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RESEARCH ARTICLE

PERFORMANCE OF SOME BIORATIONAL INSECTICIDES FOR SUPPRESSING BEAN APHID, APHIS CRACCIVORA KOCH

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ABSTRACT

The experiment was conducted in the field of Entomology, Bangladesh Agricultural University, Mymensingh to determine efficacy of bio-rational insecticides against bean aphid during September 2016 to April 2017.The experiment was laid out in randomized complete block design with 3 replications. Five sprayings were done at 15 days intervals where data were taken 3 days after each spray. The highest mean number of fruit/rachis (7.5) was observed in spinosad treated plants and the lowest number of fruit/rachis was found in control plants (4.17). After 2nd spray, the lowest mean number of aphids/rachis (3.83) was observed in Emamectin benzoate treated plants and the highest number of aphids/rachis (58.33) was found on Beauveria bassiana (66.50) treated plant which was higher than control plants (56.21). The lowest mean percentage of rachis infestation by aphid (10%) was observed in Emamectin benzoate treated plants while the highest percentage was found in control plants (35%). The highest mean number of fruit/rachis was observed in Karanja oil (7.83) treated plants and the lowest number of fruit/rachis was found in control plants (4.33). After 3rd spray, the lowest mean number of aphids/rachis (10.00) was observed in Emamectin benzoate treated plants while the highest number of aphids/rachis (76.50) was found on spinosad treated plant which was higher than control plants (67.21).But the highest mean number of fruit/rachis was observed in Karanga oil, Neem oil and spinosad treated plants, respectively. Among the selected insecticides, Emamectin benzoate, Karanja oil and Neem oil provided better protection of bean plants against bean aphid.

KEYWORDS

Bean, aphid, bio-pesticides, plant oils.

1. INTRODUCTION

Country bean, Lablab purpureus (Linn.) is a common and protein rich vegetable under the family Leguminosae. It is also known as Seem in Bangladesh, Hyacinth bean, Indian bean, Egyptian kidney bean and Bovanist bean (Rashid, 1999). It is widely cultivated mainly in the winter season in Bangladesh. The fresh pods and green seeds are eaten after boiling or used in curries. It contains appreciable amount of proteins, vitamins, calcium, phosphate, sulphur and sodium. Compared to animal protein they are very cheap, and readily available. The range of variation for crude fiber was 13.53 to 21.47%. Protein content of mature seeds varied from 23.99 to 35.51% while the range for carbohydrate was 28.18 to 48.41%. Lipid content varied from 0.76 to 1.93%. Crude fiber contents were lower than the corresponding values for tender pods and varied from 10.52 to 16.77% (Sarma et al., 2010). It also contains appreciable amount of thiamin, riboflavin, niacin, vitamin C and iron @ 0.1, 0.06, 0.7, 9.0, and 41.7 mg/100g, respectively (Rehana, 2006).

There is a great demand for both young pods and mature seeds among the people of Bangladesh, irrespective of rich and poor. Its cultivation is widespread ranging from homestead to the road side areas, borders of agricultural fields. Country bean is one of the income generating crop. Besides, it is important as the plant fixes the atmospheric nitrogen. Crop residues of legumes contain some of the N that they have fixed, and this becomes available to subsequent crops. This crop is also important for its atmospheric nitrogen fixation (Kalra, 1979). The country bean has potential for export both fresh and frozen. In spite of being a prospective crop, high incidence of insect pests decrease the yield and quality of country bean in Bangladesh.

Among sucking insect pests, aphid is one of the major limiting factors for reducing the yield of country bean due to feeding plant's phloem sap (Soffan and Aldawood, 2014). More than 5000 aphid species have been recorded of which about 450 species are from crops and vegetables and only about 100 of them are very destructive to many agricultural and horticultural crops worldwide, including Bangladesh (Blackman and Eastop, 2007). Both nymphs and adults of aphid suck phloem sap from the infested plants, while feeding they inject a toxin along with the salivary secretion into host plants. They also excrete honeydew on which sooty moulds develop which interferes with the photosynthetic ability of plants (Rizkalla et al., 1994). In addition, the pest may act as vectors for more than 50 plant viruses such as bean common mosaic virus, bean leaf roll

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virus, cucumber mosaic virus, broad bean yellow mosaic virus, etc. (Smith and Boyko, 2007; Soffan and Aldawood, 2014).

Indiscriminate use of synthetic chemicals causes hazards to human beings through food chain (Nafees and Jan, 2009). This results in serious contamination of different component of environment (surface water, aquifers, soil, air etc.) including human, wildlife and other organisms. Further, A. craccivora has also developed resistance towards many synthetic insecticides. Therefore, it is urgently needed to develop an eco-friendly and appropriate management strategy. There have been a large number of plant-products, which possess pesticidal properties and have been used successfully for controlling various pests in field and laboratory conditions (Bajpai and Sehgal, 2000; Pedigo, 2002). Bioefficacy of some biorational insecticides for the control of aphid (Aphis gossypii) on greenhouse grown cucumber has been proved to be more promising than any other conventional insecticides (Emami, 2016). Biorational pesticides showed high efficacy against aphid (Toxoptera aurantii) and effectively control aphid population (Sohail et al., 2012). Ghanim and Abdel Ghani who reported the use of plant extract to control the population of A. gossypii in an environmentally friendly way (Ghanim and Abdel Ghani, 2014). However, research work with bio-rational insecticides against bean aphid is scanty in Bangladesh. Considering the hazardous impact of chemical insecticides, the present research is planned to assess the efficacy of different bio-rational insecticides against aphid which is risk free, eco-friendly, and highly selective to target insect pest.

2. Materials And Methods

The experiment was conducted in the Field Laboratory, Department of Entomology, Bangladesh Agricultural University, Mymensingh during June, 2016 to April, 2017. The study area is situated at 24.750 N latitude and 90.500 E longitudes with an elevation of 18 meter from the mean sea level. The experiment was laid out following Randomized Complete Block Design (RCBD) with 3 replications. The land was divided Into 2 blocks, each block contains 8 plots. Thus, there were 24 unit plots altogether in the experiment. Each plot contained 3 plants, where plant to plant distance was 40 cm. The size of individual plot was 4 m2 (2m x 2m). The distance between two unit plots was 0.6 m. and between block to block was 1 m. Standard dosages of cow dung and fertilizers were applied as recommended in Fertilizer Recommendation Guide (2012). All of TSP, MOP and cowdung; and half amount of Urea were applied in the fields uniformly during final land preparation. Remaining half urea was applied during 25-30 days after planting under moist soil condition and mixed thoroughly with the soil as soon as possible for better utilization. The seed of year round country bean variety (IPSA seem 2) was purchased from the seed store of Notun bazar, Sadar, Mymensingh. Seeds were sown at the rate of 6 seed per Plot on 10 September 2016. After establishing seedling, irrigation water was provided in all the plots as and when needed. Propping of each plant by bamboo sticks was provided to facilitate creeping of the plants and to avoid their lodging. Trellis was built by bamboo sticks vertically using GI wire for support and to allow normal creeping. The bamboo sticks were 2 meter high from ground level. There were 8 treatments viz., T1= Neem oil @ 20 ml /L water, T2= Mahogany oil @ 20 ml /L water , T3= Karanja oil @ 20 ml /L water, T4= Lufenuron @ 1 ml /L water, T5= Beauveria bassiana @ 10 g /L water, T6= Spinosad @ 0.4 ml /L water, T7= Emamectin benzoate @ 1 g/L water and T8= Untreated control. Different treatments for managing bean aphid such as botanical oils, microbial derivatives were prepared by taking insecticides into plastic bottle with addition of distilled water. The insecticides were applied against bean aphid from the flowering stages of plants. A total of 5 sprays of each treatment were given at 15 days of interval. First of all, a single plant was tagged and then number of aphid rachis-1, flower-1and fruit-1 was counted with naked eye. Data were collected at 3 days intervals after each spraying of treatments. The infestation of the aphid was observed through visual observation. The collected data were properly compiled and tabulated for statistical analysis. Analysis of variance (ANOVA) was calculated by R statistics software and the mean differences among the treatments were adjusted with Duncan's Multiple Range Test (DMRT).

3. Results And Discussion

3.1 Effectiveness of treatments on mean number of aphid per rachis

Effectiveness of treatments on mean number of aphid per rachis at before spraying and after different sprayings is presented in Table 1. The pre-treatment data showed variation on the mean number of aphid per rachis among different treatments. After 1st spray, significantly the lowest number of aphid per rachis was found in T1 (4.50) and T5 (4.50) treated plots which were identical and was followed by T7 treated plot (9.66), T2 (11.67), T3 (12.00) and T6 (12.99) treated plots. The highest number of aphid/rachis was recorded in untreated control plot (64.83) followed by T4 (22.33) treated plot. After 2nd spray, significantly the lowest number of aphid per rachis was found in T1 (3.34) treated plot which was statistically similar to T5 (3.83) treated plots followed by T7 treated plot (7.67), T2 (8.67), T6 (10.84) T3 (11.17) and T4 (17.84) treated plots. The highest number of aphid/rachis was recorded in untreated control plot (71.67). After 3rd spray, significantly the lowest number of aphid per rachis was found in T1 (2.50) treated plot which was statistically similar to T5 (2.83) treated plots followed by T2 (6.00) and T7 (6.00) treated plots which are statistically identical.

The intermediate level of aphid population was recorded in T6 (7.50) followed by T3 (8.67) and T4 (14.34) treated plots. The highest number of aphid/rachis was recorded in untreated control plot (84.00). After 4th spray, significantly the lowest number of aphid per rachis was found in T5 (1.50) treated plot which was statistically similar to T1 (1.81) treated plots. The highest number of aphid/rachis was recorded in untreated control plot (124.34). After 5th spray, significantly the lowest number of aphid per rachis was found in T5 (1.00) treated plot followed by T1 (1.84) treated plots followed by T7 treated plot (3.00), T2 (3.84), T6 (4.67), T3 (4.83) and T4 (6.67) treated plots. The highest number of aphid/rachis was recorded in untreated control plot (153.32). From this table it was evident that the population of aphid gradually decreased with increasing the number of sprayings but the number of aphid gradually increased in untreated control plots up to the period of 5th spraying.

Table 1: Effectiveness of treatments on mean number of aphid per rachis at before spraying and after different sprayings.

Treatment	Before spray	After 1st spray	After 2nd spray	After 3rd spray	After 4th spray	After 5th spray
T1	20.84	4.50d	3.34d	2.50d	1.81d	1.84b
T2	25.50	11.67c	8.67c	6.00c	5.60c	3.84bc
T3	33.67	12.00c	11.17c	8.67c	6.00c	4.83b
T4	51.17	22.33b	17.84b	14.34b	11.34b	6.67b
T5	9.17	4.50d	3.83d	2.83d	1.50d	1.00c
T6	40.34	12.99c	10.84c	7.50c	6.83c	4.67bc
T7	21.17	9.66c	7.67c	6.00c	5.50c	3.00bc
T8	58.33	64.83a	71.67a	84.00a	124.34a	153.32a
LSD		4.16	3.78	3.11	2.68	3.69
CV (%)		7.52	9.36	7.12	10.67	11.42

Values are average of three replications. In a column means having dissimilar letter (s) differ significantly at 5 % level of probability.

T1= Neem oil @ 20 ml /L water, T2= Mahogany oil @ 20 ml /L water, T3= Karanja oil @ 20 ml /L water, T4= Lufenuron @ 1 ml /L water, T5= Beauveria bassiana @ 10 g /L water, T6= Spinosad @ 0.4 ml /L water, T7= Emamectin benzoate @ 1 g/L water and T8= untreated control.

3.2 Number of aphid per rachis in bean plants after 1st, 2nd and 3rd sprays

Number of aphid per rachis after 1st, 2nd and 3rd sprays of biorational insecticides presented in Fig. 1. After 1st spray, the lowest mean number of aphids/rachis (9.21) was observed in Emamectin benzoate treated plants followed by Neem oil (20.83), Beauveria bassiana (21.17) and Mahogany oil (25.50) while the highest number of aphids/rachis (58.33) was found on Lufenuron which was higher than control plants (51.17) followed by spinosad (40.33) and Karanja oil (33.67). After 2nd spray, the lowest mean number of aphids/rachis (3.83) was observed in Emamectin benzoate treated plants followed by spinosad (15.83), Mahogany oil

(23.67) and Neem oil (33.33) while the highest number of aphids/rachis (58.33) was found on Beauveria bassiana (66.50) treated plant which was higher than control plants (56.21) followed by Karanja oil (54.17) and Lufenuron (49.83).After 3rd spray, the lowest mean number of aphids/rachis (10.00) was observed in Emamectin benzoate treated plants followed by Neem oil (10.50), Mahogany oil (24.00) and Karanja oil (30.67) while the highest number of aphids/rachis (76.50) was found on spinosad treated plant which was higher than control plants (67.21) followed by Lufenuron (66.33) and Beauveria bassiana (35.83).From this figure it was evident that Emamectin benzoate was effective after 3 sprays followed by neem oil and Mahogany oil but spinosad was effective after 2 sprays and Beauveria bassiana was only effective up to 3-4 days after 1st spray of insecticides.

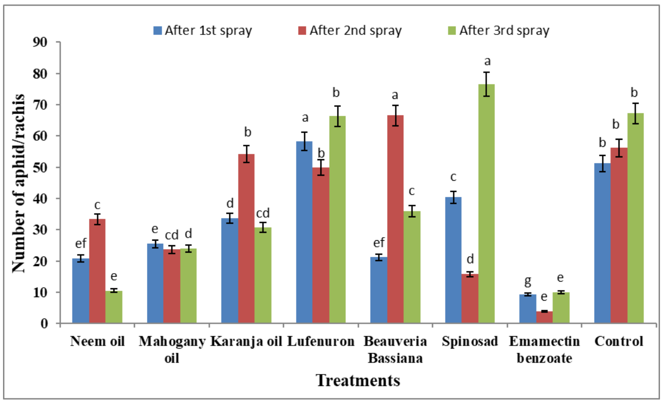

Figure 1: Efficacy of biorational insecticides on the number of aphid in country bean

3.3 Percentage of rachis infestation by aphid in bean plants after 1st, 2nd and 3rd sprays

Mean percentage of rachis infestation by aphid after 1st, 2nd and 3rd sprays of biorational insecticides presented in Fig. 2. After 1st spray, the lowest mean percentage of rachis infestation (20%) by aphid was found in Emamectin benzoate treated plants followed by Neem oil (25%), Mahogany oil (30%) and Beauveria bassiana (35%) while the highest percentage of rachis infestation was found in control plants (45%) which was identical to Spinosad (45%) and Lufenuron (45%) followed by Karanja oil (40%). After 2nd spray, the lowest mean percentage of rachis infestation by aphid (10%) was observed in Emamectin benzoate treated plants which was identical to spinosad (10%) followed by Mahogany oil (20%) and Beauveria bassiana (20%) while the highest percentage was found in control plants (35%) followed by Neem oil (30%), Karanja oil (25%) and Lufenuron (25%) treated plants.After 3rd spray, the lowest mean percentage of rachis infestation by aphid (10%) was observed in Emamectin benzoate treated plants which was identical to spinosad (10%) followed by Mahogany oil (15%), Neem oil (20%), and Karanja oil (20%) while the highest percentage was found in control plants (40%) followed by Lufenuron (25%) which was identical to Beauveria bassiana (25%).

From this figure it was evident that Emamectin benzoate was the most effective against aphid after each spray followed by spinosad where neem oil and Mahogany oil was also effective after 3rd sprays.

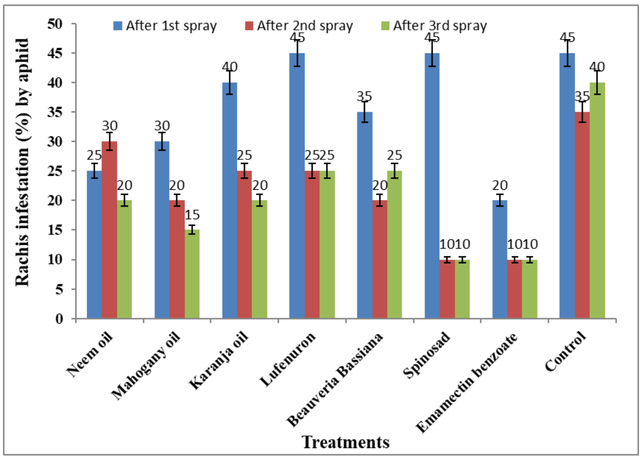

Figure 2: Efficacy of biorational insecticides on rachis infestation by aphid in country bean

3.4 Number of fruit per rachis in bean plants after 1st, 2nd and 3rd sprays

Number of fruit per rachis after 1st, 2nd and 3rd sprays of biorational insecticides presented in Figure 3. After 1st spray, the highest mean number of fruit/rachis (7.5) was observed in spinosad treated plants followed by Emamectin benzoate (6.5), Karanja oil (6.33) and Neem oil (5.83) and Lufenuron (5.67) while the lowest number of fruit/rachis was found in control plants (4.17) followed by Beauveria bassiana (4.83) and Mahogany oil (5.33).After 2nd spray, the highest mean number of fruit/rachis was observed in Karanja oil (7.83) treated plants followed by spinosad (6.67) which was identical to that of Mahogany oil (6.67) followed by Emamectin benzoate (6.33) and Lufenuron (6) while the lowest number of fruit/rachis was found in control plants (4.33) followed by Beauveria bassiana (5) and Neem oil (5.67). After 3rd spray, the highest mean number of fruit/rachis was observed in Neem oil (7.67) treated plants followed by Emamectin benzoate (7.33) and Spinosad (7.17) and while the lowest number of fruit/rachis was found in control plants (4.2) followed by Beauveria bassiana (5), Mahogany oil (5.17), Karanja oil (5.33) and Lufenuron (5.67).

From this figure it was evident that neem oil, Karanja oil, spinosad and Emamectin benzoate were effective after 3 sprays for the highest number of fruits per rachis.

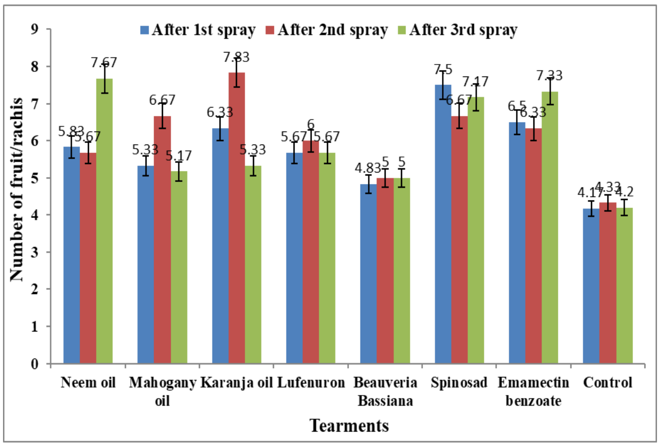

Figure 3: Effectiveness of biorational insecticides on fruit production of country bean

For several reasons of using synthetic chemical insecticides for managing insect pest, there is an immediate requirement to introduce and popularise natural, safe pest management products, mainly from plant and microbial sources, for use against insect pests, especially Aphis craccivora (Ahmed et al., 2020). In the present experiment, emamectin benzoate, karanja oil, neem oil and spinosad were effective on bean aphids which were similar to previous findings (Morshed et al., 2023). Similar findings were also found by who reported the treatment with Abamectin 1.9 EC @ 3 g a.i./ha and Spinosad 45SC @ 125 g a.i./ha, were found effective for controlling aphids, thrips, and whiteflies on tomato plants (Gaikwad et al., 2014). Microbial biopesticides are effectively incorporated as a component of IPM programs for successful control of different insects of different crops (Wraight et al., 2000; Singh and Kaur 2020). A group researchers also observed the effectiveness of Abamectin in aphids, thrips and mites, by using Abamectin 1.8EC @ 0.5ml/l, Thiamethoxam 25WG @ 1g/l, Diafenthiuron 50WP @ 0.75g/l (Sujay et al., 2012). In the present study the biorational insecticides Abamectin, Spinosad, Neem oil and Emamectin benzoate were found promising to reduce the aphid infestation in the field. Similar results were found by who used 1.8% Abamectin, 25% Imidacloprid, 2.5% Lamda-cyhalothrin powder, 25% Pymetrozine, 5% Pyrethrin, 1% Matrina water and reported that from Abamectin about 98.90% protection was found against aphid (Sun et al., 2013). A group researcher also revealed that Abamectin, Azadirachtin and the Detergent provided better performance against aphid, A. craccivora, whitefly and spider mite (Saad et al., 2007).

4. Conclusion

The use of bio-rational insecticides as an alternative to synthetic pesticides due to its environmental safety, toxicity against sucking pests and is particularly for aphid control. From this experiment it may be concluded that Emamectin benzoate, Karanja oil and Neem oil were very effective for the management of bean aphid.

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