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FIELD EFFIECY OF BIOPESTICIDES AGAINST *Epilachna dodecastigma* (COLEOPTERA: COCCINELLIDAE) ON PUMPKIN

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ABSTRACT

Epilachna beetle *Epilachna dodecastigma* (Wied.) is a destructive pest on cucurbit in many parts of the world. The experiment was conducted to evaluate the field efficacy of five biopesticides in the Entomology field laboratory of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh during March to October 2017. Five treatments of three concentrations as Bioneem plus 1.0 EC and Ecomec 1.8 EC @ 0.05%, 0.10% and 0.15% while oils of neem, karanja and castor @ 5%, 7.5% and 10% were applied. The effectiveness of the treatments against the epilachna beetle was evaluated on the basis of percent reduction of beetle population at 24, 48, 72 and 120 hours after treatments (HATs). The number of beetle population decreased soon after spray but with increasing time the number of beetle population was also increased. However, among the treatments ecomec 1.8 EC at 0.15% concentration proveded the best results upto 67.2% beetle population reduction followed by Bioneem plus 1.0 EC after 120 HATs as compared to control. The highest number of fruits (9.3) was harvested at 0.15% concentrated Ecomec 1.8 EC treated plot as 62.4 kg while the lowest in the control treatments. Therefore, being biopesticides having less or no hazard on human health and environment they might be incorporated for safe control of *E. dodecastigma* on pumpkin in field conditions.

Keywords: *Epilachna dodecastigma*, biopesticides, field efficacy, yield, sweet gourd

Introduction

Among the vegetable pests the epilachna beetle viz*., Epilachna dodecastigma* (Wied.) is quite common a destructive insect of cucurbits in Bangladesh (Khan *et al*. 2000). It is widely distributed throughout the country and causes extensive damage to crops (Anam *et al*. 2006, Rahaman *et al*. 2008). Both the grubs and adults scrap the chlorophyll of the leaves, skeletonize, present a lace like appearance, and later on the leaves dry up and fall off (Endo *et al.* 2004). Nowadays, this insect is controlled by conventional insecticides of organophosphates and synthetic pyrethroids for quick knock down but having serious drawbacks (Liu *et al.* 2003, Khursheed and Raj 2013).

Sweet gourd, *Curcurbita moschata*, is one of the largest used edible vegetables cultivated worldwide (Prasad *et al.* 2008). It is renowned due to their unique medicinal properties and enriches of ß-carotene, vitamin A and C, phenols, flavonoids, amino acids and carbohydrates (Wang *et al.* 2002, Zhang *et al.* 2002). The antioxidants is believed to be achieved through several possible mechanisms by stimulating enzymatic defense system to health (Zhou and Yu 2004). Considering the significance of this pest in pumpkin and ill-effects of using chemicals, an attempt was made to find out the field efficacy of some biopesticides such as Ecomec 1.8 EC, Bioneem plus 1.0 EC, and oils of castor, karanja and neem against the epilachna beetle.

Materials and Methods

The experiment was conducted in the Entomology Field Laboratory of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur during March to August 2017. The soil of the experimental site was medium high land with silty clay in texture having 50.8% sand, 32.4% silt, 16.8% clay and p^H 6.13 belongs to the Old Himalayan Piedmont Plain of Agro Ecological Zone (AEZ-1).

Cultivation of sweet gourd: Healthy sweet gourd *Cucurbita moschata* seeds were collected from the local market and the seedlings were raised in the poly bags (6 × 8 cm^2). The seedlings were transferred into the main field at 4-5 leaves stage of one seedling per pit (45 × 45 × 40cm^3). The field experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 replications. The whole experimental plot (33.5 L × 8 W m) was divided into 3 equal blocks. Each block was divided into 16 plots, thus there were 48 plots. The size of a unit plot was 2 m × 2 m. Distance maintained 0.5 m between blocks while 0.5 m between the plots to facilitate different intercultural operations. Cowdung and other chemical fertilizers were applied according to the fertilizer recommendation guide (FRG 2012). Intercultural operations were done as and when necessary.

Treatments: Five different treatments as oils of neem (*Azadirachta indica*), castor (*Ricinus communis*), karanja (*Nigella sativa*) and two biopesticides of Bioneem plus 1.0 EC, Abamectin (Ecomec 1.8 EC) were collected from the local market of Dinajpur town for assay. Three doses of 5, 7.5 and 10% of each oil while 0.05%, 0.10% and 0.15% for biopesticides were prepared separately. A single drop of tween-20 was added as an emulsifier only for oils treatments and mixed properly before application. Seedlings of sweet gourd were observed daily. Treatments were applied on the plants by using hand sprayer (2 L) when the plants were infested by epilachna beetle.

Data collection: Data were recorded after 1st spray by visual observation. Second and third sprays were initiated at each 15 days after first and second spray. Plants were randomly selected and tagged from each plot at different growth stages. The effect of biopesticides on epilachna beetle was determined by counting the number of epilachna beetle/plant at pre and post (24, 48, 72 and 120 hours after treatments (HATs). The percent reduction of adult epilachna beetle/plant was calculated as stated by Podder *et al.* (2013). Reduction (%) = $(P_r\text{-}P_o)/P_r \times 100$, Where, Pr = Pre count $plant^{-1}$, P_o= Post count $plant^{-1}$. The fruits were harvested from the field while matured and recorded the number and weight of fruit per plot. The fruits yield was measured with the help of electric balance (model: ACS-C6) as Japan standard.

Statistical analysis

The effects of the treatments on the number of epilachna beetle reduction and yield were determined using multivariate analysis with the help of IBM SPSS Statistics version 25.0 (Armonk, NY: IBM Corp). Pairwise comparisons among treatments were made using Tukey's HSD test ($P < 0.05$).

Results and Discussion

Evaluation of biopesticides against the *E. dodecastigma* after first spray: The efficacy of treated biopesticides significantly ($P < 0.05$) reduced the number of insects soon after spray but with increasing time the number of insects was also increased (Table 1). Among the treatments the highest (67.2%) reduction of epilachna beetle was observed in Ecomec 1.8 EC @ 0.15% at 120 HATs which is statistically significant ($P < 0.05$, $F = 3.42$, $df = 15$) while the lowest (13.3%) in karanja oil @ 5% concentration. On the contrary, in the control treatment, the percent reduction of epilachna beetles was comparatively lower. Mean epilachna beetle population increased up to 25% in the control conditions.

Tested all biopesticides showed promising results to check infestation of epilachna beetle on sweet gourd plant. However, among them, Ecomec 1.8 EC @ 0.15% had promising effects against the ravages of the beetle at 120 HATs. The results of the present experiment are parallel with Tithi *et al*. (2021). They tested four botanical oils of black cumin (*Nigella sativa*), sesame (*Sesamum indicum*), castor (*Ricinus communis*) and neem (*Azadirachta indica*) against the grub of *E. dodecastigma* on bitter gourd and found good results. Our findings are in close proximity with that of Mala *et al*. (2012). They experienced that plant based insecticide effectively reduced epilachna beetle in field conditions. The finding of the study was close proximity with Mondal and Ghatak (2009). They cited that neem azal, a neem besed insecticide was effectively reduced of adult *Henosepilachna vigintioctopunctata* in field conditions. In our experiment, Bioneem plus 1.0 EC was found to be the most toxic ranking next to Ecomec 1.8 EC. Agian, the results of the present experiment are comparable with Karmakar and Bhole (2001). They opined that the botanicals have good effect in controlling coleopterons beetle including *E. dodecastigma*.

Table 1. Reduction (%) of epilachna beetle treated by different biopesticides at indicated time of intervals after first spray

Treatments	Doses (%)	Precount	24 HAT	48 HAT	72 HAT	120 HATs
Bioneem plus 1.0 EC	0.05	4.3 a	38.9 bcd	38.9 abc	30.6 abc	22.2 ab
	0.10	4.0 a	58.9 a-d	50.6 ab	50.6 ab	39.4 **a**
	0.15	4.3 a	70.0 ab	70.0 ab	61.7 ab	55.0 a
Ecomec 1.8 EC	0.05	4.0 a	52.2 a-d	50.6 ab	50.6 ab	39.4 a
	0.10	5.0 a	67.2 abc	67.2 ab	60.6 ab	52.2 a
	0.15	4.0 a	85.0 a	85.0 a	78.3 a	67.2 a
Castor oil	5.00	4.0 a	32.8 cde	32.8 abc	26.1 abc	15.0 ab
	7.50	4.3 a	46.7 bcd	46.7 ab	38.3 abc	31.7 ab
	10.0	3.3 a	58.9 a-d	58.9 ab	47.8 ab	41.1 a
Karanja oil	5.00	3.7 a	30.0 de	21.7 bc	15.0 bc	13.3 ab
	7.50	4.0 a	47.8 bcd	28.3 bc	26.1 abc	15.0 ab
	10.0	4.3 a	61.1 a-d	44.4 abc	36.1 abc	25.0 ab
Neem oil	5.00	4.0 a	32.8 cde	26.1 bc	26.1 abc	15.0 ab
	7.50	3.3 a	50.0 a-d	41.7 abc	41.7 ab	30.6 ab
	10.0	3.7 a	63.9 a-d	63.9 ab	55.6 ab	38.9 a
Control	0.00	3.0 a	0.0 e	-8.3 c	-16.7 c	-25.0 b

Means within a column followed by the same letters are not significantly different by ANOVA and Tukey's HSD test at $P < 0.05$. HAT = Hours after treatments. Substraction (-) sign represent percent increase of epilachna beete.

Evaluation of biopesticides against the *E. dodecastigma* after second spray: Significant variation ($P < 0.05$) was found in the percent reduction of epilachna beetle due to treatments of biopesticides and their doses after 2nd spray (Table 2). Among the treatments, statistically ($P < 0.05$, $F = 8.60$, $df = 15$) the highest (69.8%) reduction of epilachna beetle was observed in Ecomec 1.8 EC @ 0.15% concentration at 120 HATs while the lowest (12.2%) in karanja oil @ 5% concentration. On the contrary, in the control treatment, the percent reduction of epilachna beetles was comparatively lower than the other treatments in all cases. Mean epilachna beetle population increased up to 22.5% in the control conditions. The efficacy of treated biopesticides reduced the number of insects soon after spray but with increasing time the number of insects also increased in all cases except cotrol treatments.

The finding of the study was close proximity with Podder *et al*. (2013). They evaluated the effectiveness of different botanicals and chemical insecticide in managing *Epilachna dodecastigma* where neem, mahogany, biskatali, pithraj treated plots showed significant variation over untreated control. Neem oil at 13% concentration was the most effective among the botanicals. Researchers, nowadays, addressed that numerous plant products having a series of pest control properties such as insecticidal, antifeedant, repellent, growth inhibitory, and chitin synthesise but eco-friendly and attracted in attention of pest control program (Swaminathan *et al.* 2010). Again, Sharma and Saxena (2012) found that 1.0% concentration of *Eucalyptus globulus* leaf extracts gave 80.0 to 93.3% larval mortality of epilachna beetle. Our results are in line with the aforesaid researchers.

Evaluation of biopesticides against the *E. dodecastigma* after third spray: Significant variation ($P < 0.05$) was found in the percent reduction of epilachna beetle due to application of biopesticides and their doses after third spray (Table 3).. Among the treatments, the highest (71.8%) reduction of epilachna beetle was observed in Ecomec 1.8 EC @ 0.15% concentration at 120 HATs which is statistically significant ($P < 0.05$, $F = 8.02$, $df = 15$) while the lowest (10.8%) in karanja oil @ 5% concentration. On the contrary, in the control treatment, the percent reduction of epilachna beetles was comparatively lower than the other treatments in all cases. Mean epilachna

Table 2. Reduction (%) of adult epilachna beetle treated by different biopesticides at indicated time of intervals after second spray

Treatments	Doses (%)	Precount	24 HAT	48 HAT	72 HAT	120 HATs
Bioneem plus 1.0 EC	0.05	5.7 a	38.5 cde	29.0 cd	29.0 c-f	23.4 bc
	0.10	5.0 a	61.7 abc	53.3 a-d	53.3 a-d	41.1 abc
	0.15	6.0 a	72.7 ab	72.7 ab	61.3 ab	54.6 ab
Ecomec 1.8 EC	0.05	7.0 a	52.4 a-e	52.4 a-d	47.6 a-e	42.9 abc
	0.10	6.0 a	71.6 ab	71.6 ab	61.3 ab	54.6 ab
	0.15	6.7 a	80.2 a	80.2 a	74.6 a	69.8 a
Castor oil	5.00	5.3 a	30.6 e	30.6 cd	25.0 def	16.7 bc
	7.50	5.7 a	47.8 b-e	47.8 bcd	35.6 b-f	30.0 bc
	10.0	6.0 a	61.3 abc	54.6 abc	54.6 a-d	43.2 abc
Karanja oil	5.00	4.7 a	28.9 e	23.3 de	16.7 f	12.2 cd
	7.50	5.0 a	46.7 b-e	28.9 cd	20.6 ef	13.9 cd
	10.0	5.7 a	60.7 a-d	46.8 bcd	38.5 b-f	28.2 bc
Neem oil	5.00	5.3 a	31.1 de	25.6 cd	25.6 def	18.9 bc
	7.50	5.3 a	49.0 bcde	44.3 bcd	44.3 b-f	36.0 abc
	10.0	5.7 a	65.8 abc	65.8 ab	57.5 abc	38.3 abc
Control	0.00	6.0 a	-6.7 f	-6.7 e	-17.8 g	-22.5 d

Means within a column followed by the same letters are not significantly different by ANOVA and Tukey's HSD test at $P < 0.05$. HATs = Hours after treatments. Substraction (-) sign represent percent increase of epilachna beete.

Table 3. Reduction (%) of adult epilachna beetle treated by different biopesticides at indicated time of intervals after third spray

Treatments	Doses (%)	Precount	24 HAT	48 HAT	72 HAT	120 HATs
Bioneem plus 1.0 EC	0.05	6.3 a	42.5 b-e	42.5 b-e	32.8 bcd	26.1 bcd
	0.10	5.7 a	60.7 a-d	60.7 a-d	56.0 abc	42.1 a-d
	0.15	6.3 a	69.7 ab	69.7 ab	63.1 ab	57.5 ab
Ecomec 1.8 EC	0.05	7.3 a	50.6 b-e	50.6 a-e	45.8 a-d	41.1 a-d
	0.10	6.3 a	62.7 a-d	62.7 abc	57.9 abc	53.2 abc
	0.15	7.0 a	81.3 a	81.3 a	76.6 a	71.8 a
Castor oil	5.00	6.0 a	34.0 de	34.0 cde	27.3 bcd	17.0 cde
	7.50	6.7 a	45.2 b-e	45.2 b-e	40.5 a-d	34.9 a-d
	10.0	6.3 a	57.9 a-d	57.9 a-d	48.4 a-d	42.9 a-d
Karanja oil	5.00	6.7 a	28.7 ef	19.8 ef	15.6 de	10.8 de
	7.50	6.3 a	48.1 b-e	30.3 cde	24.7 cd	13.9 cde
	10.0	6.3 a	37.8 cde	45.2 b-e	38.5 a-d	24.4 bcd
Neem oil	5.00	5.7 a	33.7 de	28.2 de	28.2 bcd	15.1 cde
	7.50	5.7 a	52.4 a-e	41.0 b-e	41.0 a-d	34.3 a-d
	10.0	6.3 a	63.1 abc	63.1 abc	56.4 a-d	40.0 a-d
Control	0.00	8.3 a	0.0 f	-9.5 f	-13.7 e	-18.5 e

Means within a column followed by the same letters are not significantly different by ANOVA and Tukey's HSD test at $P < 0.05$. HAT = Hours after treatments. Substraction (-) sign represent percent increase of epilachna beete.

beetle population increased up to 18.5% in the control conditions.

Novel innovative research illustrated that diverse plant products have been tried by several researchers with a good degree of success against epilachna beetle (Tithi *et al*. 2021). Present findings are in consistent with Podder *et al.* (2013). They assessed the effectiveness of botanicals for managing *E. dodecastigma* where neem oil showed significant toxic effect. Outcomes also revealed that trialed biopesticides markly reduced the infestation of epilachna beetle. This indicated that the pest controlling properties of tested treatments were not distributed uniformly. Similar observations were found by Kodandaram *et al*. (2014). They observed the efficacy and persistent toxicity of some biopesticides and concluded that Emamectin benzoate 5 SG @ 10 g a.i. /ha and thiodicarb 75 WP @ 70g a.i. / ha proved to be the most effective with highest reduction of epilachna population of 75.3 and 73.9%, respectively. Khursheed and Raj (2013) evaluated the potency of some conventional insecticides and biopesticides and found that lambda-cyhalothrin and carbaryl were most effective against *Henoeilachna vigintioctopunctata* in bitter gourd.

Evaluation of different biopesticides on the yield of sweet gourd: The mean (± SE) number of fruits and yield per plot varied due to different treatments (Table 4). Significantly ($P < 0.05$, $F = 10.41$, $df = 15$) the highest (9.3) number of fruits were observed in Ecomec 1.8 EC @ 0.15% concentration while the lowest (4.70) in karanja oil @ 5% concentration. Similarly, the highest (62.4 kg) yield was observed in Ecomec 1.8 EC @ 0.15% concentration treated plots while the lowest (31.8 kg) in karanja oil @ 5% concentration which are statistically significant ($P < 0.05$, $F = 10.26$, $df = 15$). On the contrary, the number of fruits and yield in the control treatments was comparatively lower than all treatments. In control treatment, the number of fruits was 4.7 and provided 31.3 Kg weight.

Biopesticide have the ability to reduce the epilachna beetle thus reduced the leaves damaged from the insect infestation and thus increased the fruits yield. Results of the present study are consistent with those of Hassan *et al*. (2020). They experienced that 10% concentrated kalozira oil treated plot significantly ($P < 0.05$) provided the highest (9.7) number of fruits provided as 33.7 kg of

Table 4. Mean (± SE) number of fruits and yield per plot (4m²) as treated by different biopesticides

Treatments	Doses (%)	Number of fruits	Fruits yield (kg)
Bioneem plus 1.0 EC	0.05	5.7 cde	33.9 e
	0.10	7.0 bcd	44.2 b-e
	0.15	8.3 ab	53.5 ab
	0.05	6.3 b-e	42.0 b-e
Ecomec 1.8 EC	0.10	7.7 abc	51.6 abc
	0.15	9.3 a	62.4 a
	5.00	5.3 de	35.2 de
Castor oil	7.50	5.7 cde	37.1 cde
	10.0	7.3 a-d	49.3 a-d
	5.00	4.7 e	31.8 e
Karanja oil	7.50	5.3 de	33.5 e
	10.0	6.7 b-e	41.4 bcd
	5.00	5.3 de	34.5 de
Neem oil	7.50	6.3 b-e	42.7 b-e
	10.0	8.0 ab	52.1 abc
Control	0.00	4.7 e	31.3 e

Means within a column followed by the same letters are not significantly different by ANOVA and Tukey's HSD test at $P < 0.05$

sweet gourd while treated with neem, pithraj, kalozira and tishi oils against the notorious insect *A. foveicollis*.

Based on bio-efficacy it can be concluded that Ecomec 1.8 EC might be used against the *E. dodecastigma* for safe management. Bioneem plus 1.0 EC, and oils of neem castor, and karanja also provided promising results in comparison with control treatment.

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