiculata* subsp. *sesquipedalis*) is one of the most popular vegetables in Bangladesh. It has potentiality for export of both fresh and frozen and can be grown all year round [4]. It is extensively grown in *kharif* season and plays an important role when there is a shortage of vegetables supply in the market in Bangladesh.
Flower and pod-feeding Lepidopterans cause serious yield losses to edible legumes particularly in tropical and sub-tropical zones [5]. *Maruca vitrata* F. (Lepdoptera: Crambidae), a genetically complex species [6, 7], is recognized as one of the most serious legume pests [8, 9, 10, 11] due to an extensive host range, high damage potential and cosmopolitan distribution [6,12, 13]. Larvae of *M. vitrata* feed on flowers, stems, peduncles and pods of food legumes, thus damage occurs at all developmental stages from seedling to poding stages [14], however, greatest damage occurs at flowering stage [15]. For example, typical yield losses on cowpea due to *M. vitrata* range from 20–88% [16]. Thus, Yard-long bean growers face serious losses at pod harvest caused by *M. vitrata* infestation and consequently employ an array of agronomic management regimes such as application of conventional insecticides which cause adverse effects to the environment and human health, but fail to achieve satisfactory level of control [17, 18]. Therefore, the present study was undertaken to evaluate the efficacy of two microbial derivatives *viz.*, emamectin benzoate and spinosad against legume pod borer in the yard long bean field.

Materials and Methods
The field trial of two microbial derivatives *viz.*, emamectin benzoate and spinosad each having three doses along with a standard insecticide and untreated control was conducted against legume pod borer, *Maruca vitrata* F. at experimental field of Entomology Department of BAU, Mymensingh in *kharif* season 2016.

The yard long bean seeds (Long Red Mollika) were sown on April 01, 2016 in 24 plots. Treatments were assigned in randomized complete block design with three replications. The distances of plot to plot and replicate to replicate were 1.0 m and 2.0 m, respectively. Each plot measuring 2.65m x 1.2m had 24 plants. Intercultural operations were done as and when needed. Fertilizers were applied as per recommendation [19]. Treatments were as follows:

T_1 = Emamectin benzoate (Proclaim 5SG) @ 0.5g, 1.0g and 1.5g /L of water.

T_2 = Spinosad (Tracer 45SC) @ 0.2ml, 0.4ml and 0.6ml /L of water.

T_3 = Standard insecticide (Nitro 505EC) @ 1.0 ml / L of water.

T_4 = Control (Untreated)

All tested microbial derivatives and insecticide were sprayed at the above mentioned doses on the yard long bean plants using high volume knapsack sprayer. First spray was done at the time of flowering and was continued 7 days intervals up to harvesting. To ensure complete coverage of plants, spraying was done uniformly on the entire plant maintaining the distance around 25 cm between the nozzle and inflorescence. Sprayer was washed and cleaned after each spraying. Only water was sprayed in untreated control plots. The spraying was applied in the afternoon to avoid bright sunlight, drift caused by wind and save honey bees. Data were collected on first, third and seventh day after spraying. Number of healthy and infested flowers were counted and recorded from randomly selected 10 inflorescences per plot and to calculate percentage of flower infestation at each observation. During each data collection, number of healthy and infested pods were recorded and weighed to calculate the percentage of pod infestation and percentage yield increased. The number of legume pod borer larvae were counted and recorded from randomly selected 10 infested pods before spray and on 1st, 3rd and 7th day after spraying to calculate percentage of surviving larvae. All data were analyzed statistically after appropriate transformations and the means were separated using DMRT by MSTAT computer software.

Results and Discussion

Two bacterial-fermented biopesticides *viz.* emamectin benzoate and spinosad were evaluated against *Maruca vitrata.* The efficacy of these microbial derivatives was assessed as the percent flower and pod infestation, percent survival of larvae and pod yield (Tables 1- 4). The data clearly showed that both the microbial derivatives had significant ($P<0.01$) effect on the reduction of percent flower and pod infestation, percent larvae survived and increase of yield compared to the untreated control. The flower and pod damage ranged from 8.36 to 30.86% and 7.67 to 39.57%, respectively. Spinosad @ 0.6 ml/L and 0.4 ml/L sprayed at 7 days intervals provided only 8.36 and 10.02% of flower infestation as well as 7.67 and 8.98% of pod infestation. The reduction of flower and pod infestation over control was 72.90 to 67.54% and 80.61 to 77.29%, respectively (Table 1 and Table 2). On the other hand, emamectin benzoate @ 1.5 g/L and 1.0 g/L applied at 7 days intervals provides protection of flower and pod infestation of 11.71 to 13.73% and 11.62 to 12.52%. The reductions of flower and pod infestation over control were 62.04 to 55.52% and 70.65 to 68.37%, respectively (Table 1 and Table 2). The effectiveness of spinosad and emamectin benzoate increased with the increase of dose in respect of flower and pod infestation reduction.

Table 1: Effect of microbial derivatives on the percentage of infested flowers of yard long bean caused by legume pod borer, *M. vitrata*

Treatments	Dose	Infested flower (%)	Percent reduction of flower damage over control
Emamectin benzoate (Proclaim 5 SG)	0.5 g/L	16.77 (4.09) b	45.67
	1 g/L	13.73 (3.70) bc	55.52
	1.5 g/L	11.71 (3.42) bc	62.04
Spinosad (Tracer 45 SC)	0.2 ml/L	16.11 (4.01) b	47.80
	0.4 ml/L	10.02 (3.16) c	67.54
	0.6 ml/L	8.36 (2.88) c	72.90
Nitro 505 EC	1 ml/L	17.84 (4.21) b	42.17
Control (Untreated)	-	30.86 (5.55) a	-
Level of significance	-	0.01	-
CV (%)	-	8.38	-

Figures in parentheses are the square root transformations. Means in each column followed by the same letter(s) are not significantly different by DMRT.

The result revealed that both spinosad and emamectin benzoate provided the maximum protection of flower and pod damage against *Maruca vitrata*. This finding is in conformity with [20] who reported the efficacy of spinosad 45 SC @ 0.015% with 84.70% reduction in flower damage over control followed by emamectin benzoate (82.08%) in red gram. Spinosad 45 SC @ 0.4 ml/L recorded the lowest pod damage (8.5%) in red gram due to *Maruca vitrata* [21]. In another report spinosad 45 SC @ 90 g a.i/ha was found to be most effective against *Maruca vitrata* in pigeonpea by recording 10.6% of pod damage [22]. It was also reported that spinosad 45 SC @ 0.015% was effective and showed the highest (52.10%) reduction in pod damage in red gram due to *Maruca vitrata* [20].

Table 2: Effect of microbial derivatives on the percentage of infested pods of yard long bean caused by legume pod borer, *M. vitrata*

Treatments	Dose	Infested pod (%)	Percent reduction of pod damage over control
Emamectin benzoate (Proclaim 5 SG)	0.5 g/L	16.09 (4.00) b	59.34
	1.0 g/L	12.52 (3.52) bc	68.37
	1.5 g/L	11.62 (3.40) bc	70.65
Spinosad (Tracer 45 SC)	0.2 ml/L	13.47 (3.66) bc	65.97
	0.4 ml/L	8.98 (2.99) c	77.29
	0.6 ml/L	7.67 (2.76) c	80.61
Nitro 505EC	1 ml/L	18.93 (4.34) b	52.15

Control (Untreated)	-	39.57 (6.28) a	-
Level of significance	-	0.01	-
CV (%)	-	9.68	-

Figures in parentheses are the square root transformations. Means in each column followed by the same letter(s) are not significantly different by DMRT

The tested microbial derivatives spinosad and emamectin benzoate, irrespective of doses, offered significantly lower percentage of survival of larvae 31.85 to 36.28% and 34.43 to 40.67%, respectively (Table 3). This result is in conformity with [23] who stated that spinosad 48 SC @ 0.005% recorded 63.99% larval reduction of *Maruca vitrata* in urd bean. It was also reported that spinosad 2.5 EC 12.5 g a.i/ha was effective with 79.71, 71.68 and 75.78 % reduction in *Plutella xylostella* larval population over control in cabbage at seven days after spraying [24]. In another report spinosad 45 SC @ 62 and 84 g a.i/ha were found effective in controlling the larvae of *Helicoverpa armigera* on cotton with 100% larval mortality at 10 days after spraying [25]. Spinosad @ 0.018% was also found to record minimum number (0.2/plant) of larvae of *Spodoptera litura* on groundnut [26]. It was revealed that emamectin benzoate 5 SG @ 10 g a.i./ha showed significantly the highest population reduction (86.23%) of *Plutella xylostella* in cabbage over control [24]. Similarly, it was reported that emamectin benzoate 5 SG @ 11 g a.i/ha was highly effective against *Helicoverpa armigera* in tomato with 92.48% reduction in larval population over control [27]. It was also noticed that emamectin benzoate 5 EC @ 15g a.i/ha could record higher larval population reduction of 83.53, 75.14 and 86.38%, respectively at 7 days of spraying in all the three sprayings given [28].

Table 3: Effect of microbial derivatives on the percentage of surviving larvae of legume pod borer, *M. vitrata* inside the pods of yard long bean

Treatments	Dose	Surviving larva (%)
Emamectin benzoate (Proclaim 5 SG)	0.5 g/L	40.67 c
	1.0 g/L	35.72 c
	1.5 g/L	34.43 c
Spinosad (Tracer 45 SC)	0.2 ml/L	36.28 c
	0.4 ml/L	32.34 c
	0.6 ml/L	31.85 c
Nitro 505EC	1 ml/L	68.14 b
Control (Untreated)	-	94.66 a
Level of significance	-	0.01
CV (%)	-	12.46

Means in each column followed by the same letter(s) are not significantly different by DMRT

As a result of the higher overall efficacy in reducing larval population, flower damage and pod damage due to *Maruca vitrata*, spinosad and emamectin benzoate both of them recorded the highest yield of 18.05 – 19.36 ton/ha as well as 16.98 – 17.39 ton/ha, respectively (Table 4). The highest pod yield increased over control (54.31%) recorded in the treatment with spinosad @ 0.6 ml/L which was very close to the different doses of spinosad and emamectin benzoate (Table 4). These two microbial derivatives were statistically at par with each other. It was revealed that the highest yield (1744 kg/ha) of red gram was registered with spinosad 45 SC @ 90g a.i/ha against *Maruca vitrata* [22]. Spinosad 45 SC recorded 10.30 q/ha yield of chick pea against gram pod borer [29]. It was reported that spinosad 45 SC registered the highest yield of red gram (688kg/ha) against *Maruca vitrata* [21]. Emamectin benzoate 5% SG @ 11 g a.i./ha registered grain yield of 2291kg/ha which is 28.99 % increase over control of 1776 kg/ha [30]. It was found that emamectin benzoate 5 SG @ 6.75g a.i./ha was effective against bollworms of cotton and recorded yield of 734.00 kg/ha [31]. In pigeonpea, emamectin benzoate 5 WSG @ 8, 9.5 and 11 g a.i./ha recorded yield of 1246, 1570 and 1761 kg/ha, respectively while control registered only 1098 kg/ha [32].

From this experiment it was found that standard insecticide Nitro 505 EC showed the lowest percent reduction in flower and pod damage (42.17 and 52.15%), 68.14 % of surviving larvae of *Maruca vitrata* and only 31.49% yield increased which was the minimum yield increased over control. In this study, both spinosad and emamectin benzoate exhibited better performance in respect of reduction of flower and pod damage, reducing larval population and yield increased in comparison to standard insecticide Nitro 505 EC.

Table 4: Effect of microbial derivatives on the pod yield and % increase of pod yield of yard long bean

Treatments	Dose	Yield (t/ha)	Yield increase (%)	Benefit cost ratio
Emamectin benzoate (Proclaim 5 SG)	0.5 g/L	13.91 cd	36.40	1.33
	1.0 g/L	16.98 a-c	47.90	1.57
	1.5 g/L	17.39 ab	49.13	1.56
Spinosad (Tracer 45 SC)	0.2 ml/L	14.90 b-d	40.62	1.36
	0.4 ml/L	18.05 ab	51.01	1.52
	0.6 ml/L	19.36 a	54.31	1.52
Nitro 505EC	1 ml/L	12.91 d	31.49	1.25
Control (Untreated)	-	8.84 e	0.00	0.88
Level of significance	-	0.01	-	-
CV (%)	-	8.62	-	-

Means in each column followed by the same letter(s) are not significantly different by DMRT

These results revealed that both the spinosad and emamectin benzoate might be more toxic to *Maruca vitrata* in comparison to chemical insecticide. Spinosad and emamectin benzoate being a contact and stomach poison along with translaminar movement and local penetration properties were more toxic and by this mode of action it killed about 70% of legume pod borer. Their quantity required in the spray mixture was mass less than that of conventional insecticide against this insect and showed the best performance. There is no report on resistance of the legume pod borer against spinosad and emamectin benzoate. The toxicity levels of tested insecticides were in the following order Spinosad > Emamectin benzoate> Nitro 505EC.

Although, spinosad showed good result but in consideration of benefit cost ratio emamectin benzoate exhibited better performance. The benefit cost ratio of emamectin benzoate were 1.33, 1.57 and 1.56 at the doses of 0.5 g/L, 1.0 g/L and 1.5 g/L whereas the benefit cost ratio of spinosad were 1.36, 1.52 and 1.52 at the doses of 0.2 ml/L, 0.4 ml/L and 0.6 ml/L, respectively (Table 4). The microbial derivative ememectin benzoate may, therefore, be recommended for the effective and economic control of *Maruca vitrata* in yard long bean field.

Conclusion

From the results it was explored that both the spinosad and emamectin benzoate were more toxic to *Maruca vitrata* in comparison to chemical insecticide nitro 505 EC. Although, spinosad showed good result but in consideration of benefit cost ratio emamectin benzoate exhibited better performance. Emamectin benzoate @ 1.0 g/L was superior to all other insecticides in respect of benefit cost ratio and toxic action on *Maruca vitrata* and it reduced 55.52 and 68.37% flower and pod damage, respectively and consequently resulting 47.90% increase of pod yield of yard long bean.

References

1. Messina MJ. Legumes and soybeans: overview of their nutritional profiles and health effects. The American Journal of Clinical Nutrition. 1999; 70:439-450.
2. Heiser CB. Seed to civilization: The story of food. Harvard University Press, 1990, 254.
3. Leikam D, Lamond RE, Bonczkowski LC, Hickman JS, Whitney DA. Using legumes in crop rotations. L-778. Kansas State University Agricultural Experiment Station and Cooperative Extension Service, 2007, 4.
4. Rashid MM. Sabji Biggan (in Bengali). Rashid publishing house, Dhaka, 1999, 526p.
5. Rouf FMA, Sardar MA. Effect of crude seed extract of some indigenous plants for the control of legume pod borer (*Maruca vitrata* F.) on country bean. Bangladesh Journal of Agricultural Research. 2011; 36:41-50.
6. Margam VM, Coates BS, Ba MN, Sun W, Binso-Dabire CL, Baoua I et.al. Geographic distribution of phylogenetically-distinct legume pod borer *Maruca vitrata* (Lepidoptera: Pyraloidea: Crambidae). Molecular Biology Reports. 2011; 38:893-903.
7. Periasamy M, Schafleitner R, Muthukalingan K, Ramasamy S. Phylogeographical structure in mitochondrial DNA of legume pod borer (*Maruca vitrata*) population in tropical Asia and sub-saharan Africa. PloS ONE 10, 2015, e0120457. Doi: http://dx.doi.org/10.1371/journal.pone.0124057.
8. Abate T, Afmpofo JK. Insect pests of beans in Africa: their ecology and management. Annual Review of Entomology. 1996; 41:45-73.
9. Jackai LEN. Integrated pest management of borers of cowpea and beans. Insect Science and Its Application. 1995; 16:237-250.
10. Shanower TG, Romeis J, Minja EM. Insect pests of pigeon pea and their management. Annual Review of Entomology. 1999; 44:77-96.
11. Sharma HC. Bionomics, host plant resistance, and management of the legume pod borer, *Maruca vitrata* – a review. Crop Protection. 1998; 17:373-386.
12. Sharma HC, Saxena KB, Bhagwat VR. The Legume Pod Borer, *Maruca vitrata*: Bionomics and Management. ICRISAT Information Bulletin. 1999; 55:37.
13. Taylor TA. The bionomics of *Maruca testulalis* (Geyer) (Lepidoptera: Pyralidae), a major pest of cowpeas in Nigeria. Journal of the West African Science Association. 1967; 12:111-129.
14. Singh SR, Taylor TA. Pest of grain legumes and their control in Nigeria. In: SR Singh, HF van Emden and TA Taylor (Editors), Pests of Grain legumes: Ecology and control. Academic Press, London, 1978, 99-111.
15. Singh SR, Jackai LEN. The legume pod-borer, *Maruca testulalis* (Geyer): past, present and future research. Insect Science and Its Application. 1988; 9:l-5.
16. Singh SR, Jackai LEN, Dos Santos JHR, Adalla CB. Insect pests of Cowpea. In: SR Singh (Editor), Insect pests of tropical food legumes. Wiley, Chichester, 1990, 43-89.
17. Srinivasan R, Yule S, Chang JC, Malini P, Lin MY, Hsu YC *et al*. Towards developing as ustainable management strategy for legume pod borer, *Maruca vitrata* on yard long bean in Southeast Asia. In: R Holmer, G Linwattana, P Nath, JDH Keatinge, (Editors), High value vegetables in Southeast Asia: production, supply and demand. AVRDC- The World Vegetable Center, Taiwan, 2012, 76-82.
18. Yule S, Srinivasan R. Evaluation of bio-pesticides against legume pod borer, *Maruca vitrata* Fabricius (Lepidoptera: Pyralidae), in laboratory and field conditions in Thailand. Journal of Asia–Pacific Entomology. 2013; 16:357-360.
19. Zaman SMH. Irrigated Crop Production Manual. Department of Agricultural Extension (DAE), Moushumi printers, 15, Mirpur road, Dhaka, 1992, 12-14.
20. Haritha B. Biology and Management of *Maruca vitrata* (Geyer) in Pigeonpea.; MSc Thesis, Department of Entomology, Acharya N.G. Ranga Agricultural University Rajendranagar, Hyderabad, India, 2008.
21. Rao GVR, Ashwini Kumari PR, Rameswar Rao V, Reddy YVR. Evaluation of spinosad and indoxacarb for the management of legume pod borer, *Maruca vitrata* (Geyer) in pigeonpea. Journal of Food Legumes. 2007; 20:126-127.
22. Vishal M, Ujagir R. Evaluation of naturalyte spinosad against pod borer complex in early pigeonpea. Indian Journal of Plant Protection. 2005; 33:211-215.
23. Lakshmi PSR, Rajasekhar P, Rama Subba Rao V. Bio-efficacy of certain insecticides against spotted pod borer in urd bean. Indian Journal of Pulses Research. 2002; 15:201-202.
24. Suganya Kanna S, Chandra Sekaran S, Regupathy A, Lavanya D. Emamectin 5 SG (proclaim) - A newer insecticide for diamond back moth *Plutella xylostella* (L.)

management in cabbage. Pestology. 2005; 29:24-27.
25. Prasad R, Yadav GS, Rohilla HR. Bioefficacy of some new insecticides against *Helicoverpa armigera* (Hubner) on pigeonpea. Journal of Insect Science. 2009; 22:204-206.
26. Mutkule DS, Jagtap PK, Supriya Deshpande, Deshpande A. Efficacy of some newer insecticides against defoliators and leaf minor pests on groundnut. Pestology. 2010; 34:20-22.
27. Murugaraj P, Nachiappan RM, Velvanrayanan V. Efficacy of emamectin benzoate (proclaim 5% SG) against tomato fruit borer, *Helicoverpa armigera* Hub. Pestology. 2006; 30:11-16.
28. Kuttalam S, Vinoth Kumar B, Kumaran N, Boomathi N. Evaluation of bio-efficacy of flubendiamide 480 SC against fruit borer, *Helicoverpa armigera* Hub. In tomato. Pestology. 2008; 32:13-16.
29. Sidde Gowda DK, Suhas Yelshetty, Patil BV. Field efficacy of novaluron (rimon 10 EC) against pigeon pea pod borer, *Helicoverpa armigera* (Hubner). Pestology. 2004; 28:16-18.
30. Raghvani BR, Poshiya VK. Field efficacy of newer molecules of insecticides against pod borer (*Helicoverpa armigera* Hub.) in chickpea. Pestology. 2006; 30:18-20.
31. Gaikwad RS, Waghmare UM, Khan FS, Bhute NK. Bio-efficacy of certain newer insecticides against bollworm complex of cotton. Pestology. 2009; 33:18-20.
32. Dodia DA, Prajapathi BG, Asharya S. Efficacy of insecticides against stem borer, *H. armigera*, infesting Pigeon pea. Journal of Food Legumes. 2009; 22:144-145.