Asian Research Journal of Agriculture

Volume 17, Issue 2, Page 407-413, 2024; Article no.ARJA.118617
ISSN: 2456-561X

Assessment of Botanicals against the Fruit Borer (*Helicoverpa armigera*) on Tomato

Takia Benta Reza [a], S. M. Mizanur Rahman [a], Md. Abdur Rahaman [b], Mamtaz Begum [c], Tirsa Mrong Shilpa [a] and Mst. Nur Mohal Akhter Banu [a*]

[a] Department of Entomology, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.
[b] NATP-2, PIU, Bangladesh Agricultural Research Council, Dhaka, Bangladesh.
[c] Planning and Development Department, Bangladesh Open University, Gazipur, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. Author TBR conducted the research work. Author NA designed supervised the study and edited and the manuscript. Author MAR perform the analysis and edited the manuscript. Authors SMMR, MB and TMS managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/arja/2024/v17i2462

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/118617

Original Research Article

Received: 06/04/2024
Accepted: 11/06/2024
Published: 14/06/2024

ABSTRACT

The experiment was conducted under the central farm of Sher-e-Bangla Agricultural University, Dhaka in order to assess the efficacy of six promising botanicals (of 50gm/L) against tomato fruit borer (*Helicoverpa armigera*). The botanicals assessed weree neem leaf extract, Datura seed extract, Garlic bulb extract, Mahogany seed extract, Black pepper seed extract and Allamanda leaf extract. The lowest number of infested fruits in early, mid and late fruiting stages (2.67, 5.63 and 4.48 fruits plot^{-1} respectively) were obtained from the plots that were treated with neem leaf extract.

**Corresponding author: E-mail: nurmohalsau@yahoo.com;*

Cite as: Reza , Takia Benta, S. M. Mizanur Rahman, Md. Abdur Rahaman, Mamtaz Begum, Tirsa Mrong Shilpa, and Mst. Nur Mohal Akhter Banu. 2024. "Assessment of Botanicals Against the Fruit Borer (Helicoverpa Armigera) on Tomato". Asian Research Journal of Agriculture 17 (2):407-13. https://doi.org/10.9734/arja/2024/v17i2462.

The highest number of infested fruits were from control plots with 11.33, 16.28, and 13.55fruits/plot obtained at early, mid and late fruiting stage respectively. Similarly, the highest yields of 2.45 kg/plot, 3.10 kg/plot and 2.91 kg/plot at early, mid and late fruiting stages respectively were obtained from the plots treated with neem leaf extract. Increses of weight over control were 75%, 55.78% and 88.96% at early, mid and late harvest respectively. Based on total yield obtained from three harvest (8.54kg/plot) compared to yield of control (5.03kg/plot) and lower toxicity to the environment as well as human being, neem leaf extract was the most promising botanicals for the effective management of tomato fruit borer.

Keywords: Tomato; botanicals; neem leaf extract; fruit borer; management.

1. INTRODUCTION

In Bangladesh, the tomato (*Lycopersicum esculentum* L.) is cultivated in 73151.55 acres area with a production of 0.4 million metric ton [1]. The yields are low in comparison with other tomato-growing countries in the World [2 and 3]. Among the several factors contributing to the low tomato production in Bangladesh, insect pests are significant. This crop is mainly attacked by several pests such as tomato fruit borer, leaf miner, fruit worm, aphids, stink bugs, leaf-footed bugs, hornworm and whitefly.The tomato fruit borer, *Helicoverpa armigera*is highly destructive causing serious damage [4] and its incidences are impacted by the stage of the crop and the time of plantation [5]. A yield loss of 35% to 37.79% is attributed to *Helicoverpa armiger infestation* [6]. Affected fruits have a low market value. Seed viability is also impacted due to the damage [7]. Tomato fruit borer is a polyphagous insect pesst that has been reported from 181 cultivated and uncultivated plant species in India and distributed in 45 families [8]. The farmers of Bangladesh control this pest by the application of chemical insecticides and the presence of insecticide residues in market samples of tomato has been reported [9]. Biorational insecticides are suggested to be an ecologically viable, alternate insect pest management strategy. Biorational or 'reduced risk' insecticides are natural compounds that effectively control insect pests, but have low toxicity to non-target organisms and the environment [10]. In Bangladesh, a few attempts have been made to evaluate botanical extracts against pests of tomato [11,12]. In light of the above back ground, the research work has been undertaken to assess the efficacy of botanicals against fruit borer of tomato.

2. MATERIALS AND METHODS

2.1 Experimental Site

This study was carried out in the central farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207 during September 2019 to January 2020. The experimental site was situated at 23.074^0/N latitude and 90.0035^0/E longitude with an altitude of 8.2 meter from sea level. The experimental site is under the subtropical climate and its climatic conditions are characterized by low temperature and scanty rainfall during the winter (rabi season). Soil of the experimental site belongs to "The Modhupur Tract", AEZ-28.

2.2 Planting Materials

Seed material used for planting in this study were of the variety BARI Tomato-15, obtained from Bangladesh Agricultural Research Institute (BARI), Gazipur.

2.3 Treatments of the Experiment

Seven treatments were applied in this experiment including control. All the treatment were applid three times, at early fruiting stage (40 days after transplant), mid fruiting stage (80 days after transplant) and late fruting stage (100 days after transplant).

Preparation of botanical leaf extracts: Fresh leaves of neem, and Allamonda were collected from SAU campus, washed thoroughly with running tap water, and chopped with a knife. Four hundred milliliter of water was added with chopped leaves and ground well with a blender to make it a suspension. The mixture was kept undisturbed overnight, filtered through fine cloth and poured into a volumetric flask (1L) and water was added to make the volume one liter.

Preparation of seed and bulb extracts: Datura seeds, Garlic bulbs, Mahogany seeds, and blackpepper seeds were collected from Siddik bazar, Dhaka, washed thoroughly with running tap water till the adhered fruit particles were removed. Four hundred milliliter of water was added with those (seeds and bulb) and ground well in a blender to make a suspension. The suspension was left

Table 1. List of botanicals and their doses

Treatment No.	Botanicals	Scientific name	Dose
T_1	Neem leaf extract	*Azadirachta indica*	50gm/L
T_2	Datura seed extract	*Datura stramonium*	50gm/L
T_3	Garlic bulb extract	*Allium sativum*	50gm/L
T_4	Mahogany seed extract	*Swietenia mahagoni*	50gm/L
T_5	Blackpepper seed extract	*Piper nigrum*	50gm/L
T_6	Allamonda leaf extract	*Allamanda cathartica*	50gm/L
T_7	Control	Water	

undisturbed overnight, filtered through fine cloth and poured into a volumetric flask (1 L). Fresh water was added to make the volume one liter.

2.4 Experimental Design andLayout

The treatmental plots were arranged randomized complete block design (RCBD) with three replications. Each plot size was 3.6m×1.6m. Four week-oldseedlings were transplanted to the field . Spacing between plants (50cm) and rows (75cm), inter cultural operations and fertilizer applications were followed as per recommendation of Bangladesh Agricultural Research Institute (BARI).

Total number of fruits and infested fruits of five randomly selected plants per plot were recorded at each harvest. Tomatoes exhibit synchronous maturity of fruits which means several pickings are required to harvest.Three time harvest were done at early fruiting stage (40 days after transplant), mid fruiting stage (80 days after transplant) and late fruting stage (100 days after transplant). Infested fruits recorded at each observation were pooled and finally expressed in percentage. The damaged fruits were spotted out by the presence of holes made by the larvae. Yield was calculated by pooling the weight of each harvest.

2.5 Statistical Analysis

The data obtained for different characters were statistically analyzed to find out the significance for different treatments. The analysis of variance was performed by using the STAT-10 Program. The significance of the difference among the treatments were estimated by Tukey's HSD Test at 5% level of probability.

3. RESULTS AND DISCUSSION

3.1 Effect of Botanicals on *H. armiger* During Early Fruiting Stage

Highest number of infested fruits (11.33/ plot) was obtained from control plots (untreated) which differed significantly from all other treatments (Table 2). The most effective botanical was neem leaf extract with the lowest number of infested fruits (2.67fruits/plot) obtained from T_1 which was significantly different from any other treatments in the experiment. Our results are concurring with previous studies [13], reported that the lowest number of infested fruit (0.17) was obtained when the crop was treated with neem oil @ 3.0 m/l of water at three days intervals. Satisfactory control of *H. armigera* on pigeon pea was obtained through application of neem oil [14]. Neemactin (0.00075%) and neem gold (0.00045%) were very effective in reducing larval population of *H. armigera* on tomato [15].

Highest number (48.33fruits/plot) of healthy fruits was obtained from T_1 which was significantly different from any other treatments in the experiment. This treatment showed 70.59% increase of healthy fruits over control treatment. Lowest number of healthy fruits (28.33 fruits/plot) was obtained from control treatment (untreated). Eventually, it showed significant variation from all other treatments of the present experiment. [13] reported that the highest yield (66.80 tonnes) was recorded when the crop was treated with neem oil@ 3.0 ml/L at three days intervals.

The yield of (2.45kg/plot) of healthy fruits obtained from T_1 was the highest which was significantly different from all other treatments (Table 2). [16] aAlso reported that neem seed kernel extract (NSKE @ 5%) was found most effective in reducing the *H. armigera* population and pod damage in chickpea. It was demonstrated that azadirachtin was effective systemically and when insects ingest azadirachtin and it had interrupt growth and development of insects.

3.2 Effect of botanicals against *H. armigera* during Mid Fruiting Stage

All treatments were better than control. The lowest number (5.63 fruits/plot) of infested fruit was obtained from T_1 which was significantly

Table 2. Effect of botanicals against fruit borer at early fruit bearing stage of tomato

Treatments	Number of infested fruit/plot	Decrease over control (%)	Number of healthy fruits/plot	Increase over control (%)	Weight (kg) of healthy fruits /plot	Increase over control (%)
Neem leaf extract (T_1)	2.67 f	76.43	48.33 a	70.59	2.45 a	75.
Datura seed extract (T_2)	9.67 b	14.65	34.00 e	20.01	1.65 e	17.86
Garlic bulb extract (T_3)	8.33 c	26.47	37.33 d	31.76	1.8d	28.57
Mahogany seed extract (T_4)	5.33 e	52.95	45.66 b	61.17	2.2b	57.14
Black pepper seed extract (T_5)	6.67 d	41.12	42.66 c	50.58	2.0c	42.85
Allamonda leaf extract (T_6)	10.33 b	8.82	31.66 e	11.75	1.5f	7.14
Untreated (T_7)	11.33 a	-	28.33 f	-	1.4 f	-
LSD 0.05	**1.23**	-	**2.54**	-	**0.12**	-
CV(%)	**11.48**	-	**13.74**	-	**13.66**	-

In a column means followed by similar letter (s) are statistically identical at 0.05 level of probability

Table 3. Effect of botanicals against fruit borer at mid fruit bearing stage of tomato

Treatment	Number of infested fruits/plot	Decrease over control (%)	Number of healthy fruit /plot	Increase over control (%)	Weight (kg) of healthy fruits /plot	Increase over control (%)
Neem leaf extract (T_1)	5.63 f	65.41	63.32 a	48.98	3.10 a	55.78
Datura seed extract (T_2)	13.33 bc	18.12	46.67 e	9.81	2.18 e	9.04
Garlic bulb extract (T_3)	12.23 cd	24.87	50.56 d	18.96	2.459 d	25.12
Mahogany seed extract (T_4)	8.33 e	48.83	59.28 b	39.48	2.86 b	43.71
Blackpepper seed extract (T_5)	10.67 d	34.45	54.68 c	28.65	2.61 c	30.65
Allamonda leaf extract (T_6)	14.67 ab	9.88	44.21 f	4.02	2.11 e	6.03
Untreated (T_7)	16.28 a	-	42.50 g	-	1.99 f	-
LSD0.05	**1.42**	-	**1.36**	-	**1.1777**	-
CV(%)	**6.99**	-	**9.08**	-	**12.67**	-

In a column means followed by similar letter (s) are statistically identical at 0.05 level of probability

Table 4. Effect of botanicals against fruit borer at late fruiting stage of tomato

Treatment	Number of infested Fruit/plot	Decrease over control (%)	Number of healthy fruits/plot	Increase over control (%)	Weight (kg) of healthy fruits/plot	Increase over control (%)
Neem leaf extract (T_1)	4.48 d	66.93	59.35 a	82.72	2.91 a	88.96
Datura seed extract (T_2)	10.35 b	23.61	42.67 e	31.37	1.99 e	29.22
Garlic bulb extract(T_3)	8.77 c	35.27	46.50 d	43.16	2.21 d	43.56
Mahogany seed extract (T_4)	5.24 d	61.32	55.23 b	70.04	2.75 b	78.57
Black pepper seed extract (T_5)	7.68 c	43.32	50.78 c	56.34	2.41 c	56.49
Allamonda leaf extract (T_6)	11.72 b	13.50	37.34 f	14.96	1.73 f	10.38
Untreated (T_7)	13.55 a	-	32.48 g	-	1.54 g	-
LSD0.05	**1.74**	-	**2.07**	-	**1.14**	-
CV(%)	**11.5**	-	**12.51**	-	**12.9**	-

In a column means followed by similar letter (s) are statistically identical at 0.05 level of probability.

different from all other treatments. Highest fruit infestation (16.28 /plot) was obtained from control plots (untreated) which was statistically similar with T_6. Highest number (63.32 fruits/plot) of healthy fruits were obtained from T_1 which was significantly different from all other treatments. Lowest number of healthy fruits per plot (42.50 /plot) was obtained from control plots (Table 3).

The highest yield (3.10 gm/plot) of healthy fruits obtained from T_1, was significantly different from others treatments. This treatment showed 56.01% increase over control. Lowest weight of healthy fruits (1.99 gm/plot) was obtained from control (Table 3).

3.3 Effect of Botanicals against *H. armigera* during Late Fruiting Stage

At late fruit bearing stage, lowest number (4.48fruits/plot) of infested fruits was obtained from T_1 which was statistically similar to T_4 but different from all other treatments. T_1 showed 66.93% decrease of fruit infestation over control. Highest fruit infestation (13.55 / plot) was observed in control plots. All treatments performed better than control (Table 4).

Highest number (59.35fruits/plot) of healthy fruits was obtained from T_1 which was significantly different from all other treatments and this was found to be -88.96% increase of healthy fruits over control. Lowest number of healthy fruits (32.48/plot) was obtained from control which was statistically different from all other treatments (Table 4). The highest weight (2.91 kg/plot) of healthy fruits obtained from T_1 which was significantly different from all other treatments. This treatment showed 88.96% increase of weight over control. Lowest weight of healthy fruits per plot (1.54 kg/ plot) was obtained from control plots (Table 4). [17] demonstrated 100% antifeedant, larvicidal and pupicidal activities of Neem gum nano formulation, a novel biopesticide prepared from the neem gum extract (*Azadirachta indica*) against *Helicoverpa armigera* (Hub.) and *Spodoptera litura* (Fab.) at 100 ppm. [18] observed that Plant based biopesticides such as extracts of neem and eucalyptus are gaining increasing attention as potential alternatives to synthetic pesticides due to their reduced toxicity to non-target species and the environment. They evaluate the efficacy of ethanolic and aqueous extracts of neem (*Azadirachta indica*) as biopesticides against the brinjal fruit and shoot borer (BFSB) (*Leucinodes orbonalis*), a major pest of brinjal (eggplant) crop. The biopesticides were applied to brinjal fruit and their efficacy was evaluated by monitoring the mortality of BFSB larvae and pupae. The results showed that neem leaf extracts were effective in controlling BFSB larvae, a 5% concentration of ethanolic extracts of neem caused 82% mortality of BFSB larvae.

4. CONCLUSION

From the above discussion, we found that, among the botanicals neem leaf extract @ 50gm/L gave the best performance and decrease 76.43%, 65.41% and 66.93% fruits infestation at early fruit stage, mid fruiting stage and late fruiting stage respectively. So, it can be concluded that neem leaf extract could be a potent source to enhance protection from fruit borer and ultimately improve the productivity and quality of tomato.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ACKNOWLEDGEMENTS

We thank anonymous reviewers for their kind review of the manuscript. This research was financially supported by Sher-e-Bangla Agricultural University.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. BBS. Statistical pocket book. Statistics division, ministry of planning, Government of the People's Republic of Bangladesh, Dhaka; 2021-2022.
2. Aditya TL, Rahman L, Alam MS, Ghoseh AK. Correlation and path co-efficient analysis in tomato. Bangladesh J. Agric. Sci. 2010;26(1):119- 122.
3. Alam MJ, Ahmed KS, Mollah MRA, Tareq MZ, Alam MJ. Effect of planting dates on the yield of mustard seed. Intl. J. Appl. Sci.Biotech.2015;3(4):651-654.

4. Muthukumaran N, Selvanarayanan V. Studies on influence of microbial inoculants on feeding preference of fruitworm towards tomato accessions. In: Natl, S. (Ed.). On golden thoughts on current microbial research. Book of abstracts, Department of Microbiology, Annamalai University, Tamil Nadu, India; 2013.
5. Chakraborty K, Santosh R, Chakravarthy A. Incidence and abundance of tomato fruitborer, *Helicoverpa armigera* (Hubner)in relation to the time of cultivation in the northern parts of West Bengal, India. Curr. Biot. 2011;5: 91-97.
6. Dhandapani N, Shelkar UR, Murugan M. Biointensive pest management (BIPM)in majorvegetable crops:an Indian perspective. Food Agric. Environ. 2003; 1:333-339.
7. Karabhantanal S, Awaknavar J, Patil R, Patil B. Integrated management of the tomato fruit borer, *Helicoverpa armigera* Hubner. Karnataka J. Agric. Sci. 2010;18:977-981.
8. Manjunath TM, Bhatnagar VS, Pawar CS, Sithanatham S. Economic importance of *Heliothis* sp. in India and an assessment of the irnatural enemies and host plants. Proc. Workshop Biol. Contr. Heliothis, ICRISAT. Nov. 1985;11-15.
9. Ravi M, Santharam G, Sathiah N. Ecofriendly management of tomato fruit borer, *Helicoverpa armigera* (Hubner). J. Biopest. 2008;1:134-137.
10. Hara A. Finding alternative ways to control alien pest part 2: New insecticides introduced to fight old pests. Hawaii Landscape. 2000;4:5.
11. Karim MA. Insect pest management of vegetable crops. Proceeding of a symposium on resent advances in vegetable development of Bangladesh, 24-25 April, 1994;198-199.
12. Jacob Y, Sheila K. Comparison of capsules of sex pheromone of *Heliothis (Helicoverpa) armigera* (Hubner) (Lepidoptera: Noctuidae). Boletin de Sanidad Vegetal Plagas, 1992;18(2): 427-434.
13. Mustafiz SSB, Chowdhury MTI, Akter A. Efficacy of some botanicals in controlling fruitborer (*Heliothis armigera*) in tomato. Acad. J. Entom. 2015;8(3):140-149.
14. Rao MS, Raman GV, Srimannarayan G, Venkateswarlu B. Efficacy of botanicals against gram pod borer, *Helicoverpa armigera* Hubner. Pestology. 1999; 23:1822.
15. Pant SK. Bioefficacy of some insecticides and neem products against *Helicoverpa armigera* Hubner on tomato. Pestology. 2000;24:30-32.
16. Bhushan S, Singh RP, Shanker R. Bio-efficacy of neem and *Bt* against pod borer, *Helicoverpa armigera*in chickpea. J. Biopest. 2011;4:87-89.
17. Kamaraj C, Gandhi PR, Elango G, Karthi S, Chung IM, Rajakumar G. Novel and environmental friendly approach; Impact of Neem (*Azadirachta indica*) gum nano formulation (NGNF) on *Helicoverpa armigera* (Hub.) and *Spodoptera litura* (Fab.). International Journal of Biological macromolecules. 2018;107, part A:59-69.
18. Hamza A, Manzoor M, Anees M, Javaid A, Rizwan M, Malik T, Ferdosi FH, Intisar A, Sami A, Haider HZ, Haider MS. Bioefficacy of some botanical extracts against brinjal fruit and shoot borer [*leucinodes orbonalis* (guenee); lepidoptera, pyrallidae). Plant Protection, 2023;07(02): 263-272.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/118617