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Eco-friendly management approach to control cabbage flea beetle in Jashore region of Bangladesh

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Abstract

The experiment was conducted during *rabi* season 2018-19 and 2019-20 at Regional Agricultural Research Station Jashore to develop a bio-rational based sustainable management approach to control flea beetle of cabbage. The experiment was laid out in a randomized complete block design with three dispersed replications. Cabbage seedlings were transplanted on 10th November 2018 and 11th November 2019, respectively. The experiment was five different treatments with one control treatment viz. T_1 = White color sticky trap + Matrin (Biotrine 0.5% @ 1ml/L of water) @ 1ml/L of water, T_2 = Spraying of Antario @1.0 ml/L of water, T_3 = Alternate spraying of fizimite and Antario @ 1ml/L of water, T_4 = Spraying of Bio-clean (D-Lemonine 5% SL) + application of recharge @ 3gm/L of water, T_5 = Spraying with Nitro 505EC (Chlorpyriphos + Cypermethrin) @ 2.0 ml/L of water and T_6 = Untreated control. The whole plant was thoroughly covered by spray emulsion. The lowest number of flea beetle (14.59 in 2018-19 and 10.33 in 2019-20) was found in the treatment T_5 (Spraying with Nitro 505EC (Chlorpyriphos + Cypermethrin) @ 2.0 ml/L of water) and highest (35.76 in 2018-19 and 42.53 in 2019-20) in control (T_6) treatment. The lowest percent of head infestation of cabbage was also recorded in T_5 treatment (14.03% in 2018-19 and 5.10% in 2019-20) and the highest in T_6 treatment (27.61% in 2018-19 and 23.69% in 2019-20). The highest yield (33.40 t/ha in 2018-19 and 32.49 t/ha in 2019-20) was recorded from T_5 treatment and the lowest (26.87 t/ha in 2018-19 and 24.78 t/ha in 2019-20) in control (T_6) treatment in both the year. On an average, 16.55-20.33 flea beetle were captured in yellow sticky trap per week in both the year. The highest gross margin (438466 Tk.//ha in 2018-19 and 262366 Tk.//ha in 2019-20) was also observed in the T_5 treatment in both the year and the lowest (342916 Tk.//ha in 2018-19 and 187666 Tk.//ha in 2019-20) in untreated control (T6) treatment. Finally, the results revealed that the treatment T_5 was more profitable compared to other approaches as well as the highest crop yield with marginal benefit cost ratio.

Key words: Cabbage, flea beetle, eco-friendly management, yield, economics

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Introduction

Cabbage (*Brassica oleracea* var. capitata) is an important and popular winter leafy vegetables in Bangladesh (Jany *et al.*, 2008). It is also one of the five best vegetables in the world (Rashid, 1999). The taste

in cabbage is due to the "Sinigrin glucoside" and it is rich in minerals and vitamin A, B1, B2, and C (Singh *et al.,* 2004). Cabbage have nice impressive health benefits. Many studies have suggested that increasing consumption of plant-based foods like cabbage decreases the risk of diabetes, obesity, heart disease, and overall mortality. It can also help promote a healthy complexion, increased energy, and overall lower weight (Ware, 2017). The average yield of cabbage in Bangladesh is low (16.8 t/ha) compared to other countries of the world (BBS, 2017). The reason of lower yield is due to the attack of some insect pests in Cabbage. Although integrate management of insect pests in vegetables were studied by different research group in Bangladesh where pesticide use frequencies during vegetable production, pheromone traps, pesticide residues in vegetables, metal contents in vegetables and their management etc. were reported (Islam *et al*., 2020; Yeasmin *et al*., 2019; Uddin *et al.*, 2015; Islam *et al.*, 2015a; Islam *et al.*, 2015b; Islam and Ando, 2012; Islam, 2012). Flea beetle (*Phyllotreta spp*.) considered as the major insect pest of Brassicaceae crop (Mayoori and Mikunthan, 2009) all over the world along with Bangladesh. Flea beetle (*Phyllotreta striolata*) damages cabbage quickly at large scale. Flea beetle (*Phyllotreta cruciferae*) is now becoming a major insect pest of cabbage now-a-days. The adult beetles do the damage. Adults are 3–5 mm long, metallic blue-black or light brown and are often seen crawling over trailer loads of rapeseed at harvest. They have long antennae, large hind legs and jump when disturbed. The larvae are white with numerous, very small, dark spots on the back, a black head and tail and three pairs of dark legs. When fully grown, they can reach 6 mm in length. It damages cabbage quickly at large scale. Adult feeding can be seen as characteristic shot-holing of the leaves. Plants infested with larvae lose vigour, becoming stunted, and die if the infestation is severe. Farmers are applying foliar application of broad-spectrum insecticides indiscriminately in an attempt to control those pests. Such pesticide use, besides being costly, detrimental to the environment and human health, is degrading the natural resource base by destroying the predators and parasitoids. Considering the above facts, the present study has been designed to develop a bio-rational based sustainable management approach for the major insect pests of cabbage.

Materials and Methods

The experiment was conducted during *rabi* (November to April) season 2018-19 and 2019-20 at Regional Agricultural Research Station, Jashore. The experiment was laid out in a randomized complete block design with three dispersed replications. Cabbage seedlins were transplanted on 10th November 2018 and 11th November 2019. The unit plot size was 5 m x 4 m with 50 cm row to row and 40 cm plant to plant distance. The fertilizers were applied at recommended doses @ 300, 200, 250 kg ha^{-1} of urea, triple super phosphate (TSP), muriate of potash (MoP) and 5 t ha^{-1} cow dung. All cowdung, TSP and ½ MoP was applied at final land preparation. Rest of MoP and whole urea was applied in 3 equal splits at 10 DAT, 25 DAT and heading stage. The normal intercultural operations were done as and when necessary. The treatments were as follows: T_1 = White color sticky trap + Matrin (Biotrine 0.5% @ 1ml/L of water) @ 1ml/L of water, T_2 = Spraying of Antario @1.0 ml/L of water, T_3 = Alternate spraying of fizimite and Antario @ 1ml/L of water, T_4 = Spraying of Bio-clean (D-Lemonine 5% SL) + application of recharge @ 3gm/L of water, T_5 = Spraying with Nitro 505EC (Chlorpyriphos + Cypermethrin) @ 2.0 ml/L of water and T_6 = Untreated control. The whole plant was thoroughly covered by spray emulsion. Number of healthy and infested heads were counted and recorded from randomly selected 2m^2 area of each treatment replicates at 7 days' interval. Treatment wise percent head infestation was calculated from the pooled data of fives observations. Number of flea beetle were counted and recorded from five randomly selected heads at 7 days' interval. And number of flea beetle captured by yellow sticky trap were counted at 7 days' interval.

Results and Discussion

***Effect of treatment packages against flea beetle during 2018-19*:** The effects of different treatment on cabbage against flea beetles are presented in Table 1. The lowest number of flea beetle was found in T_5 treatment (14.59) used Nitro 505 EC (Chlorpyriphos + Cypermethrin) @ 2.0 ml/L of water and the highest number of flea beetle of cabbage in control (T_6) treatment (35.76). The lowest percent of head infestation of cabbage was recorded in the same T_5 treatment (14.03%) and the highest in T_6 treatment (27.61%). The significant highest head yield of cabbage (33.40 t/ha) was recorded from T_5 treatment followed by T_4 (33.18 t/ha) and T_3 (32.33 t/ha) treatment and the lowest in control plot (26.87 t/ha). On an average 16.55 flea beetle were captured in yellow sticky trap per week. The lowest number of flea beetle infestation and % head infestation recorded in T_5 treatment mainly due to the proper control of flea beetle of cabbage by spraying of Nitro 505EC @ 2 ml/L of water, resulted the highest head yield (33.40 t/ha).

Table 1. Effect of different treatment packages on cabbage against flea beetle during 2018-19.

Treatments	No. of flea beetle/5 head/plot	% Head infestation	Yield (t/ha)	No. of adult flea beetle captured/sticky trap/week
T_1	25.52	23.47	29.08	16.55
T_2	22.26	21.33	31.36	-
T_3	21.24	21.74	32.33	-
T_4	16.86	15.10	33.18	-
T_5	14.59	14.03	33.40	-
T_6	35.76	27.61	26.87	-
LSD $_{(0.05)}$	2.29	2.87	1.92	-
CV (%)	5.53	7.67	3.22	-

*T_1 = White color sticky trap + Matrin (Biotrine 0.5% @ 1ml/L of water) @ 1ml/L of water, T_2 = Spraying of Antario @1.0 ml/L of water, T_3 = Alternate spraying of fizimite and Antario @ 1ml/L of water, T_4 = Spraying of Bio-clean (D-Lemonine 5% SL) + application of recharge @ 3gm/L of water, T_5 = Spraying with Nitro 505EC (Chlorpyriphos + Cypermethrin) @ 2.0 ml/L of water and T_6 = Untreated control.

***Effect of treatment packages against flea beetle during 2019-20*:** There was a significant effect of different treatment on cabbage against flea beetles (Table 2). As in 2018-19, the lowest number of flea beetle (10.33) and head infestation (5.10%) was found in T_5 treatment and the highest in control (T_6) treatment (no. of flea beetle 42.53 and head infestation 23.69 %). The significant highest head yield of cabbage (32.49 t/ha) was recorded from T_5 treatment, similar to T_4 (32.14 t/ha) treatment and the lowest in control (T_6) treatment (24.78 t/ha). On an average, 20.33 flea beetle were captured in yellow sticky trap per week. The number of flea beetle and head infestation was 29 and 64% lower in the second year (2019-20) compared to the first year (2018-19) in T_5 (Spraying with Nitro 505EC (Chlorpyriphos + Cypermethrin) @ 2.0 ml/L of water) treatment. Finally, the head yield of cabbage was similar in T_5 treatment both in the year.

***Economic Analysis*:** Economic analysis for the management of flea beetle on cabbage was calculated in both the year (Table 3 and 4). In 2018-19, the results revealed that the highest gross return (501000 Tk./ha) and gross margin (438466 Tk./ha) recorded from the

treatment T_5 and the lowest gross return (403050 Tk./ha) and gross margin (342016 Tk./ha) was in T_6 (control) treatment. The region of highest gross margin in T_5 treatment mainly due to the significantly highest head yield of cabbage. As a result, the highest (40.8) marginal benefit cost ration (MBCR) was observed in T5 (Spraying with Nitro 505EC (Chlorpyriphos + Cypermethrin) @ 2.0 ml/L of water) treatment over the control (T_6) treatment.

Table 2. Effect of different treatment packages on cabbage against flea beetle during 2019-20.

Treatments	No. of flea beetle/5 head/plot	% Head infestation	Yield(t/ha)	No. of adult flea beetle captured/sticky trap/week
T_1	30.06	18.39	27.86	20.33
T_2	27.53	16.40	29.86	-
T_3	33.13	20.76	30.87	-
T_4	22.40	12.33	32.14	-
T_5	10.33	5.10	32.49	-
T_6	42.53	23.69	24.78	-
LSD $_{(0.05)}$	6.569	1.331	0.758	-
CV (%)	13.05	4.61	1.41	-

*T_1 = White color sticky trap + Matrin (Biotrine 0.5% @ 1ml/L of water) @ 1ml/L of water, T_2 = Spraying of Antario @1.0 ml/L of water, T_3 = Alternate spraying of fizimite and Antario @ 1ml/L of water, T_4 = Spraying of Bio-clean (D-Lemonine 5% SL) + application of recharge @ 3gm/L of water, T_5 = Spraying with Nitro 505EC (Chlorpyriphos + Cypermethrin) @ 2.0 ml/L of water and T_6 = Untreated control.

Table 3. Economic analysis of different management tactic against flea beetle of cabbage during 2018-19.

Treatments	Yield (t/ha)	Gross return (Tk/ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR
T_1	29.08	436200	65424	370776	6.27
T_2	31.36	470400	65734	404666	12.0
T_3	32.33	484950	65734	419216	14.6
T_4	33.18	497700	64734	432966	20.6
T_5	33.40	501000	62534	438466	40.8
T_6	26.87	403050	60134	342916	-

Cost of relevant materials or activities: [1]Farmgate price of cabbage @ Tk. 15.00 per kg [Cost of Azadirechtin (Bio-neem plus 1EC) @ 230Tk/100ml, Ripcord 10EC @ 110Tk/100ml, Nitro (Chloropyriphos + Cypermethrin) @ 150Tk/100ml, Ascend @ 250Tk/100ml, Autostin @ 35Tk/10g, Yellow sticky trap @ 35Tk/trap; Cost of spray: Two labours/spray/ha @ Tk 300/labour/day, Spray volume required: 500L/ha].

Similarly, in 2019-20, the highest gross return was recorded in the T5 treatment (324900 Tk./ha) and the lowest in T6 (247800 Tk./ha) treatment. The highest gross margin (262366 Tk./ha) was also observed in the same T_5 treatment and the lowest (187666 Tk./ha) in T_6

treatment. Finally, the highest MBCR (32.1) was in T_5 treatment over the control (T_6) treatment.

Table 4. Economic analysis of different management tactic against flea beetle of cabbage during 2019-20.

Treatments	Yield (t/ha)	Gross return (Tk/ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR
T_1	27.86	278600	65424	213176	5.82
T_2	29.86	298600	65734	232866	9.1
T_3	30.87	308700	65734	242966	10.9
T_4	32.14	321400	64734	256666	16.0
T_5	32.49	324900	62534	262366	32.1
T_6	24.78	247800	60134	187666	-

Cost of relevant materials or activities: [1]Farmgate price of cabbage @ Tk. 10.00 per kg [Cost of Azadirechtin (Bio-neem plus 1EC) @ 230Tk/100ml, Anterio 330 Tk /100ml, Fizimite 400Tk/100ml, Biotrine 350 Tk/100ml, Recharge 160 Tk/100gm, Nitro (Chloropyriphos + Cypermethrin) @ 150Tk/100ml, Yellow sticky trap @ 35Tk/trap; Cost of spray: Two labours/spray/ha @ Tk 300/labour/day, Spray volume required: 500L/ha].

Conclusion

From the above results it may be concluded that the treatment T_5 (Spray of Nitro (Chloropyriphos + Cypermethrin) @ 1ml/L of water) was more effective against flea beetle of cabbage in respect of reducing the number of flea beetle and head infestation as well as the highest head yield with the highest economic return.

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