Research article **Bangladesh Journal of Entomology**
ISSN (Print): 1021-1004, ISSN (Online): 3007-3332, Website: www.bangladeshes.org
Bangladesh J. Entomol. (2024) 32(2): 135-146

EFFECTIVENESS OF BIORATIONAL INSECTICIDES APPLIED ON SWEET GOURD FOR CONTROLLING RED PUMPKIN BEETLE

Arghya Paul[1], Md. Ramiz Uddin Miah[1], Md. Raihan Talukder[2], Ankita Bishnu[3] and Md. Shamim Hossain[1]*

[1]Department of Entomology, [2]Department of Environmental Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh, [3]Department of Agriculture, Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj-8100, Bangladesh

Received: 20 September 2024; Accepted: 7 October 2024

ABSTRACT

The red pumpkin beetle (*Aulacophora foveicollis*) is the critical insect pests of sweet gourd according to their high relative abundance in the field. To evaluate the effectiveness of different biorational insecticides against red pumpkin beetle the present study was conducted in the experimental field of entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh during January 2023 to June 2023. With average temperature of 25.8°C and relative humidity of 91.2% during experimental period, seven different biorational insecticides were applied for field evaluation. The treatments of the experiment were Neem oil, Mahogony oil, Bio-clean 5 SL (De-limonin 5%), Bio-action 1.5 SL (Matrine 1.5%), Biotrin 0.5 AS (Matrine 0.5%), Spinomax 44.03 SC (Spinosad 44.03% w/w), BiomaxM 1.2 EC (Abamectine 1.2%) with an untreated control (using water only) for comparison. The lowest abundance of red pumpkin beetle at early cropping stage (4.0) and late cropping stage (2.7); rate of infestation at early cropping stage (89.7%) and late cropping stage (91.3%); leaf area damage (10.0%) and late cropping stage (3.7%) was observed in Biotrin 0.5 AS treated plot. The lowest floral infestation (8.3%) was also observed in Biotrin 0.5 AS treated plot. Biotrin 0.5 AS performed better than other biorational insecticides in all the aspects of controlling red pumpkin beetle.

Keywords: Red pumpkin beetle, sweet gourd, biorational insecticides, Biotrin 0.5 AS.

INTRODUCTION

Cucurbitaceae is one of the largest and most crucial vegetable families grown worldwide. It contains 965 species under 134 genera (Khandaker *et al.* 2018). Sweet gourd, a very popular vegetable under the Cucurbitaceae family, is cultivated

*Corresponding author: *shamim.ent@bsmrau.edu.bd*

in 6.83% of the land area in Bangladesh (Islam *et al.* 2017). In Bangladesh, about 1.78 lakh MT (Metric Tons) of sweet gourd is produced in the Rabi season and 1 lakh MT of sweet gourd is produced in the Kharif season (BBS 2015). Sweet gourd is very vulnerable to attack by several insect pests. A total of 21 arthropod species attacks cucurbitaceous crops in Bangladesh. Among them, 20 are insects and 1 is mite species (Ali *et al.* 2016). The red pumpkin beetle (*Aulacophora foveicollis*) is one of the most critical insect pests of sweet gourd according to their high relative abundance in the field (Nancy *et al.* 2018). In Bangladesh, the red pumpkin beetle (*Aulacophora foveicollis*) is the most devastating insect pest of sweet gourd. The damage potential of red pumpkin beetle is one of the most critical constraints of sweet gourd production in Bangladesh (Khan 2014). Red pumpkin beetles attack young plants, leaves, and flowers. It feeds on both the upper and lower surface of the leaves and produces a characteristic circular ring-like injury. They are capable of causing 30 to 100% yield loss of sweet gourd (Afroz *et al.* 2020). Farmers in Bangladesh mainly uses Malathion, an organophosphate insecticide to control red pumpkin beetle (Hasan *et al.* 2013). Furthermore, synthetic insecticides such as Karate 2.5 EC, Ripcord 10 EC and Shobicron 425 EC are frequently used for controlling cucurbit fruit flies in Bangladesh (Ahmed *et al.* 2022). These synthetic insecticides has hazardous effects on human health, the environment and other biodiversity (Rahaman & Prodhan 2007). Chemical insecticides may cause cancer, damage the nervous, reproductive, and immune systems, and induce hepatotoxicity in both acute and chronic form (Cataudella *et al.* 2012). Biorational insecticides are safe, environmentally friendly and less toxic insecticides for controlling insects (Horowitz & Ishaaya 2004). It degrades quickly and less hazardous to biodiversity. Different studies showed positive reports for controlling red pumpkin beetle by using biorational insecticides. Therefore, biorational insecticides can be a sustainable solution for the management of red pumpkin beetle infesting sweet gourd.

MATERIALS AND METHODS

The research was carried out in the experimental field of Department of entomology Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, during the period of January to June 2023. Total 24 plots were prepared with 3

replications; each block containing 8 plots. The area of the plots was 3m × 2m with 1m plot to plot distance and 1m block to block distance. During the experimental period the temperature fluctuated between 10° to 40°C with an average of 25.8°C and relative humidity was ranged from 91.2% to 93% with an average of 80%. The experiment was conducted by Randomized Complete Block Design (RCBD) with three replications and eight treatments including an untreated control. The treatments were as follows:

Neem oil @ 5ml/L of water+1–2 drops Tween 20, Mahogony oil @ 5ml/L of water+1–2 drops Tween 20, Bio-clean 5 SL (De-limonin 5%) @ 1ml/L of water, Bio-action 1.5 SL (Matrine 1.5%) @ 3ml/L of water, Biotrin 0.5 AS (Matrine 0.5%) @ lml/L of water, Spinomax 44.03 SC (Spinosad 44.03% w/w) @1ml/L of water, BiomaxM 1.2 EC (Abamectine 1.2%) @ 1ml/L of water and an untreated control.

"BARI Mistikumra-1" seedlings were transplanted the experimental field with the plant to plant and row to row distance of 1m in both the cases. Each plot was containing 6 pits of 45cm of diameter and 45 cm depth. Every pit was mixed up with the proper quantity of decomposed cow dung and farmyard manure. The fertilizer was applied according to Fertilizer Recommendation Guide 2018 such as urea 55–85kg/ha, MoP 28–55kg/ha and TSP 45–50kg/ha (FRG 2018). Different intercultural operations such as weeding, loosening of soil, irrigation, setting up bamboo trellis and fertilization was done time to time for optimum growth of plants.

The treatments were applied when approximately 5% infestation was recorded; 15 days after transplanting. The treatments were applied at 7 days intervals. Total 6 application of biorational insecticides were done till the last harvest. The data were recorded on population abundance of red pumpkin beetle, number of red pumpkin beetle from randomly selected 5 vines (1m top length), percent leaf infestation, percent damage severity after 48h of application. The healthy and infested fresh leaf weight and dry leaf weight data was recorded. The floral infestation data was taken after 48h of spraying. The data was analyzed by using IBM SPSS Statistics 20 and RStudio software. In IBM SPSS, a one-way ANOVA was performed followed by Duncan's Multiple Range Test (DMRT) to separate means. The p-value was determined using RStudio at a significance level of 5%.

RESULTS AND DISCUSSION

Effect of biorational insecticides on red pumpkin beetle at early cropping stage: The Table 1 represents the effect of biorational insecticides on abundance and leaf infestation by red pumpkin beetle at early cropping stage. All the treatments applied in the experimental field showed the significant level of variation for number of red pumpkin beetle per plot, rate of leaf infestation and damage severity at early cropping stage. After first three consecutive spray, highest mean number of red pumpkin beetle per plot was seen in untreated control (23.3) plot, followed by Mahogony oil treated plot (10.3). Bio-Clean 5 SL and BiomaxM 1.2 EC showed the same number of red pumpkin beetle per plot (8.7), followed by Bio-action 1.5 SL (8.0) treated plot. The lowest number of red pumpkin beetle was found in Biotrin 0.5 AS (4.0), followed by Spinomax 44.03 SC (5.3) and Neem oil treated plot (7.0) treated plot.

The highest rate of leaf infestation was found in untreated control (98.9%), followed by neem oil (91.9%), BiomaxM 1.2 EC (90.1%) and Bio-action 1.5 SL (89.9%). The lowest rate was found in Spinomax 44.03 SC (87.7%). Mahogony oil and Bio-Clean 5 SL showed almost the same rate of leaf infestation (89.6%), followed by Biotrin 0.5 AS (89.7%).

The damage severity was measured by visual inspection. The highest damage severity was observed in untreated control plot (18.5%). The Bio-Clean 5 SL, Bio-action 1.5 SL and BiomaxM 1.2 EC treated plot showed the same rate of damage severity (13.5%), followed by Mahogony oil (13.0%). The lowest rate of damage severity was observed in Biotrin 0.5 AS (10.0%) treated plot, followed by Spinomax 44.03 SC (11.3%) and Neem oil (12.6%).

The highest percentage of reduction of damage severity over control was observed in Biotrin 0.5 AS (42.9%), followed by Spinomax 44.03 SC (36.9%) and Neem oil treated plot (31.5%). The Mahogony oil and Bio-Clean 5 SL showed the same percentage of reduction of damage severity over control (28.0%). The lowest percentage of reduction of damage severity over control was observed in Bio-action 1.5 SL and BiomaxM 1.2 EC treated plot (26.8%).

Parvin *et al*. (2023) reported that, during the summer season the lowest abundance of red pumpkin beetle was observed in Sunmectin 1.8 EC (Abamectin)

tread plot which was 3.0 at early cropping stage and 1.6 per plant at late cropping stage among six biorational insecticides applied on ash gourd. The result is almost closer to the present study. Depending on sweet gourd variety, the abundance ranges from 3.1 to 4.0 and the rate of leaf infestation ranges from 28.5% to 34.8% at early cropping stage (Kamal *et al*., 2014). Depending on weather condition this percentage may vary. In the research, muskmelon showed the highest percentage of leaf infestation 89.3% over control (Khan, 2018). Khan *et al*. (2011) reported that, depending on cucurbit varieties leaf area damaged by the red pumpkin beetle ranges from 0.0 to 70%. He found that, the red pumpkin beetle causes the highest (58.0%) leaf area damage in sweet gourd.

Table 1. Effect of different biorational insecticides on abundance and leaf infestation by red pumpkin beetle after 48 hours of spraying at early cropping stage

Treatment	Number of RPB	Rate of leaf infestation (%)	Damage severity (%)	Reduction of damage severity over untreated control (%)
Neem oil	7.0b	91.9ab	12.6b	31.5
Mahogony oil	10.3b	89.6b	13.0b	28.0
Bio-Clean 5 SL	8.7b	89.6b	13.5b	28.0
Bio-action 1.5 SL	8.0b	89.9b	13.5b	26.8
Biotrin 0.5 AS	4.0b	89.7b	10.0b	42.9
Spinomax 44.03 SC	5.3b	87.7b	11.3b	36.9
BiomaxM 1.2 EC	8.7b	90.1b	13.5b	26.8
Untreated control	23.3a	98.9a	18.5a	
CV (%)	6.1%	10.1%	16.5%	

In a column, means having similar letter(s) are not significantly different at 5% level of significance (P=0.05%) according to Duncan's Multiple Range Test (DMRT).

Effect of biorational insecticides on red pumpkin beetle at late cropping stage: The Table 2 represents the effect of biorational insecticides on insect pest abundance and leaf infestation of red pumpkin beetle at late cropping stage. After last three consecutive spray, the highest mean number of red pumpkin beetle per plot was seen in untreated control (10.3) plot, followed by Mahogony oil (6.3). The Bio-Clean 5 SL and BiomaxM 1.2 EC treated plot showed almost the same number of red

pumpkin beetle (4.7), following that of Neem oil and Bio-action 1.5 SL (4.3). The lowest number of red pumpkin beetle was found in Biotrin 0.5 AS (2.7) treated plot followed by Spinomax 44.03 SC (3.3) treated plot.

The highest rate of leaf infestation was found in untreated control (100%) plot, followed by Bio-Clean 5 SL (99.0%), Bio-action 1.5 SL (92.8%), Mahogony oil (92.2%) and Neem oil (91.9%). Th lowest percentage of leaf infestation was found Spinomax 44.03 SC (91.0%), followed by Biotrin 0.5 AS (91.3%) and BiomaxM 1.2 EC (91.8%).

The highest damage severity was observed in untreated control plot (7.0%), followed by Mahogony oil (5.1%). Bio-action 1.5 SL and BiomaxM 1.2 EC and showed almost the same rate of damage severity (4.8%). This was following that of Neem oil and Bio-Clean 5 SL which showed the same rate of damage severity (4.2%). The lowest percentage of damage severity was observed in Biotrin 0.5 AS (3.7%), followed by Spinomax 44.03 SC (4.1%) treated plot.

The highest percentage of reduction of damage severity over untreated control was observed in Biotrin 0.5 AS (42.9%), followed by Spinomax 44.03 SC (41.4%). Neem oil and Bio-Clean 5 SL showed almost the same percentage of reduction over untreated control (40.0%), followed that of Bio-action 1.5 SL and BiomaxM 1.2 EC expressed the same rate of reduction over control (31.4%). The lowest percentage of reduction over control was observed in Mahogony oil (27.1%). As the plant matures, the plant tissue becomes hard and the damage severity reduces with time. There is another reason, continuous spraying of biorational insecticides. The insect abundance is reduced with time, so the damage severity is lower in the later three sprays.

At fruiting stage, the abundance of red pumpkin beetle ranges from 3 to 3.3 per plant and the rate of leaf infestation ranges from 12 to 17% depending on sweet gourd variety *(Kamal et al*., 2014). Parvin *et al*. (2023) found that, the reduction of abundance of red pumpkin beetle over control ranged from 30 to 65% on ash gourd plant. The highest reduction over control (65.0%) was observed in Sunmectin 1.8 EC treated plot at late cropping stage.

Table 2. Effect of different biorational insecticides on abundance and leaf infestation by red pumpkin beetle after 48 hours of spraying at late cropping stage

Treatment	Number of RPB	Rate of leaf infestation (%)	Damage severity (leaf area damage)	Reduction of damage severity over untreated control (%)
Neem oil	4.3b	91.9b	4.2b	40.0
Mahogony oil	6.3b	92.2b	5.1b	27.1
Bio-Clean 5 SL	4.7b	99.0b	4.2b	40.0
Bio-action 1.5 SL	4.3b	92.8b	4.8b	31.4
Biotrin 0.5 AS	2.7b	91.3b	3.7b	47.1
Spinomax 44.03 SC	3.3b	91.0b	4.1b	41.4
BiomaxM 1.2 EC	4.7b	91.8b	4.8b	31.4
Untreated control	10.3a	100a	7.0a	
CV (%)	4.8%	7.2%	13.2%	

In a column, means having similar letter(s) are not significantly different at 5% level of significance (P=0.05%) according to Duncan's Multiple Range Test (DMRT).

Effect of biorational insecticides on leaf weight: The Table 3 represents the effect of biorational insecticides on fresh and oven dry leaf weight of sweet gourd plant. There was significant difference among all leaf weights. Leaf weights were measured by a digital weighing machine. The fresh leaf weight was measured directly after collection from the experimental field. In case of dry leaf weight, the leaves were dried in a hot air oven at 55° C for 48 hours.

The highest weight of 5 healthy fresh leaf was measured in Neem oil (26.8g), followed by Spinomax 44.03 SC (23.2g), Mahogony oil (22.1g) and Bio-Clean 5 SL (22.0g) treated plot. The same weight was measured from Bio-action 1.5 SL and BiomaxM 1.2 EC treated plot (21.9g). The lowest weight was measured in untreated control (18.7g), followed by Biotrin 0.5 AS (21.4g).

The highest weight of 5 Infested fresh leaf was measured in Neem oil (21.4g), followed by Spinomax 44.03 SC (20.2g), Biotrin 0.5 AS (18.8g), Mahogony oil (17.1g) and Bio-Clean 5 SL (16.7g) treated plot. The lowest leaf weight was measured in untreated control (12.6g), followed by BiomaxM 1.2 EC (14.9g) and Bio-action 1.5 SL (15.3g) treated plot.

The highest weight of 5 healthy dry leaf was measured jointly in Neem oil and Biotrin 0.5 AS (6.1g) treated plot, following that of almost the same weight was measured from Bio-action 1.5 SL, Spinomax 44.03 SC and BiomaxM 1.2 EC treated plot (6.0g). The lowest weight was measure from untreated control (5.5g), followed by same weight (5.9g) was measured from Mahogony oil and Bio-Clean 5 SL treated plot.

The highest weight of 5 infested dry leaf was measured from Neem oil (5.5g) treated plot, followed by Biotrin 0.5 AS (5.2g), Spinomax 44.03 SC (5.1g), Bio-Clean 5 SL (4.6g) and Bio-action 1.5 SL (4.1g) treated plot. The lowest weight was measured form untreated control (3.1g), followed by Mahogony oil (3.5g) and BiomaxM 1.2 EC (3.9g) treated plot.

The highest dry and fresh leaf weight was measured from Neem oil treated plot. Several scientists have proved neem products and byproducts have growth-promoting properties in plants (Rehman *et al*., 2021).

Table 3. Effect of biorational insecticides on fresh and oven dry leaf weight (w/w) of sweet gourd plant

Treatment	5 Healthy fresh leaf weight (g)	5 Infested fresh leaf weight (g)	5 Healthy dry leaf weight (g)	5 Infested dry leaf weight (g)
Neem oil	26.8a	21.4a	6.1a	5.5a
Mahogony oil	22.1b	17.1abc	5.9a	3.5cd
Bio-Clean 5 SL	22.0b	16.7bcd	5.9a	4.6abc
Bio-action 1.5 SL	21.9b	15.3cd	6.0a	4.1abcd
Biotrin 0.5 AS	21.4bc	18.8abc	6.1a	5.2ab
Spinomax 44.03 SC	23.2b	20.2ab	6.0a	5.1ab
BiomaxM 1.2 EC	21.9b	14.9cd	6.0a	3.9bcd
Untreated control	18.7c	12.6d	5.5b	3.1d
CV (%)	10.4%	8.3%	8.7%	9.4%

In a column, means having similar letter(s) are not significantly different at 5% level of significance (P=0.05%) according to Duncan's Multiple Range Test (DMRT).

Effect of biorational insecticides on floral infestation: The Table 4 represents the effect of biorational insecticides on floral infestation by red pumpkin beetle. The highest number of infested flowers was counted from untreated control (9.3) plot, followed by Mahogony oil (8.7), BiomaxM 1.2 EC (5.7), Bio-Clean 5 SL (5.3) and

Bio-action 1.5 SL (4.7) treated plot. The lowest number was observed from Biotrin 0.5 AS (2.0), followed by Spinomax 44.03 SC (3.0) and Neem oil (3.3) treated plot.

Again, the highest number of healthy flowers was counted from Spinomax 44.03 SC (23.3) treated plot, followed by Mahogony oil (22.7). The same number of healthy flowers was counted from Bio-Clean 5 SL, Bio-action 1.5 SL and Biotrin 0.5 AS treated plot (22.3). The lowest number of healthy flowers was counted from untreated control (16.0), followed by BiomaxM 1.2 EC (21.3) and Neem oil (22.0) treated plot.

The highest percentage of floral infestation was observed form untreated control (36.8%) plot, followed by Mahogony oil (27.7%), BiomaxM 1.2 EC (21.0%), Bio-Clean 5 SL (19.2%) and Bio-action 1.5 SL (17.3%) treated plot. The lowest percentage was observed from Biotrin 0.5 AS (8.3%), followed by Spinomax 44.03 SC (11.2%) and Neem oil (13.1%) treated plot.

According to the findings of Parvin *et al*. (2023), at late cropping stage, the floral infestation ranges from 8.6 to 28.9% in different biorational insecticides treated plot in ash gourd. The lowest floral infestation was observed in Biotrin 0.5 AS (8.6%) treated plot which is almost similar to present findings.

Table 4. Effect of biorational insecticides on floral infestation by red pumpkin beetle

Treatment	Number infested flower	Number healthy flower	Floral infestation (%)
Neem oil	3.3c	22.0a	13.1c
Mahogony oil	8.7ab	22.7a	27.7ab
Bio-Clean 5 SL	5.3ab	22.3a	19.2bc
Bio-action 1.5 SL	4.7bc	22.3a	17.3bc
Biotrin 0.5 AS	2.0c	22.3a	8.3c
Spinomax 44.03 SC	3.0c	23.3a	11.2c
BiomaxM 1.2 EC	5.7abc	21.3a	21.0bc
Untreated control	9.3a	16.0b	36.8a

In a column, means having similar letter(s) are not significantly different at 5% level of significance (P=0.05%) according to Duncan's Multiple Range Test (DMRT).

CONCLUSION

The Biotrin 0.5 AS (Matrine 0.5%) @ lml/L of water at 7 days interval showed the best result for controlling red pumpkin beetle among all the biorational insecticides. So, Biotrin 0.5 AS might be an effective and sustainable biorational insecticide to restrict the red pumpkin beetle population reaching at the economic injury level.

ACKNOWLEDGEMENT

The authors wish to acknowledge the Research Management Wing (RMW) of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706 and the Ministry of Science and Technology, Bangladesh, for funding the research work.

RFERENCES

AFROZ, M., AMIN, M., MIAH, M. & HOSSAIN, M. 2020. Incidence of major insect pests on sweet gourd germplasm. *Bangladesh J. Agric. Res.* **44**(4): 621–630. Https://Doi.Org/10.3329/Bjar.V44i4.45697.

AHMED, F., SHEIKH, B., RAHMAN, M., RAHMAN, M. M., AFROZ, M. & AMIN, R. 2022. Efficacy of selected insecticides in cucurbit fruit fly management. Https://Journal.Esbangladesh.Org.

ALI, M. R., CHOWDHURY, M. S. U. M., KARIM, M. A., HOSSAIN, M. M. A. & MUSTAFI, B. A. A. 2016. Pest Risk Analysis (PRA) of cucurbits in Bangladesh. Department of Agricultural Extension, Khamarbari, Farmgate, Dhaka-1205. Pp 1-209.

BBS. (2015). Statistical pocketbook Bangladesh 2015 (Sid) Ministry of Planning.

CATAUDELLA, E., MALAGUARNERA, G., GAGLIANO, C., CONDORELLI, G., ANTIC, T., RAMPELLO, L., ERDOGAN, Ö., RAMPELLO, L. & MALAGUARNERA, M. 2012. Pesticides exposure and the management of acute hepatic injury. *Acta Medica Mediterranea*. **28**(3): 245-252.

FRG. 2012. Fertilizer Recommendation Guide. Bangladesh Agricultural Research Council (BARC), Farm gate, Dhaka-1215. Pp 1-284.

HASAN, M., UDDIN, M. & HAQUE, M. 2013. Efficacy of Malathion for controlling red pumpkin beetle, *Aulacophora Foveicollis* (Lucas) in cucurbitaceous vegetables. *Progres. Agric*. **22**(1-2): 11-18.

HOROWITZ, A. R. & ISHAAYA, I. 2004. Biorational insecticides— Mechanisms, selectivity and importance in pest management. *Ins. Pest Manag.* P. 1-28.

ISLAM, M. A., ALAM, M. J., ISLAM, M. & ISLAM, M. K. 2017. Up scaling and field validation of bio-rational based integrated management package against fruit fly of sweet gourd at Jessore region.

KAMAL, M. M., UDDIN, M. M., SHAJAHAN, M., RAHMAN, M. M., ALAM, M. J., ISLAM, M. S., RAFII, M. Y. & LATIF, M. A. 2014. Incidence and host preference of red pumpkin beetle, *Aulacophora Foveicollis* (Lucas) on cucurbitaceous vegetables. *Life Sci. J*. **11**(7): 459-466.

KHAN, M. M. H. 2014. Effect of different management tactics on the incidence and movement of red pumpkin beetle, *Aulacophora Foveicollis* on the leaves of sweet gourd, *Cucurbita moschata*. *Jahangirnagar Univ. J. Biol. Sci.* **3**(2): 73-80.

KHAN, M. M. H. 2018. Occurrence, distribution, host preference and damage severity of red pumpkin beetle- a review. *Malaysian J. Halal Res. J.* **1**(1): 03-09.

KHAN, M. M. H., ALAM, M. Z. & RAHMAN, M. M. 2011. Host preference of red pumpkin beetle in a choice test under net case condition. *Bangladesh J. Zool*. **39**(2): 231-234.

KHANDAKER, M., AKTER, S. & IMAM, M. Z. 2018. *Trichosanthes Dioica* Roxb.: A Vegetable with diverse pharmacological properties. *Food Sci. Human Wellness*. **7**(1): 34-48.

NANCY, N. P., AMIN, M. R., MIAH, M. R. U. & MIAH, M. G. 2018. Diversity of Insects in sweet gourd field of Bangladesh. *Indian J. Ecol*. **45**(4): 854-857.

PARVIN, R., AMIN, M. R., AFROZ, M., ALAM, M. Z. & MIAH, M. R. U. 2023. Management of red pumpkin beetle and fruit fly in ash gourd using biorational insecticides. *Ecol. J.* **5**(1). Https://Doi.Org/10.59619/Ej.5.1.2.

RAHAMAN, M. A. & PRODHAN, H. 2007. Effects of net barrier and synthetic pesticides on red pumpkin beetle and yield of cucumber. *Int. J. Sustain. Crop Prod*. 2(3).

REHMAN, A., NAWAZ, M., CHATTHA, M. U., KHAN, I., CHATTHA, M. B., HUSSAIN, F., AYUB, M. A., IQBAL, M. M., AHMED, F., ASLAM, M. T., KHAN, F. A., KHARAL, M. & HASSAN, M. U. 2021. Neem coated urea improves the productivity, nitrogen use efficiency and economic return of wheat crop. *Int. J. Agric. Biol.* **26**(3): 450–460. Https://Doi.Org/10.17957/Ijab/15.1856.