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Full Length Research Paper

Effectiveness of the insecticide treatments against the leaf infestation by red pumpkin beetle

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Neem oil, Mehagoni oil, Bishkatali leaf extract, larvin 75 WP and diazinon 60 EC were assessed for their performance in controlling Red pumpkin beetle *Aulacophora foveicollis* (Lucas). Bottle Gourd variety BARI Lau-4 was planted in Entomology Field Laboratory of Bangladesh Agricultural University (BAU), Mymensingh, following Randomized Complete Block Design (RCBD) with three replications . The effectiveness of the treatments against the pest was evaluated on the basis of beetle population per plant and leaf infestation at 24, 48 and 72 HAT and 7 DAT in field level. Considering the effects of chemical insecticides, both larvin 75 WP and diazinon 60 EC were found to be statistically identical and highly effective in reducing beetle population. Among the botanicals, Neem oil at 7.5% showed better response whereas beetle population was relatively higher in Bishkatali leaf extract treated plots. For each treatment, the number of red pumpkin beetle per plant was at its minimum at 24 HAT that exhibited upward trends in the following intervals. In addition, after the final spray, percent leaf infestation decreased only in the chemical treated plots other than few exceptions.

Key words: Red pumpkin beetle, chemical insecticides, botanicals, effectiveness.

INTRODUCTION

Vegetable cultivation is one of the most important and dynamic branches of agriculture in Bangladesh, a country with sub tropical climate. Among the vegetables cultivated in Bangladesh Bottle Gourd, a cucurbit is now drawing attention to a greater extent. Bottle gourd *Lageneria vulgaris* locally known as Lau is generally a winter crop, possibly tropical or sub-tropical in origin, but nowadays it is grown throughout the year (Anonymous, 1994). It is a delicious and favourite traditional vegetable in Bangladesh. It contains carbo-hydrates, minerals and vitamins. Young fruits are cooked as vegetables dish. Young stems and leaves are used as leafy vegetables while the tender bottle gourd is used to prepare sweet dishes with sugar and milk. In Bangladesh, it is cultivated in an area of about 10,000 ha, producing about 62,000 m tons of vegetables. Bottle gourd production is more or less hindered by a number of insect pests. However, among them, red pumpkin beetle, *Aulacophora foveicollis* (Lucas), is one of the most important constraints to cucurbit production capable of causing 30-100% yield loss (Alam, 1969; Gupta and Verma, 1992; Dhillon et al., 2005). Adult beetles feed voraciously on the leaf lamina by making irregular holes. The maximum damage is done when the crop is in the cotyledon stage. The larvae cause damage in various ways by boring into the roots along with the underground stem portion as well as by feeding on the leaves and fruits line in contact with the soil (Srivastava and Butani, 1998). For the control of the beetle, many methods have been adopted but insecticides are still playing a key role for its control. But non judicial and repeated application of

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insecticides at improper doses may cause several problems such as disrupting natural enemy complexes, secondary pest outbreak, pest resurgence, development of insecticide resistance and environmental pollution (Hagen and Franz, 1973; Kavadia et al., 1984; Desmarchelier, 1985; Fishwick, 1988). In order to find alternatives to these harmful insecticides, many plant parts and plant extracts such as neem, mahogany and bishkatali can be used effectively because these are less expensive and biodegradable, hence they are environmentally suitable (Heyde et al., 1984). In Bangladesh, traditional botanical products are being used by the farmers for control long before now. Among them, the neem and mahogany proved their unique source for numerous active ingredients of insecticidal properties (Talukder and Howse, 1993). Under this circumstance, this research was undertaken to investigate the insecticidal effectiveness and to determine the suitable doses of three botanicals (neem oil, mehagoni oil and bishkatali leaf extract) and two synthetic insecticides (larvin 75 WP and diazinon 60 EC) to control the red pumpkin beetle *A. foveicollis* (Lucas).

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Entomology Field Laboratory of Bangladesh Agricultural University (BAU), Mymensingh, located at 24.750N latitude and 90.50E longitude at a mean elevation of 7.9 to 9.1 m above the sea level.

Experimental design

The experimental design employed in this research was Randomized Complete Block Design (RCBD) with three replications and six treatments. An illustration of this design is shown in Table 1.

Preparation and application of test insecticides and botanicals

Two insecticides, that is, Larvin 75 WP and Diazinon 60 EC selected for the experiment were collected from a local pesticide dealer. Insecticide solutions were prepared by mixing known amount of formulated product (ml or g) in known quantity of water (lit.) to get the designated doses. Botanical oils (plant part ingredients dissolved in sesame oil) were collected from the laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh. From the stock of the botanical oils, three concen-trations (2.5, 5 and 7.5%) were prepared with distilled water (that is, 2.5 ml, 5 ml and 7.5 ml oil/100 ml distilled water) containing 0.1% nondiet. Nondiet was used (as emulsifier) for proper mixing of the oils with water. Bishkatali leaf extract was prepared by boiling 1 kg leaf into 5, 10 and 10 L of water respectively for 2 h. The treatments (botanicals and synthetic insecticides) were applied after 35 days of showing the seed in the field.

Assessment of treatment effects

The data were recorded before spraying (at 0 h) and after 24, 48 and 72 h along with 7 days of botanicals and insecticides application. Data were taken on the number of red pumpkin beetle per plant and number of infested leaf per plant before and after applying the treatments. Finally, the percentage of leaf infestation was calculated using the following formula:

Percentage of infested leaves = Number of infested leaves/Number of total leaves × 100%

Analysis of data

The data were analyzed statistically using analysis of variance and the treatment means were compared by DMRT (Duncan's Multiple Range Test).

RESULTS AND DISCUSSION

Effects of botanicals and synthetic insecticides on red pumpkin beetles at different time intervals after 1st spray

The number of red pumpkin beetle ranged from 0 to 1.33 at 24 HAT, 0 to 2.33 at 48 HAT, 0.33 to 2.00 at 72 HAT and 0 to 2.33 at 7 DAT, where the control hit the highest number of beetle at 7 DAT followed by bishkatali leaf extract at 10% level of concentration at 7 DAT. It also revealed that for each treatment, the lowest number of red pumpkin beetles per plant was observed at 24 HAT which increased with the intervals, and finally the highest number of insect was observed at 7 DAT.

The results also showed that numbers of red pumpkin beetle per plant were more or less statistically identical, which implies that there was no significant difference at 24, 48 and 72 HAT and at 7th DAT of 1st spray (Table 2).

Effects of botanicals and insecticides at different time intervals after 2nd spray

After 2nd spray, number of red pumpkin beetles at 0 h of 2nd spray was lower than that of 1st spray in most of the treatment. The number of red pumpkin beetle ranged from 0 to 1.00 at 24 HAT, 0 to 3.67 at 48 HAT, 0 to 2.33 at 72 HAT and 0 to 4.13 at 7 DAT, where the control hit the highest number of beetle (4.13) at 7 DAT followed by bishkatali leaf extract at 10% level of concentration

Table 1. Experimental design.

Design: Randomized Complete Block Design (RCBD)	Treatments
Replication: 3	Treatments: 6
Total number of plot : 54	T_1- Neem oil @ 2.5, 5 and 7.5%
Plot Size : 4m × 2.5 m	T_2- Mahogany oil @ 2.5, 5 and 7.5%
Plot to plot distance : 1m	T_3- Bishkatali leaf extract @ 1:5, 1:10 and 1:15
Block to block distance: 1m	T_4 - Larvin 75 WP @1.5, 2 and 2.5 g/L
Unit plot area : $10m^2$	T_5 - Diazinon 60 EC @1.5, 2 and 2.5 ml/L
Net area: 0.06 ha.	T_6- Control(untreated)
Variety : Bottle Gourd variety BARI Lau-4	

Table 2. Number of red pumpkin beetles per plant before and after 1st spray.

Treatment	Concentration	Before spray (0 hour)	After spray			
			24 hours	48 hours	72 hours	7 days
Neem oil	2.5 %	2.33	1.33ab	1.33ab	1.67a	1.67a
	5 %	2.00	1.33ab	1.00ab	1.33ab	1.33ab
	7.5%	3.00	0.00b	0.33b	1.00ab	1.00ab
Mehagoni oil	2.5%	2.33	1.33ab	1.00ab	1.33ab	1.67a
	5%	1.67	0.67ab	1.00ab	1.33ab	1.33ab
	7.5%	2.00	0.67ab	0.67ab	1.33ab	1.33ab
Bishkatali leaf extract	5%	2.67	1.00ab	1.33ab	1.33ab	1.33ab
	10%	2.33	0.67ab	1.33ab	0.33b	2.00a
	15%	3.33	0.33b	0.33b	0.67b	1.33ab
Larvin 75 WP	1.5 g/L	2.00	0.67ab	1.33ab	1.67a	1.67a
	2 g/L	2.00	0.00b	0.33b	1.00ab	1.00ab
	2.5 g/L	2.33	0.00b	0.00b	0.33b	1.33ab
Diazinon 60 EC	1.5 ml/L	1.67	0.33b	0.67b	1.67a	1.67a
	2 ml /L	2.00	0.33b	0.33b	1.67a	1.00ab
	2.5 ml /L	2.00	0.00b	0.00b	0.67ab	1.33ab
Control		2.33	1.00ab	2.33a	2.00a	2.33a
LSD		1.15	0.73	0.73	0.94	1.05
Level of significance.		NS	NS	*	NS	NS

Means followed by common letter(s) are not significantly different; * = Significance at 5% level;
DAT= Days after Treatment & HAT=Hours after Treatments.

at 7 DAT. It also revealed that for each treatment, the lowest number of red pumpkin beetles per plant was at 24 HAT which increased with the intervals and finally the highest number of insect was observed at 7 DAT (Table 3).

The results also showed that numbers of red pumpkin beetle per plant were more or less statistically identical, implying that there was no significant difference at 24, 48 and 72 HAT and at 7th DAT of 2nd spray.

Efficacy of botanicals and synthetic insecticides at different time intervals after 3rd spray

It was observed that number of red pumpkin beetles was reduced after the application of 3rd spray than that of the 2nd spray in most of the treatment. The number of red pumpkin beetle ranged from 0 to 2.00 at 24 HAT, 0 to 2.33 at 48 HAT, 0 to 3.00 at 72 HAT and 0.33 to 2.66 at 7 DAT, where the control one hit the highest number of

Table 3. Number of red pumpkin beetles per plant before and after 2nd spray.

Treatment	Concentration	Before spray (0 hour)	After spray			
			24 hours	48 hours	72 hours	7 days
Neem oil	2.5%	1.33	0.67b	1.00ab	1.33ab	2.33a
	5%	1.33	0.33b	0.33b	0.00b	2.00a
	7.5%	1.00	0.33b	0.00b	0.67b	0.67b
Mehagoni oil	2.5%	1.67	0.67b	1.33ab	2.00a	1.67a
	5%	1.33	0.00b	1.00ab	0.67b	0.67b
	7.5%	1.33	0.00b	0.67b	1.00ab	1.00ab
Bishkatali leaf extract	5%	2.33	0.33b	0.67b	1.00ab	2.33a
	10%	1.33	0.33b	0.00b	1.00ab	2.33a
	15%	1.00	0.67b	0.00b	0.67b	1.33ab
Larvin 75 WP	1.5g/L	1.67	0.00b	0.33b	1.00ab	1.33ab
	2g/L	1.33	0.00b	0.67b	0.33b	1.33ab
	2.5g/L	0.67	0.00b	0.33b	0.00b	0.00b
Diazinon 60 EC	1.5ml/L	1.33	0.33b	1.00ab	1.67a	2.00a
	2 ml /L	1.67	0.33b	0.00b	1.00ab	0.33b
	2.5 ml /L	1.33	1.00ab	0.00b	0.00b	1.00ab
Control		**3.00**	**1.00ab**	**3.67a**	**2.33a**	**4.13a**
LSD		0.98	0.59	0.75	1.02	1.19
Level of significance.		NS	NS	*	NS	NS

beetle (3.00) at 72 HAT followed by Mehagoni oil at 2.5% level of concentration at 7 DAT (Table 4).

It was revealed that for each treatment, the lowest number of red pumpkin beetles per plant was observed at 24 HAT which increased with the intervals and finally the highest number of insect was observed at 7 DAT.

The results also showed that numbers of red pumpkin beetle per plant were more or less statistically identical, implying that there was no significant difference at 24, 48 and 72 HAT and at 7th DAT of 3rd spray.

Effect of different doses and sprays of botanicals and synthetic insecticides on the population of *A. foveicollis*

It was observed that the interaction on treatment, dose and time was non-significant after 2nd spray, whereas the interaction was significant after the 1st and 3rd sprays (Table 5).

The red pumpkin beetle population ranged from 0.53 to 1.53 in the case of botanicals, in which the lowest number (0.53) of beetle was observed at 7.5% neem oil after 2nd and 3rd sprays, and bishkatali leaf extract was less effective at 5% level of concentration.

Again considering the effects of chemicals, the lowest number of insect (0.27) per plant was found in the plot treated with larvin 75 WP at 2.5 g/L followed by diazinon 60 EC at 2.5 ml/L (0.33) after the 3rd spray. Another point to be mentioned is that the highest population was observed most often at the 1st spray which showed a declining trend in the following sprays except the control plots.

Effect of botanicals and synthetic insecticides and different sprays on *A. foveicollis* population

Among the treatments, the highest number of beetle (1.089) was found in bishkatali leaf extract treated plot while the lowest (0.51) was found in larvin 75 WP treated plot. For each treatment, the minimum number of beetle per plant was observed after the 3rd spray out of the three sprays (Table 6). Considering the performance of chemicals, both Larvin 75 WP and Diazinon 60 EC exhibited better efficacy and there was no statistical difference between them.

Among the botanicals, neem oil showed better response in managing the red pumpkin beetle although they are statistically identical. These findings are more or less in agreement with those of Tandon et al. (2009). They exposed red pumpkin beetles to 5 and 10% concentrations of the extracts of *Azadirachta indica, Annona squamosa*, *Convolvulus microphyllus and Melia*

Table 4. Number of red pumpkin beetles per plant before and after 3rd spray.

Treatment	Concentration of Treatment	Before spray (0 hour)	After spray			
			24 hours	48 hours	72 hours	7 days
Neem oil	2.5%	1.33b	0.67b	1.00b	1.33bc	2.00ab
	5%	1.00b	0.33b	0.67b	1.00bc	1.33a-d
	7.5%	0.67b	0.33b	0.00b	0.67bc	1.00bcd
Mehagoni oil	2.5%	1.67b	0.67b	1.33ab	1.33bc	2.33a
	5%	1.33b	0.00b	1.00b	1.33bc	1.33 a-d
	7.5%	1.33b	0.00b	0.67b	0.67bc	1.33 a-d
Bishkatali leaf extract	5%	1.67b	0.33b	0.67b	1.00bc	2.00ab
	10%	1.00b	0.33b	0.00b	1.00bc	1.67abc
	15%	1.67b	0.67b	0.00b	0.67bc	1.33 a-d
Larvin 75 WP	1.5g/L	1.33b	0.00b	0.33b	1.00bc	1.33 ad
	2g/L	0.67b	0.00b	0.67b	0.33bc	0.67cd
	2.5g/L	0.67b	0.00b	0.33b	0.00c	0.33d
Diazinon 60 EC	1.5ml/L	1.67b	0.33b	1.00b	1.67ab	1.33 ad
	2 ml /L	1.00b	0.00b	0.33b	0.00c	1.00bcd
	2.5 ml /L	0.67b	0.33b	0.00b	0.00c	0.67cd
Control		**3.33a**	**2.00a**	**2.33a**	**3.00a**	**2.66ab**
LSD		0.55	0.42	0.67	0.71	0.62
Level of significance.		**	**	*	**	*

Table 5. Number of beetle after application of different doses and sprays of botanicals and synthetic insecticides.

Treatment	Concentration	After 1st spray	After 2nd spray	After 3rd spray
Neem oil	2.5%	1.43ab	1.33	1.13bcd
	5%	1.40abc	0.80	0.87 bf
	7.5%	0.93bc	0.53	0.53def
Mehagoni oil	2.5%	1.33abc	1.40	1.27bc
	5%	1.13abc	0.73	0.87 bf
	7.5%	0.80bc	0.73	0.80cf
Bishkatali leaf extract	5%	1.53ab	1.33	1.47b
	10%	1.33abc	1.00	0.80cf
	15%	1.20bc	0.73	1.00be
Larvin 75 WP	1.5g/L	1.33abc	0.87	0.80cf
	2g/L	0.87bc	0.73	0.47ef
	2.5g/L	0.80bc	0.80	0.27f
Diazinon 60 EC	1.5ml/L	1.07bc	1.27	1.00 be
	2 ml /L	1.07bc	0.80	0.33f
	2.5 ml /L	0.67c	0.73	0.33f
Control		**2.00a**	**2.07**	**2.53a**
LSD		0.39	0.51	0.31
Level of sig.		*	NS	**

Table 6. Number of beetle per plant after application of treatments in three sprays.

Treatment	After 1st spray	After 2nd spray	After 3rd spray
Neem oil	1.29b	0.89 b	0.89 b
Mehagoni oil	1.09b	0.96b	0.93b
Bishkatali leaf extract	1.36b	1.02b	1.09b
Larvin 75 WP	1.00b	0.80b	0.51c
Diazinon 60 EC	0.93b	0.93b	0.56c
Control	**2.000a**	**2.07a**	**2.53 a**
Level of sig.	**	**	**
LSD	0.41	0.51	0.27

Table 7. Percentages of infested leaves before and after application of botanicals and synthetic insecticides.

Treatment	Concentration	% of infested leaves before application	% of infested leaves after 3rd spray	% of increased or decreased in leaf Infestation
Neem oil	2.5%	16.66	27.33ab	10.33bc
	5%	15.66	23.33abc	6.33c
	7.5%	17.66	12.66def	-5.00d
Mehagoni oil	2.5%	14.66	22.66abc	9.33bc
	5%	14.00	24.33abc	10.33bc
	7.5%	18.33	14.66cdef	-3.66d
Bishkatali leaf extract	5%	13.00	25.00ab	12.00b
	10%	9.66	19.33bcde	9.66bc
	15%	15.00	21.33bcd	6.33c
Larvin 75 WP	1.5g/L	18.33	25.33bcd	7.00c
	2g/L	15.33	7.500f	-8.00de
	2.5g/L	21.33	10.00ef	-11.33c
Diazinon 60 EC	1.5ml/L	12.00	9.33bcde	-7.00c
	2 ml /L	15.66	8.00f	-7.33de
	2.5 ml /L	18.33	8.333f	-10.00e
Control		**14.33**	**31.66a**	**17.33a**
Level of sig.		NS	**	**

+ = increased & - = decreased.

azedarach respectively in laboratory bioassays. The result showed that plant *Azadirachta indica* elicited repellency of 60.1 - 80%, *Anona squamosa* and *Melia azedarach* elicited repellency of 40.1 - 60% and *Convolvulus microphyllus* elicited repellency of 20.1 - 40%.

Effect of different doses of botanicals and synthetic insecticide on percentage of leaf infestation

The highest (27.33%) percentage of infested leaf after the 3rd spray was observed at 2.5% neem oil and the lowest (7.00%) was observed at 2. 5 g/L of larvin 75 WP. Among the treatments, the maximum increase of leaf infestation was 12.00% at 5% bishkatali leaf extract and the maximum reduction of leaf infestation was 11.33% at larvin 75 WP at 2.5 g/L. Considering the performance of chemicals, larvin 75 WP and diazinon 60 EC showed more or less similar result against red pumpkin beetle. Among the three botanicals, maximum reduction of leaf infestation was 5.00% at 7.5% neem oil and 3.00% at 7.5% mehagoni oil (Table 7). These results are similar with those of Araya and Emana (2009), who revealed that botanicals have good effect in controlling

coleopterous beetle up to 67%.

Conclusion

The effectiveness of botanicals showed a declining trend in managing the red pumpkin beetle with increasing the time after application. Only neem oil at 7.5% provided good result against red pumpkin beetle up to 3 days after application. Larvin and diazinon showed more or less similar result against red pumpkin beetle. Larvin 75 WP at 2.5 g/L and diazinon 60 EC at 2.5 ml/L were very effective to reduce the number of insect per plant. The lowest number of beetle per plant was 0.27 and 0.33 for larvin 75 WP and diazinon 60 EC at 2 g/L and 2.5 ml /L respectively. Among the three botanicals, 5% bishkatali leaf extract was the least effective to control the insect as the highest number (1.47) of beetle was at 5% bishkatali leaf extract followed by mehagoni oil (1.27) at 2.5%. Among the treatments, the maximum increase of leaf infestation was 12.00% at 5% bishkatali leaf extract and the highest (11.33%) reduction of leaf infestation was found after 2.5 g/L larvin application. Among the three botanicals, the highest (5.00%) reduction of leaf infestation was observed when the plants were treated with 7.5% neem oil. Among the three doses of each treatment, 7.5% neem oil, 2 and 2.5 g/L of larvin, and 2 and 2.5 ml/L diazinon was most effective in reducing the number of insect per plant and the percentages of leaf infestation. It may be concluded that neem oil at 7.5% level of concentration provided a good result against red pumpkin beetle which may be used to control or manage the beetle for the avoidance of excessive use of synthetic insecticides in a view to ensure a safe and friendly environment.

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