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BIORATIONAL MANAGEMENT OF SUCKING PESTS OF TOMATO

T Ahmed, MRU Miah*, M Nasrin and MR Amin

Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh

***Correspondence**: Md Ramiz Uddin Miah, Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh, E-mail: ramizmiah@bsmrau.edu.bd

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ABSTRACT

The biorational insecticides namely Biomax 1.2 EC, Ripcord 10 EC, Sunmectin 1.8 EC, Spinosad 12.5 SC, Mahogany oil, Neem oil, and Detergent (Veem liquid) with concentrations of 1 ml/L, 2 ml/L, 2 ml/L, 2 ml/L, 5 ml/L, 5 ml/L and 20 ml/L of water, respectively were applied to manage jassid and whitefly attacking tomato (*Solanum lycopersicum*) plants. The efficacy of the biorational insecticides was compared to control treatment (untreated). Results showed that the biorational treatments significantly reduced the incidence of jassid and whitefly, and exerted lower level of virus infection compared to the control. The biorational treatments did not affect the level of K, Ca and Mg contents of the fruit and presented significantly higher amount of yield and benefit-cost ratio than that of control. The biorational treatment Sunmectin 1.8 EC showed the lowest abundances of whitefly and jassid, and revealed the lowest level of virus infected plants, leaves and fruits. The plants treated with Sunmectin 1.8 EC resulted the highest yield (58t/ha) and benefit cost ratio (6.1). The tested biorational approaches specially Sunmectin 1.8 EC may be used as a tool of integrated management program of sucking pests of tomato like jassid and whitefly.

Keywords: Biorational insecticide, *Solanum lycopersicum*, jassid, whitefly, yield

Introduction

Tomato *Solanum lycopersicum* is one of the most popular vegetables in Bangladesh and throughout the globe as well. The crop is cultivated in an area of about 30756 ha of land with the total production of 414 thousand mt. The average yield of tomato in Bangladesh is 13.9 (t/ha) (BBS 2018). The soil and climatic conditions of Bangladesh are favorable for tomato cultivation but still the yield per hectare area is rather low in comparison to other countries due to the attack of insect pests and other factors.

The sucking insects specifically aphid (*Aphis gossypii)*, white fly (*Bemisia tabaci)*, thrips (*Scirtothrips dorsalis)*, and jassid (*Amarasca biguttula biguttula)* attack tomato plants in Bangladesh and many other countries of the world. They suck sap from the plants with their piercing sucking mouthparts and the infested plants causing leaf curling, leaf and fruit dropping and withering. The sucking insects help in transmitting of virus diseases (Jones 2003). The sucking insects deposit honeydew on the infested leaves of the plant which develops sooty mold fungi causing the plants to suffer from photosynthetic activity. The deposition of honey dew at the juvenile stage of the plant may decrease both yield and quality of the crop (Agegnehu *et al*. 2014).

The white fly is a highly polyphagous insect in tropical and subtropical zones on vegetable (Oliveira *et al*. 2001, Perring 2001, Jones 2003). The adult is the most mobile stage and is responsible for colonizing the host plant. Yield losses due to direct and indirect damage caused by whitefly, thrips and jassid were reported to the extent of 20 to 100%, 23.7% and 54%, respectively (Papisarta and Garzia 2002, Kagezi *et al*. 2001, Ghosal *et al.* 2013).

Farmers always desire quick curative action for controlling pests and they use synthetic insecticides to control sucking insects of tomato. Those insecticides are hazardous for human, natural enemies and pollinators of crop plants. Biorational insecticides are relatively non-toxic to people with few environmental side-effects. Considering the importance of tomato and problems encountered regarding insect pest management of this crop, the present study was undertaken to evaluate the efficacy of some biorational insecticides against whitefly and jassid attacking tomato.

Materials and Methods

Study site and condition: The study was conducted from November 2018 to April 2019 in the field of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur (25°25' N and 89°5' E), Bangladesh. The site has subtropical climate with mean annual rainfall of 2376 mm, relative humidity of 65.8%, and temperature of 24.4° C (Amin *et al*. 2018).

Cultivation of tomato variety: The study was done with tomato variety BARI Tomato 14. Seeds of the tomato were collected from Horticulture Research Center, Bangladesh Agricultural Research Institute, Gazipur. The experiment was laid out in a completely randomized block design, replicated thrice with spacing of row to row and plant to plant 60 cm and 50 cm respectively. The land was divided into 24 equal plots with plot to plot distance of 1.0 m and block to block distance 1.5 m. Four weeks old seedlings were transplanted on 27 November 2018 in the experimental plots size of 3m×3m. Each plot contained five rows, and each row had five plants. Manures and fertilizers were applied according to the Fertilizer Recommendation Guide (FRG 2012). Irrigation and weeding were done whenever necessary.

Application of treatments and data collection: The biorational insecticides namely Biomax 1.2 EC, Ripcord 10 EC, Sunmectin 1.8 EC, Spinosad 12.5 SC, Mahogany oil, Neem oil, and Detergent (Veem liquid) with concentrations of 1 ml/L, 2 ml/L, 2 ml/L, 2 ml/L, 5 ml/L, 5 ml/L and 20 ml/L of water, respectively were applied to manage jassid and whitefly attacking tomato plants. The control plots were kept free from management of jassid and whitefly. Field inspection was carried out weekly to observe the incidence of the insects on the tomato plants. The insecticides were sprayed eight times at 7 days' interval from the advent of the insect pests. To collect data of the jassid and whitefly incidence, underside of leaves was observed carefully and the number of jassid and whitefly per selected 3 leaves per plant after 24, 48 and 72 hours of spraying were recorded.

Observation of virus infection level: At the first harvest of fruit, total number of plants and number of virus infected plants of each plot were counted and virus infection level of plant for each treatment was calculated into percentage. To find out the infection level of leaves and fruits, all the leaves and fruits of the infected plants and number of infected leaves and fruits of those plants were counted at the first harvest of fruit then percent infection level of leaf and fruit were calculated.

Calculation of yield and benefit-cost ratio: At every harvest, the plucked fruits of each treatment were separated into marketable and infested categories and their weights were measured. The yield of each plot was converted into kg/ha. The economic analysis and benefit-cost ratio (BCR) were calculated based on the total expenditure for each treatment and the total return per hectare. The total expenditure for a treatment indicates the costs for labor and inputs. The gross return of a treatment is the total price obtained from the total yield of the treatment. The net return was calculated by subtracting the expenditure of a treatment from its gross return. The adjusted net return of each treatment was calculated by subtracting the net return of the control from the net return of the treatments. The BCR is the result of the adjusted net return of a treatment divided by the total expenditure of the same treatment.

Data analysis: The recorded data were analyzed using analysis of variance (ANOVA) followed by least significant difference (LSD) test at 5% level of probability.

Results and Discussion

The biorational insecticides showed significant effect on the incidence of jassid at 24, 48 and 72 hours after treatment (Table 1). The incidence of jassid among the treatments varied from 16.3 to 57.7 per 3 leaves and the tested insecticides revealed statistically lower number compared to control. The lowest incidence of jassid was recorded in Sunmectin 1.8EC treated plots.

The incidence of whitefly among the treatments at 24, 48 and 72 hours after spray ranged from 6.7 to 20.8 per 3 leaves, respectively and the results differed significantly (Table 2). All the biorational insecticides showed statistically the lower number of whitefly than that of control. Among the biorational treatments, Sunmectin 1.8EC revealed the lowest incidence. The biorational treatments specifically Neem oil and Detergent showed the incidences of 33.8 and 43.9 jassids /3 leaves, respectively which are statistically lower than control. Rashid *et al.* (2012) reported that the neem oil with concentration of 2% and neem seed extract of 3% significantly reduced the thrips, whitefly and jassid population up to twelve days than untreated control on cotton. Fiaz *et al.* (2012) reported that neem oil and neem leaf extract at 5% concentration gave 37% and 39% mortality of jassid on cotton.

Virus infection level of plant, leaf and fruit among the treatments ranged from 18.5 to 66.7, 13.1 to 34.9 and 8.3

Table 1. Efficacy of different biorational treatments on the incidence of jassid on tomato plant

Biorational Treatment	Incidence of jassid at different hours after treatment		
	24HAT	48HAT	72HAT
Biomax 1.2 EC	30.3 e	33.9 d	9.7 fg
Ripcord 10 EC	18.2 g	20.5 g	11.4 f
Sunmectin 1.8 EC	16.3 g	13.4 h	7.7 g
Spinosad 12.5 SC	23.8 f	24.7 f	15.9 e
Mahogany oil	50.5 b	44.8 b	29.0 b
Neem oil	33.8 d	29.5 e	19.3 d
Detergent	43.9 c	38.9 c	24.0 c
Control	57.7 a	52.0 a	46.8 a

Means within a column followed by same letter(s) are not significantly different according to Tukey posthoc test at $p \leq 0.05$.

Table 2. Efficacy of biorational insecticides on the incidence of whitefly on tomato plant

Biorational Treatment	Incidence of whitefly at different hours after treatment		
	24HAT	48HAT	72HAT
Biomax 1.2 EC	14.3 e	12.9 d	11.7 fg
Ripcord 10 EC	12.2 g	11.5 g	10.4 f
Sunmectin 1.8 EC	8.3 g	7.4 h	6.7 g
Spinosad 12.5 SC	13.8 f	11.7 f	10.9 e
Mahogany oil	12.5 b	11.8 b	9.0 b
Neem oil	13.8 d	12.5 e	10.3 d
Detergent	15.9 c	13.9 c	11.0 c
Control	20.7 a	20.6 a	20.8 a

Means within a column followed by same letter(s) are not significantly different according to Tukey posthoc test at $p \leq 0.05$.

to 30.2% respectively and the results differed significantly (Table 3). Control plot and Sunmectin 1.8 EC revealed the highest and the lowest (76.9, 53.7, 56.1 and 18.5, 13.1, 8.3 %) percentage of plant, leaf and fruit infection respectively. Yasin *et al*. (2017) cultivated Nagina variety of tomato in Pakistan and observed 75.0% infection level. The results obtained in this study proved that Sunmectin 1.8 EC may be used as crude biorational treatments for effective management of jassid and whitefly. It was found that number of virus infected plants increased rapidly in plots with no biorational treatment application and steadily in plots under biorational treatments.

Potassium, calcium and magnesium contents in healthy and infected fruits of the treatments ranged from 1.0% to 1.3%, 1.2% to 1.3% and 0.3% to 0.4%, respectively and the results were statistically indifferent (Table 4). Yields of tomato obtained from the biorational treatments are presented in Table 5. All the tested biorational insecticides resulted higher yield than that of control. The highest yield (58.0 t/ha) was found in Sunmectin 1.8EC treated plot followed by Ripcord 10 EC (55.1 t/ha), Biomax 1.2 EC (54.1 t/ha), Spinosad 12.5 SC (48.3 t/ha). Subba *et al.* 2017 reported that the highest yield (30.15 t/ha) in acetamiprid treated plots followed by neem (27.55 t/ha), and the lowest yield was recorded from control plots (18.32 t/ha). The gross return and net return among the treatments varied from 406950 to 870000 Tk/ha and 392500 to 847805 Tk/ha, respectively. All the biorational insecticides exerted higher amount of gross and net returns compared to control. The highest gross and net returns was obtained in the treatment of Sunmectin 1.8EC. The highest and the lowest adjusted net return were found in Sunmectin 1.8 EC and Detergent treated plot (455305 and 158750 Tk/ha respectively). Sunmectin 1.8 EC and Ripcord 10 EC treated plot revealed the highest benefit cost ratio (6.1 and 6.0) and Detergent treated plot revealed the lowest benefit cost ratio 2.0 (Table 5).

The present study revealed that the biorational insecticides significantly reduced the infestation of sucking insects on tomato plants and did not affect the quality content of the fruits. All the tested biorational insecticides resulted significantly higher yield through controlling the infestation of sucking insects. Biorational insecticides have contact mode of action and they cause mortality of the pest insects, simultaneously act as antifeedants, repellents and growth regulators, and affect their population and

Table 3. Efficacy of different biorational insecticides on the infection of virus on tomato plants

Biorational Treatment	Virus infection level (%) at first harvest of fruit		
	Plant	Leaf	Fruit
Biomax 1.2 EC	30.4d	19.5cd	12.6e
Ripcord 10 EC	43.3cd	26.4c	10.0
Sunmectin 1.8 EC	18.5e	13.1d	8.3f
Spinosad 12.5 SC	45.8cd	24.9c	27.1c
Mahogany oil	66.7b	34.9b	17.0d
Neem oil	48.6c	30.8b	25.3c
Detergent	50.0c	32.2b	30.2b
Control	76.9a	53.7a	56.1a

Means within a column followed by same letter(s) are not significantly different according to Tukey posthoc test at $p \leq 0.05$.

Table 4. Efficacy of various biorational treatments on the quality content

Biorational Treatment	Content (%)		
	K	Ca	Mg
Biomax 1.2 EC	1.3 a	1.3 a	0.4 a
Ripcord 10 EC	1.0 a	1.2 a	0.3 a
Sunmectin 1.8 EC	1.0 b	1.2 a	0.3 a
Spinosad 12.5 SC	1.1 a	1.2 a	0.3 a
Mahogany oil	1.1 a	1.3 a	0.3 a
Neem oil	1.0 a	1.3 a	0.3 a
Detergent	1.1 a	1.2 a	0.4 a
Control	1.0 a	1.2 a	0.3 a

Means within a column followed by same letter(s) are not significantly different according to Tukey posthoc test at $p \leq 0.05$.

Table 5. Yield and benefit cost analysis of different treatments

Biorational Treatment	Yield (t/ha)	Cost (Tk/ha)	Return			BCR
			Gross	Net	Adjusted	
Biomax 1.2 EC	54.1	23880	811950	788070	395570	4.3
Ripcord 10 EC	55.1	24450	826500	802050	409550	6.0
Sunmectin 1.8 EC	58.0	22195	870000	847805	455305	6.1
Spinosad 12.5 SC	48.3	26560	724950	698390	305890	3.9
Mahogany oil	38.9	22565	583200	560635	168135	2.6
Neem oil	40.7	21895	610350	588455	195955	3.5
Detergent	38.0	18450	569700	551250	158750	2.0
Control	27.1	14450	406950	392500	-	-

infestation. Many authors reported impressive efficacy of biorational insecticides for reduction of population and infestation of sucking and chewing insects on different crops (Ahmed et al. 2015, Mohammad 2018, Ahmed et al. 2019).

The findings revealed that the abundance of jassid and whitefly was the lowest in Sunmectin 1.8EC treated plot after 24 and 48 hours of spraying. The lowest percentage of virus disease incidence, infected leaves, and fruits were recorded in Sunmectin 1.8EC treated plot. In case of virus disease incidence, biorational treatments performed better than untreated control. Sunmectin 1.8EC treated plot revealed the highest yield and benefit-cost ratio. So, it can be concluded that biorational management practices comprising of Sunmectin 1.8EC with concentration of 2

ml/L was the most effective in controlling whitefly and jassid as well as virus disease incidence in tomato.

References

Agegnehu E, Ousma Y and Ayalew A. 2014. Screening of some foliar chemical insecticides against whitefly (*Bemisia tabaci*) on tomato at Metema district, North Gondar, Ethiopia. Open Access Library Journal, *1:* 1-7.

Ahmed MT, Miah MRU, Amin MR and Hossain MM. 2015. Evaluation of some plant materials against pod borer infestation in country bean with reference to flower production. Annals of Bangladesh Agriculture, *18*: 71-78.

Ahmed MT, Miah MRU, Amin MR, Hossain MM, Suh SJ and Kwon YJ. 2019. Plant material as an alternative tool for management of aphid in country bean field. International Journal of Pest Management, *65*: 171-176.

Amin MR, Mia MS, Rahman H, Nancy NP and Bhuiyan MKA. 2018. Functional and group abundance of insects on eggplant. Bangladesh Journal of Agricultural Research, *43:* 647-653.

BBS. 2018. Year Book of Agricultural Statistics. Bangladesh Bureau of Statistics, Ministry of Agriculture, Government of the People's Republic of Bangladesh.

Fiaz M, Hameed A, Hassan M and Wakil W. 2012. Efficacy of plant extracts on some cotton (*Gossypium hirsutum*) pests: *Amrasca bigutulla bigutulla* Ishida and *Thrips tabaci* Lindeman. Pakistan Journal of Zoology, *44*: 277-283.

FRG. 2012. Fertilizer Recommendation Guide. Bangladesh Agricultural Research Council, Farmgate, Dhaka, Bangladesh.

Ghosal A, Chatterjee ML and Bhattacharyya A. 2013. Bio-efficacy of neonicotinoids against *Aphis gossypii* Glover of okra. Journal of Crop and Weed, *9:* 181-184.

Jones DR. 2003. Plant viruses transmitted by whiteflies. European Journal of Plant Pathology, *109:* 195-219.

Kagezi EL, Kyamanywa S, Akemo MC, Luther G and Erbaugh M. 2001. Damage-yield relationships of major pests of tomatoes in central Uganda. Integrated Pest Management Collaborative Research Support Program Annual Report, *8:* 259-262.

Mohammad A, Alam SN, Miah MRU, Amin MR and Saif HB. 2018. Biorational management packages of jassid and shoot and fruit borer of okra. Bangladesh Journal of Agricultural Research, *43*: 323-332.

Oliveira MRV, Henneberry TJ and Anderson P. 2001. History, current status, and collaborative research projects for *Bemisia tabaci*. Crop Protection, *20:* 709-723.

Papisarta C and Garzia GT. 2002. Tomato yellow leaf curl virus and its vector *Bemisia tabaci* in Sicillia (Italy): present status and control possibilities. OEPP/EPPO Bulletin, *32:* 25-29.

Perring TM. 2001. The *Bemisia tabaci* species complex. Crop Protection, *20:* 725-737.

Rashid MM, Khattak MK and Abdullah K. 2012. Evaluation of botanical and synthetic insecticides for the management of cotton pest insects. Pakistan Journal of Zoology, *44:* 1317-1324.

Subba B, Pal S, Mandal T and Ghosh SK. 2017. Population dynamics of whitefly (*Bemisia tabaci* Genn.) infesting tomato (*Lycopersicon esculentus* L.) and their sustainable management using biopesticides. Journal of Entomology and Zoology Studies, *5:* 879-883.

Yasin MU, Arain MA, Zulfiqar U, *et al.* 2017. Tomato leaf curl virus disease (TLCVD) and its resistance management practices. Journal of Global Innovation in Agriculture and Social Science, *5*: 99-104.