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EVALUATING BIO-PESTICIDES AGAINST SAP SUCKES OF YARD LONG BEAN

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Abstract

A field experiment was undertaken at research field of Entomology Division at Regional Agricultural Research Station, Jashore to evaluate the effect of four bio-pesticides and a chemical insecticides namely Bio-catch (*Vertcillium lecani* 1.15 WP), Bio-power (*Beauvaria bassiana* 1.15 WP), Bio-Magic (*Metarhizium anisopliae* 1.15 WP), Bioclean (D- limonene 5%) and Imitaf (Imidacloprid 200 SL) against the sucking insect pests of yard long bean viz., aphid, jassid and thrips during the kharif-1 season (March to July) of 2022 and 2023. The chemical insecticides Imitaf @ 0.5 mlL^{-1} of water showed the best performance in reducing the infestation of the insect pests, resulting the higher yield and MBCR. The bio-pesticide, Bio-Magic @ 6 gL^{-1} of water offered second the best performance, while the other bio-pesticides offered intermediate level of performance. The Imitaf @ 0.5 mlL^{-1} of water appeared best as it provided the lowest abundance of aphid, jassid and thrips (0.83,1.67, 1.33) while the highest percent reduction over untreated control (91.70, 85.69, 82.66%). The highest yield increase over control was calculated from Imitaf @ 0.5 ml/L of water (46.07%) followed by treatment Bio-Magic @ 6 g/L of water (29.67%). Bio-Magic @ 6 gL^{-1} of water may be used in IPM program against aphid, jassid and thrips attacking yard long bean.

Keywords: Aphid, jassid, thrips *Vigna unguiculata, biopesticides.*

Introduction

Yard long bean (*Vigna unguiculata* sub sp. *sesquipedalis*) (L.) Walp) is an important leguminous vegetable grown widely in summer season of Bangladesh. The area occupied by this crop was 5857.49 ha and the production was 21348 t during the year 2008- 2009 (Anon., 2010). It is cultivated in Chittagong, Chittagong Hill Tracts (CHTs), Faridpur, Noakhali, Camilla and Rangpur districts in Bangladesh (Uddin, 2013). But the production of yard long bean is increasing in Dhaka, Chittagong, Camilla, Narsingdi, and Jahsore districts and also other districts in Bangladesh day by day due to its increasing consumption as vegetable. It is extensively grown in kharif season when there is shortage of vegetables supply in the market. Yard long bean is one of the economically important vegetable crops in Bangladesh. But the production of this vegetable in Bangladesh is much lower compared to many Asian countries. It is an inexpensive source of vegetable protein, vitamin A, thiamin, riboflavin, calcium, vitamin C, phosphorus, sodium, potassium, magnesium and cobalt. It is a highly nutritive vegetable containing a good amount of digestible protein both in pods (23.5-26.3%) and in leaves (Ano and Ubochi, 2008). A serving of 100g of yard long bean contains 50 calories, 9.0g

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of total carbohydrates, and 3.0g of proteins, 0.2g total fat and 0.8g of minerals (Anonymous, 2013). The attack of different insect pests has been reported as one of the serious problems to yard long bean cultivation in the country. At least 11 insect pests are injurious to yard long bean. It is attacked by a number of insects like aphid, pod borer, thrips, red mite, leaf miner, leaf beetle, green sting-bug, jute hairy caterpillar, hooded hopper and semi-looper in descending order in Bangladesh (Uddin *et al.,* 2013). *Amrasca biguttulais* an insect of southern Asia. On leaf surfaces, the insect tends to move about diagonally, when distributed it immediately jumps and fly away (Jayasimha *et al*., 2012). Jassids are the sucking pest. The females lay their eggs within the leaf vein tissue, mostly on the underside of leaves. Nymphs and adults damage their hosts by sucking plant tissues. While sucking, the insects inject toxic compounds which may lead to blacked plant vessels. Jassid (*Amrasca biguttula*), Sucking insects pests are one of the serious pest of legume (Mukhtar, 2009). It was revealed that aphid and pod borer were the major insect pests. The production of yard-long bean is affected due to the frequent occurrence of these insect (Pedigo, 2002). But the production of Yard-long bean is affected due to the frequent occurrence of aphid, *Aphis sp*. (Homoptera:Aphididae), a ubiquitous group of arthropods (Pedigo, 2002). Yard long bean is especially attractive to aphids (*Aphis craccivora, Myzus persicae* and *Aphis gossypii*), jassids, thrips, green stink bug (*Nezara viridula*) and red spider mite (*Tetranychus* spp.). Aphid, the most destructive pest, causes damage by sucking sap from flowers, buds, pods and tender branches of the plants and reduces the viability of plant. Greasy cutworms (*Agrotis ipsilon*) often cause damage just after emergence Aphid, jassid, thrips and mites are gaining tremendous importance in the recent years due to their devastating damage. These pests suck the cell sap and prevent normal crop growth (Pedigo, 2002) the pointed that some botanical products used against the sucking pest. The treatment included Triazophos 40E.C. 0.04%, Neem oil 1 %, Achook 5 %, NSKE 5%, Karanj oil 1%, Eucalyptus oil 1% and an untreated control. Observation on population of sucking pests (aphids and jessed) was recorded before treatment and 3, 7 and 10 days after each spraying (Dehariya *et al*., 2018). Current pest management practices of yard long bean in Bangladesh include extensive use of chemicals known for their ability to cause negative health effects in humans and wildlife and to degrade the natural environment. In vegetable growing areas, farmers practice comprising indiscriminate use of pesticides, sometimes they spray 3-4 times in a week. But indiscriminate use of pesticides has not only complicated the management, but has also created several adverse effects such as pest resistance, outbreak of secondary pests and environmental pollution taking into consideration of the health and environmental effects of chemical pesticides, it is clear that the need for a new concept in agriculture is urgent. This new concept must be based on a drastic reduction of the application of chemical pesticides, and can result in health, environmental, and economic benefits (Pimentel & Burgess, 2014). In fact, the use of chemical pesticides has quickly become widespread worldwide and it is estimated that 35 billion kg of pesticides are applied annually (FAOSTAT, 2014).

However, it is also estimated that pests still cause the loss of 37% of 50 potential crop yield (Pimentel, 2005). Pesticides can also have many negative side effects including: human health impacts, water contamination, killing of nontarget species, residues in food, and the onset of pesticide resistance (Carvalho, 2006; Chagnon *et al*., 2015) there is renewed interest in the application of botanical pesticides for crop protection (Pedigo, 2002). Therefore, a strategic approach is needed for reduction in the use of agro-chemicals and for the implementation of sustainable practices. Furthermore, current agriculture has to implement environmentally friendlier practices that pose fewer public health risks. Cost effective crop production requires combination of optimum use of chemicals and no-chemical techniques of pest management. New chemical insecticides with novel mode of action and bio-pesticides in recent years have gained importance to overcome these problems so, to reduce unwarranted pesticide load in the environment and for sustainable production of this crop. With this view in mind, the present study was designed to select suitable bio-pesticides or new chemical insecticide against sucking insect pests attacking yard long bean.

Materials and Methods

The experiment was conducted in the research field at Regional Agricultural Research Station, Jashore (88°40'-89°50' E, 22°47'-23°470' N) during kharif-1 (March to July), season of 2022 and 2023. Yard long bean seeds of BARI Barboti-2 variety were sown in plots of 4m × 3m. The experiment was laid out in Randomize Complete Block Design having 3 replications. Four bio-pesticides and a chemical insecticide were evaluated in this study, so there were 5 treatments and an untreated control. The crop was fertilized with cowdung 15 t ha^{-1}, urea 50 kg ha^{-1}, gypsum 100 kg ha^{-1}, Zn sulphate 12 kg ha^{-1} and borax 12 kg ha^{-1} (Bangladesg Fertilizer Recommendation Guide, 2018). Weeding and other intercultural operations were done as and when necessary to raise a good crop. Treatment applications were started as soon as the infestation of sucking insects were noticed and continued at weekly interval upto last harvest of the crop. The treatments were Spraying Bio-catch (*Verticillium lecani* 1.15 WP) @ 6 gL^{-1} of water, Bio-power (*Beauvaria bassiana* 1.15 WP) @ 6 gL^{-1} of water, Bio-Magic (*Metarhizium anisopliae* 1.15 WP) @ 6 gL^{-1} of water, Bioclean (D- limonene 5%) @ 1 mlL^{-1} of water, Imitaf (Imidacloprid 200 SL) @ 0.5 ml/ litre of water, and untreated control (Water spray only). The observations of jassid were recorded on 10 randomly selected plants per plot. On each plant, six leaves (two from bottom and two each from middle and top canopy of the plant) were observed from lower canopy to record the pest count. The data on surviving population were reported on the basis of mean insect population/five leaves. For, aphid and thrips population count 10 inflorescences were randomly selected from each plot. Aphid population was counted from top 10 cm of inflorescence, while thrips population was recorded by holding the same stalk over a white piece of sticky paper and trapping it vigorously to dislodge insects. At each harvest number and weight of healthy and infested

pods were recorded and percent fruit infestation and yield (tha^{-1}) were calculated. Data were analyzed by using STAT-10 software for analysis of variance and treatment means were separated by applying LSD at 1% level of significance.

Results and Discussion

Results presented in Table 1 indicated that Imitaf treated plot had the lowest number of aphid population/ inflorescence (4.00) which was followed by Bio-power (*Beauvaria bassiana* 1.15 WP) and Bio-Magic (*Metarhizium anisopliae* 1.15 WP) treated plots (5.33) and these were followed by Bio-catch (*Verticillium lecani* 1.15 WP), Bioclean (D- limonene 5%) sprayed plot whereas the untreated control plot recorded (12.00) aphid population. The highest per cent reduction of aphid population over untreated control (66.67%) was recorded from Imitaf applied plot followed by Bio-Magic treated plots (55.58%). Almost similar results were obtained from Bio-power (55.58%), Bio-catch (52.75%), Bioclean (50%) sprayed plot. After second spray, Imitaf recorded the lowest number of aphid population/ inflorescence (2.00) which was followed Bio-catch (3.00), Bio-power (3.00), Bio-Magic (3.00), Bioclean (3.00) treated plots whereas untreated control plot recorded 11.00 the highest aphid population/ inflorescence. The highest per cent reduction of aphid population over untreated control (81.82%) was recorded from Imitaf treated plots followed Bio-catch (72.73%), Bio-power (72.73%), Bio-Magic treated plots (72.73%), Bioclean (72.73%) sprayed plot. After third spray, Imitaf recorded in the lowest number of aphid population/ inflorescence (0.83) which was followed Bio-Magic (1.83), Bio-power (2.00), Bioclean (2.00) and Bio-catch (2.17). Similarly, the highest per cent reduction of aphid population/ inflorescence over control (91.70%) was recorded from Imitaf treated plot which was followed by Bio-Magic (81.70%), Bio-power 98.0%). Almost similar result was shown by Bioclean (80%), Bio-catch (78%).

Results presented in Table 2 indicated the pooled mean of jassids population after first spray., Imitaf resulted the lowest number of jassid population (5.67/5 leaves) which was followed Bioclean (7.00/ 5 leaves), Bio-power (7.33/ 5 leaves) and similar result was recorded in Bio-Magic (7.33/5 leaves), Bio-catch (8.00/ 5 leaves) treated plot. But the untreated control plot recorded (13.00 Jassids/5 leaves). Similarly, the highest per cent reduction of jassid population/5 leaves over control (56.38%) was recorded from Imitaf applied plot which was followed by Bioclean (46.15%), Bio-power (43,62%), Bio-Magic (43,62%), Bio-catch (38.46%) treated plot. . After second spray, Imitaf spryed plot recorded the lowest number of jassid population (2.67/5 leaves) which was followed by Bioclean (3.67/ 5 leaves), Bio-Magic (3.83/ 5 leaves), Bio-catch (4.00/ 5 leaves), Bio-power (4.00/ 5 leaves) whereas untreated control plot recorded 12.67/ 5 leaves. Similarly, the highest per cent reduction of jassid population over control (78.93%) was recorded from Imitaf treated plot which was followed Bioclean (71.03%), Bio-Magic (69.77%), Bio-power (68.43%) and similar result showing Bio-catch (68,43%).

The pooled mean of jassids population, at 14 days after third spray, Imitaf recorded the lowest number of jassid population (1.67/5 leaves) which was statistically similar to Bio-Magic (2.33/ 5 leaves) which was followed by Bio-catch (2.67), Bio-power (2.67), Bioclean (2.67) whereas the untreated control recorded in (11.67). Similarly, the highest per cent reduction of jassid population over control (85.69%) was recorded from Imitaf which was followed Bio-Magic (80.03%), Bio-power (77,12%) and similar result showing Bioclean (77.12%), Bio-catch (77.12%).

Results of the study have been presented in Table 3. It was indicated that the pooled mean of thrips population at 24 hours after first spray, Imitaf recorded in the lowest number of thrips populatopn/ inflorescence (3.33) which was followed Bio-Magic (4.33) and almost similar result was found in Bioclean (4.33), Bio-catch (4.67), Bio-power (4.67) whereas untreated control plot recorded 7.67 population. Similarly, the highest per cent reduction of thrips population over control (56.58%) was recorded from Imitaf treated plot followed Bio-Magic (43.55%), Bioclean (43.55%), Bio-catch (39.11%) and similar result was found in Bio-power (39.11%). At seven days interval after second spray, Imitaf recorded the lowest thrips populatopn/ inflorescence (2.33) which was followed Bio-Magic (3.00), Bioclean (3.33) and similar result showed from Bio-catch (3.33), Bio-power (3.33) treated plot whereas the untreated control plot recorded 7.00 population. Similarly, the highest per cent reduction of thrips population over control (66.71%) was recorded from Imitaf treated plot which was followed by Bio-Magic (57.14%), Bioclean (52.43%) and similar result obtained from Bio-catch (52.43%), Bio-power (52.43%) sprayed plot. The pooled mean of thrips population, at 14 days after third spray, Imitaf sprayed plot recorded the lowest thrips population/inflorescence (1.33) which was followed by Bio-Magic (2.33) and almost similar result showed in Bioclean (2.33), Bio-catch (2.33), Bio-power (2.33) treated plot whereas the untreated control plot had 7.67 populations. Similarly, the highest per cent reduction of thrips population over control (82.66%) was recorded from Imitaf sprayed plot followed Bio-Magic (69.62%) and similar result was shown in Bioclean (69.62%), Bio- catch (69.62%), Bio-power (69.62%) treated plot.

Sucking insect pest infestation and réduction of infestation in yard long bean have been presented in Table 4. Result indicated that the Imitaf showed significantly the lowest flower infestation by aphid (2.99%) which was followed by Bio-Magic (3.62%) and Bio-power (4.10%), Bioclean (4.42), Bio- catch (4.72) whereas the untreated control showed significantly the highest flower infestation (15.13%) by aphid. It is also observed that the Imitaf showed significantly the lowest pod infestation by thrips (2.53%) which was followed Bio-Magic (3.39%) and Bio-power (3.65%) Bioclean(4.04), Bio-catch (4.08) whereas the untreated control showed significantly the highest flower infestation (15.77%) by thrips. Similarly, the Imitaf showed significantly the highest flower infestation reduction over

Table 1. Effect of different treatments bio-pesticides and chemical insecticide on the abundance of aphid in yard long bean at RARS, Jashore, in the kharif season of 2022 and 22-23

Treatments	Before spray Aphid population/ inflorescence	After first spray		After second spray		After third spray	
		Aphid population / inflorescence	% reduction of aphid population over control	Mean aphid population/ inflorescence	% reduction of aphid population over control	Mean aphid population/ inflorescence	% reduction of aphid population over control
Bio-catch (*Vertcillium lecani* 1.15 WP)	12.33ab	5.67b	52.75	3.00b	72.73	2.17b	78.30
Bio-power (*Beauvaria bassiana* 1.15 WP)	13.00ab	5.33bc	55.58	3.00b	72.73	2.00b	80.00
Bio-Magic (*Metarhizium anisopliae* 1.15 WP)	12.00ab	5.33bc	55.58	3.00b	72.73	1.83b	81.70
Bioclean (D- limonene 5%)	13.33a	6.00b	50.00	3.00b	72.73	2.00b	80.00
Imitaf (Imidacloprid 200 SL)	12.33ab	4.00c	66.67	2.00b	81.82	0.83c	91.70
Untreated control (Water spray)	11.67b	12.00a	-	11.00a	-	10.00a	-
CV%	6.83	13.30	-	9.60	-	5.30	-

Mean having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT.

T_1= spraying of Bio-catch (*Vertcillium lecani* 1.15 WP) @ 6 gL^{-1} of water, T_2= spraying of Bio-power (*Beauvaria bassiana* 1.15 WP) @ 6 gL^{-1} of water, T_3= spraying of Bio-Magic (*Metarhizium anisopliae* 1.15 WP) @ gL^{-1} of water, T_4= spraying of Bioclean (D- limonene 5%) @ 1 mlL^{-1} of water, T_5= spraying of Imitaf (Imidacloprid 200 SL) @ 0.5 mlL^{-1} of water, T_6= Control (Water spray only).

Table 2. Effect of different treatments bio-pesticides and chemical insecticide on the abundance of jassid in yard long bean at RARS, Jashore, in the kharif season of 2022 and 22-23

Treatments	Before spray Jassid population/ 5 leaves	After first spray		After second spray		After third spray	
		Jassid population/ 5 leaves	% reduction of Jassid population over control	Jassid population/ 5 leaves	% reduction of Jassid population over control	Jassid population/ 5 leaves	% reduction of Jassid population over control
Bio-catch (*Vertcillium lecani* 1.15 WP)	16.33a	8.00b	38.46	4.00b	68.43	2.67b	77.12
Bio-power (*Beauvaria bassiana* 1.15 WP)	15.33ab	7.33b	43.62	4.00b	68.43	2.67b	77.12
Bio-Magic (*Metarhizium anisopliae* 1.15 WP)	15.00abc	7.33b	43.62	3.83b	69.77	2.33b	80.03
Bioclean (D- limonene 5%)	14.33bc	7.00b	46.15	3.67b	71.03	2.67b	77.12
Imitaf (Imidacloprid 200 SL)	15.33ab	5.67c	56.38	2.67b	78.93	1.67b	85.69
Control (Water spray)	13.67c	13.00a	-	12.67a	-	11.67a	-
CV%	5.31	8.68	-	2.31	-	2.04	-

Mean having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT.

Table 3. Effect of different treatments bio-pesticides and chemical insecticide on the abundance of thrips in yard long bean at RARS, Jashore, in the kharif season of 2022 and 22-23

Treatments	Before spray thrips population/ inflorescence	After first spray		After second spray		After third spray	
		thrips population/ inflorescence	% reduction of thrips population over control	thrips population/ inflorescence	% reduction of thrips population over control	thrips population/ inflorescence	% reduction of thrips population over control
Bio-catch (*Vertcillium lecani* 1.15 WP)	8.00a	4.67b	39.11	3.33b	52.43	2.33b	69.62
Bio-power (*Beauvaria bassiana* 1.15 WP)	7.33a	4.67b	39.11	3.33b	52.43	2.33b	69.62
Bio-Magic (*Metarhizium anisopliae* 1.15 WP)	7.33a	4.33b	43.55	3.00b	57.14	2.33b	69.62
Bioclean (D- limonene 5%)	7.00ab	4.33b	43.55	3.33b	52.43	2.33b	69.62
Imitaf (Imidacloprid 200 SL)	5.67b	3.33b	56.58	2.33b	66.71	1.33b	82.66
Untreated control (Water spray)	7.00ab	7.67a	-	7.00a	-	7.67a	-
CV%	11.18	2.37	-	9.41	-	3.75	-

Mean having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT.

untreated control (80.24%) which was followed by Bio-Magic (76.07%) and Bio-power (72.90%), Bioclean (70.79), Bio-catch (68.80) by thrips. It is also observed that the Imitaf showed significantly the highest pod infestation reduction over untreated control (83.96%) which was followed Bio-Magic (78.50%) and Bio-power (76.85%) Bioclean (74.38), Bio-catch (74.18) by thrips.

Table. 4. Effect of different bio-pesticides and chemical insecticide in the flower and pod infestation of yard long bean by sucking insect pest at RARS, Jashore, during 2021-22 and 2022-23.

Treatments	(%) Flower infestation	(%) Flower infestation reduction over control	(%) Pod infestation	(%) Pod infestation reduction over control
Bio-catch (*Vertcillium lecani* 1.15 WP)	4.72b	68.80	4.08b	74.18
Bio-power (*Beauvaria bassiana* 1.15 WP)	4.10bc	72.90	3.65b	76.85
Bio-Magic (*Metarhizium anisopliae* 1.15 WP)	3.62cd	76.07	3.39bc	78.50
Bioclean (D- limonene 5%)	4.42b	70.79	4.04b	74.38
Imitaf (Imidacloprid 200 SL)	2.99d	80.24	2.53c	83.96
Untreated control (Water spray)	15.13a	-	15.77a	-
CV%	7.08		8.02	

Means having same letter(s) in a column are not significantly different at P>0.05 followed by DMRT

Results of the study on natural enemy population have been presented in Table 5. It was revealed that Imitaf showed the lowest number of natural enemy/plant (0.33) after first spray which was followed by Bio-catch (0.67), Bio-power (0.67) and Bio-Magic (0.67), Bioclean (1.00) whereas the untreated control plot recorded 2.33 natural enemy population. The highest per cent reduction of natural enemy/plant over untreated control (85.84%) was recorded from Imitaf followed by Bio-catch (71.24%) and almost similar result was found in Bio-Magic (71.24%), Bio-power (71.24%), Bioclean (57.08%) treated plot. After second spray, Imitaf recorded the lowest number of natural enemy/plant (00) which was followed by Bio-catch (0.33), Bio-Magic (0.33), Bio-power (0.67), Bioclean (0.67) treated plot whereas the untreated control plot recorded 2.00 natural enemy/plant. Zero reduce than of natural enemy/plant over untreated control (00) was found in Imitaf which was followed by Bio-catch (84%) and Bio-Magic (84%), Bio-power (67%), Bioclean (67%) treated plot. After third spray, the natural enemy/plant (00) was not found in Imitaf treated plot which was followed by Bio-Magic (00), Bio-power (0.67), Bio-catch (0.67) and Bioclean (1.00) sprayed plot. Similarly, in Bio-Magic and Imitaf sprayed plot didnot shown any natural enemy/plant (00). The highest per cent reduction of natural enemy over control was recorded from Bio-catch and Bio-power (60%) and followed by Bioclean (40%) sprayed plots.

Table 5. Effectiveness of different treatments in reducing natural enemy in yard long bean at RARS, Jashore, during 2021-22 and 2022-23.

Treatments	Before spray Natural enemy / plant	After first spray		After second spray		After third spray	
		Natural enemy / plant	(%) Reduction of natural enemy over control	Natural enemy / plant	(%)Reduction of natural enemy over control	Natural enemy / plant	(%)Reduction of natural enemy over control
Bio-catch (*Vertcillium lecani* 1.15 WP)	2.00a	0.67b	71.24	0.33b	84	0.67b	60.00
Bio-power (*Beauvaria bassiana* 1.15 WP)	1.33a	0.67b	71.24	0.67b	67	0.67b	60.00
Bio-Magic (*Metarhizium anisopliae* 1.15 WP)	2.00a	0.67b	71.24	0.33b	84	0.00b	00
Bioclean (D- limonene 5%)	1.67a	1.00b	57.08	0.67b	67	1.00b	40.00
Imitaf (Imidacloprid 200 SL)	1.33a	0.33b	85.84	0.00b	00	0.00b	00
Untreated control (Water spray)	2.00a	2.33a		2.00a		1.67a	-
CV%	3.96	4.76		2.46		6.24	-

Mean having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT.

Table 6. Effect of different different treatments on the yield of yard long bean at RARS, Jashore, during 2021-22 and 2022-23.

Treatments	Yield (t/ha)	Yield increase over control (%)
Bio-catch (*Vertcillium lecani* 1.15 WP)	7.18b	25.31
Bio-power (*Beauvaria bassiana* 1.15 WP)	7.17b	25.13
Bio-Magic (*Metarhizium anisopliae* 1.15 WP)	7.43b	29.67
Bioclean (D- limonene 5%)	7.03b	22.69
Imitaf (Imidacloprid 200 SL)	8.37a	46.07
Untreated control (Water spray)	5.73c	-
CV%	6.42	-

Mean having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT.

Table 7. Benefit cost analysis of different treatments of the yard long bean sucking insect pest at RARS, Jashore, during 2021-22 and 2022-23.

Treatments	Marketable yield (t/ha)	[1]Gross return (Tk/ha)	[2]Cost of treatment (Tk/ha)	Net return (Tk/ha)	Adjusted return (Tk/ha)	M BCR
Bio-catch (*Vertcillium lecani* 1.15 WP)	7.18b	287200	11110	276090	46890	4.22
Bio-power (*Beauvaria bassiana* 1.15 WP)	7.17b	286800	10650	276150	46950	4.41
Bio-Magic (*Metarhizium anisopliae* 1.15 WP)	7.43b	297200	10730	286470	57270	5.34
Bioclean (D- limonene 5%)	7.03b	281200	10620	270580	41380	3.90
Imitaf (Imidacloprid 200 SL)	8.37a	334800	11210	323590	94390	8.42
Untreated control (Water spray)	5.73c	229200	-	229200	-	-
CV%	6.42	-	-	-	-	-

[1]Farmgate price of yard long bean @ Tk. 40.00 per kg.

[2][Cost of Bio-catch: @Tk. 380100 ml^{-1}; Cost of Bio-power (*Beauvaria bassiana* 1.15 WP): @ Tk. 3000kg^{-1}; Cost of Bio-Magic (*Metarhizium anisopliae* 1.15 WP): @ Tk.2500Kg^{-1}; Cost of Bioclean (D- limonene 5%): @ Tk. 230100ml^{-1}; Cost of Imitaf (Imidacloprid 200 SL): @ Tk. 450100 ml^{-1}; Cost of spray: Three laborers/spray/ha @ Tk 550.00$labour^{-1}day^{-1}$; Cost of hand picking: Three laborers/ha @ Tk 550.00$labour^{-1}day^{-1}$; Spray volume required: 500Lha^{-1}].

Effect of different treatments on the yield of yard long bean have been presented in Table 6. It was indicated that the result showing significantly highest pod yield (8.37tha^{-1}) was recorded in Imitaf treated plot which was followed Bio-Magic

(7.43 tha^{-1}), Bio-catch (7.18 t ha^{-1}), Bio-power (7.17 tha^{-1}), Bioclean (7.03 tha^{-1}) whereas the lowest pod yield was found in untreated control (5.73 tha^{-1}) plot. Similarly, the highest yield increase over control was calculated from Imitaf (46.07%) followed Bio-Magic (29.67%), Bio-catch (25,31%), Bio-power (25.13%) and the lowest yield increase over control was obtained in Bioclean (22.69%).

The benefit-cost ratio (BCR) as worked out based on the expenses incurred and value of crops obtained from the treated plots for the control of aphids, jassid and thrips of yard long bean is given in Table 7. It is to be noted here that expenses incurred reffered to those only on pest control. It is revealed that the highest (8.42) marginal benefit-cost ratio (MBCR) was calculated from treatment Imitaf which was followed Bio-Magic (5.34), Bio-power (4.41), Bio-catch (4.22), Bioclean (3.90). So, considering MBCR, Imitaf may be recommended for effective management of aphids, jassid and thrips attacking yard long bean.

Conclusion

The results indicated that the chemical, insecticide Imitaf showed the best efficacy providing reduced infestation of the sucking insect pests with the higher yield and the highest MBCR. The biopesticide spraying of Bio-Magic offered second best performance, while the other bio-pesticides offered intermediate level of performance. The biopesticide, Bio-Magic may be used in IPM against the sucking insect pests of yard long bean.

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