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REDUCTION OF SUCKING INSECT ABUNDANCE USING BOTANICALS FOR PROPER GROWTH AND YIELD OF OKRA

MRU Miah[1], R Chanda[1], MR Amin[1*], MA Hoque[2] and AA Seddique[3]

[1]Department of Entomology, [2]Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh. [3]Department of Environmental Science and Engineering, Jatiya Kabi Kazi Nazrul Islam Univeristy, Mymensingh, Bangladesh.

Correcpondance: Md. Ruhul Amin, Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Email: mramin.bsmrau@gmail.com.

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ABSTRACT

The study was conducted in the experimental field of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur to evaluate the efficacy of nine plant materials against sucking insects namely jassid and whitefly on okra variety BARI Dherosh 2. All the treatments revealed a significantly lower abundance of jassid and whitefly on the okra plant in 24, 48 and 72 hours after treatment but did not affect the population of natural enemies. Okra plant exhibited better morphological attribute and yield in the botanicals treated plots compared to control. Significantly the lowest abundance of the sucking insects was found on the neem leaf extract treated plants. The neem leaf and garlic extracts showed statistically similar and higher plant morphological traits as well as yield.

Keywords: *Abelmoschus esculentus,* botanicals, jassid, white fly, predator

Introduction

Okra *Abelmoschus esculentus* L. belongs to the family Malvaceae is one of the important nutritious vegetables grown round the year in Bangladesh. The main biotic obstacle of okra production in Bangladesh is the infestation of insects which cause immense loss to the crop by reducing yield. Okra is susceptible to the attack of various insects from seedling to fruiting stage such as okra jassid, whitefly, shoot and fruit borer, cut worm, aphids etc. Among the insect pests of okra, whitefly (*Bemisia tabaci)* and jassid (*Amrasca biguttula biguttula*) are the most common, which cause direct damage to tender shoots and fruits through sucking sap and act as vectors of many plant viral diseases (Atwal 1994).

Extract of leaf, bark, seed of different plants, and vegetable oil possess an array of properties including insecticidal activity and insect growth regulatory activity against many insect and mite pests (Amin *et al*. 2017a, Amin *et al*. 2017b, Shafiullah *et al.* 2017). As botanicals are plant derived pesticides, they are less hazardous, biodegradable, and maintaining balanced bio-diversity of insect-pest. Management of jassid and whitefly by using botanicals is ecofriendly as these contain less toxic effect on the environment and human health (Ref). Considering the above mentioned importance of okra and problems encountered due to major insect pests (Jassid and Whitefly) infestation for better production of okra as well as to save the natural enemies of those insect pests, the study was undertaken to identify the most effective botanicals for reducing the infestation of jassid and whitefly on okra plant, to know the effect of the botanicals on the natural enemies of insect pests and impact on crop morphological characters and yield.

Materials and Methods

Study site and condition: The study was carried out in the experimental field of the Department of Entomology of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, from February 2016 to July 2016. The experimental site was situated at 240.09 N latitude and 900.26° E longitude with an elevation of 8.4 meters from the sea level and has sub-tropical climate.

Cultivation of okra: Seeds of the okra variety BARI Dherosh-2 were collected from Bangladesh Agricultural Research Institute, Gazipur, Bangladesh. The seeds of okra were sown directly in the main field on 10 February, 2016. The intensive care and all necessary intercultural operations, including irrigation, weeding, thinning etc. were done in the proper time to obtain healthy plants.

The design of the study: The experiment was laid out in a randomized complete block design (RCBD) with three replications. In experimental field was 22.5 m × 15.5 m. The field study was divided into 30 equal plots (2 m × 2 m) having plot to plot distance 0.5 m and block to block distance 2.0 m. The whole area of the experimental field was divided into three blocks and each block was again divided into 10 unit plots. The row to row and plant to plant spacing was maintained at 1m × 0.5 m respectively.

Preparation and application of botanicals and observation of the abundance of sucking insects: Leaves of allamonda, basil and neem, fruits of chilli and garlic, turmeric and coriander were collected, dried in an oven at 65" for 48 h to a constant weight ground in a commercial grinding machine, and sieved to pass through a 1 mm mesh screen and then dissolved in distilled water with 10 drops of 2% sodium dioctyl sulfo-succinate L^{-1}. Mahogany oil, neem oil were purchased from the market at Gazipur, Bangladesh. Okra plants were closely observed at weekly interval and the plant materials were applied in the field at the advent of the abundance of sucking insects namely jassid and whitefly. The plant material treatments were allamonda leaf extract with concentration 100 ml L^{-1}, turmeric powder 20 g L^{-1}, coriander powder 20 g L^{-1}, basil leaf extract 100 ml L^{-1}, chilli powder 20 g L^{-1}, garlic extract 100 g L^{-1}, neem leaf extract 100 ml L^{-1}, mahogany oil 5 ml L^{-1}, neem oil 5 ml L^{-1} water and control (untreated). The plant materials were applied at 7 days interval and the abundance (number $plant^{-1}$) of jassid and whitefly at 24, 48 and 72 hours after treatment (HAT) were counted. Abundance (number $plant^{-1}$) of lady bird beetles, ant and spider were observed at 72 HAT.

Observation of plant morphological characteristics: At the first harvest of the pod, three plants were randomly selected from three rows of each plot. Number of branches of the plants were counted, then five leaves were randomly selected from the middle position of the plants. Length and widths of the leaves were measured using a scale. The height was measured from the soil surface to the top of the plants.

Fruit harvesting and measurement of yield: Green pods when they attained the edible stage were harvested and the first harvest was starteded 55 days after planting. Fruits were harvested six times at every alternate day. The total amount of harvested fruit in each treatment plot was converted into t ha^{-1}.

Statistical analysis: Data were analyzed by one way analysis of variance and the mean differences of the treatments were separated by Least Significant Difference (LSD) test at the 5% level of probability.

Results and Discussion

Effects of different plant materials on the abundance of jassid on the okra plant at 24, 48 and 72 hours after treatment (HAT) are presented in Table 1. Results showed that the number of jassid at 24, 48 and 72 HAT varied from 20.2 to 98.4, 19.9 to 89.0 and 15.9 to 77.0 $plant^{-1}$, respectively and the results differed significantly ($p < 0.05$). All the treatments revealed a significantly lower abundance of jassid compared to control. The lowest abundance of jassid at 24, 48 and 72 HAT was found on neem leaf extract treated plant.

Abundance of whitefly on okra plant at 24, 48 and 72 HAT with various plant materials revealed a significant difference ($p < 0.05$) and the treatments exerted lower abundance compared to control (Table 2). Whitefly showed their abundance from 20.1 to 101.20, 19.1 to 95.0 and 13.5 to 67.0 $plant^{-1}$ at 24, 48 and 72 HAT, respectively. Whitefly showed the lowest abundance at 24, 48 and 72 HAT when the plants were treated with neem leaf extract.

The findings indicated that the botanicals used in this experiment were effective in reducing the abundance of nymphs and adults of jassid and whitefly on okra plant. This might be due to repellent, antifeedant and toxic effect of the plant materials. Abundance of the pest insects reduced by the time of exposure because the penetrability of the compound of the crude botanicals into the cuticle of the insect is very slow and cause mortality leisurely.

There has been reviewed by many authors that the plant materials individually or in the sequential application of biopesticides or chemical insecticides significantly reduced sucking insect population and infestation on different crops. Amin *et al*. (2017c) reported that sequential application of neem oil with biopesticides and chemical insecticides reduced aphid population on yard long bean at 24, 48 and 72 HAT and revealed a lower level of flower infestation compared to control.

There was no effect of the plant materials on the abundance of the natural enemies like ants and lady bird beetle, but the spider showed significantly lower abundance compared to

Table 1. Effect of different plant materials on the abundance of jassid on okra plant at different hours after treatment

Treatment	Abundance of jassid (number leaf^{-1}) at different hours after treatment (HAT)		
	24HAT	48HAT	72HAT
Allamanda leaf extract	53.0 bc	47.9 bc	39.7 bc
Turmeric powder	60.7 b	49.1 b	42.7 b
Coriander powder	31.8 gh	29.9 e	20.1 ef
Basil leaf extract	49.3 cd	43.1 bc	30.5 c
Chilli powder	23.1 hi	28.8 ef	18.9 fg
Garlic extract	41.3 ef	34.8 d	24.4 d
Neem leaf extract	20.2 i	19.9 f	15.9 g
Mahogany oil	47.3 de	37.5 cd	25.1 d
Neem oil	35.4 fg	33.5 de	22.8 de
Control	98.4 a	89.0 a	77.0 a
CV (%)	9.8	9.7	7.9
$LSD_{0.05}$	9.7	6.7	3.9

Means within a column followed by same letter(s) are not significantly different at 5% level of significance by Least Significant Difference (LSD) test.

Table 2. Effect of different plant materials on the abundance of whitefly on okra plant at different hours after treatment

Treatment	Abundance of whitefly (number leaf^{-1}) at different hours after treatment (HAT)		
	24HAT	48HAT	72HAT
Allamanda leaf extract	58.5 bc	42.6 bc	35.7 bc
Turmeric powder	61.0 b	65.9 b	40.4 b
Coriander powder	29.8 gh	29.9 ef	19.8 ef
Basil leaf extract	48.6 cd	40.1 bc	31.4 c
Chilli powder	22.9 hi	27.5 f	15.7 fg
Garlic extract	45.33 de	37.9 d	23.7 d
Neem leaf extract	20.1 i	19.1 g	13.5g
Mahogany oil	41.4 ef	39.7 cd	27.6 d
Neem oil	33.5 fg	35.9 de	21.4 de
Control	101.2 a	95.0 a	67.0 a
CV (%)	10.7	8.9	6.9
$LSD_{0.05}$	8.6	7.9	3.9

Means within a column followed by same letter(s) are not significantly different at 5% level of significance by Least Significant Difference (LSD) test.

Table 3. Botanicals used as a tool for management of sucking insects on okra affect the abundance of natural enemies on the plant

Treatment	Abundance (number plant^{-1}) of natural enemies		
	Ant	Spider	Ladybird beetle
Allamanda leaf extract	13.6 a	7.4 ab	8.2 a
Turmeric powder	14.4 a	7.8 ab	9.0 a
Coriander powder	14.8 a	7.6 ab	8.8a
Basil leaf extract	13. 8 a	7.5 ab	8.3 a
Chilli powder	13.3 a	7.5 ab	8.4 a
Garlic extract	13.5 a	7.3 b	7.8 a
Neem leaf extract	13.7 a	7.8 ab	7.9 a
Mahogany oil	13.9 a	7.7 ab	8.7 a
Neem oil	13.7 a	7.4 ab	7.9 a
Control	14.9 a	8.0 a	9.1 a
CV (%)	3.8	4.9	9.4
$LSD_{0.05}$	0.8	0.6	1.3

Means within a column followed by same letter(s) are not significantly different at 5% level of significance by Least Significant Difference (LSD) test.

Table 4. Botanicals used as a tool for management of sucking insects on okra affect plant morphological traits and yield of the crop

Treatment	Plant morphological traits					Yield (t ha^{-1})
	Plant height (cm)	Number of branch plant-1	Number of leaf plant-1	Length of Leaf (cm)	Width of Leaf (cm)	
Allamanda leaf extract	71.8 b	2.9 b	30.9 c	9.2 c	9.1 c	1.9 c
Turmeric powder	71.1 b	1.0 c	29.3 d	8.0d	8.7 c	1.8 c
Coriander powder	79.9 ab	3.4 ab	31.2 bc	10.3 bc	10.7 bc	2.5 b
Basil leaf extract	72.9 b	2.9 b	30.4 c	8.1 d	8.2 d	1.9 c
Chilli powder	73.4 b	1.3 c	30.2 c	8.6 d	8.0 d	1.9 c
Garlic extract	85.1 a	3.9 a	35.7 a	12.1 a	11.0 a	2.8 a
Neem leaf extract	86.2 a	4.8 a	36.1 a	12.3 a	11.1 a	2.9 a
Mahogany oil	79.1 ab	3.2 ab	31.1 bc	9.6 c	9.3 bc	2.2 b
Neem oil	79.6 ab	3.8 a	34.2 b	11.6 b	10.9 b	2.7 a
Control	51.0 c	0.9 d	28.3 d	6.3 e	5.9 e	1.5 d
CV (%)	4.2	4.2	4.9	4.2	3.5	4.7
LSD0.05	6.1	2.3	30.9 c	0.9	0.2	0.2

Means within a column followed by same letter(s) are not significantly different at 5% level of significance by Least Significant Difference (LSD) test.

control plot (Table 3). Results showed that the abundance of ant among the treatments ranged from 13.3 to 14.9, spider from 7.3 to 8.0 and lady bird beetle from 7.8 to 9.1 plant^{-1}. Siddiqua *et al*. (2016) reported that plant materials significantly reduced the abundance of jassid on cotton plants at 24, 48 and 72 HAT but the effect of the botanicals on the beneficial insects were statistically insignificant. The integument of the ant and lady bird beetle possessed thick cuticle which hindered the penetration of the plant materials into their nervous system, thus they did not respond significantly to the studied treatments. Hence, it could be said that the botanicals had no detrimental effect on the population abundance of the ant and lady bird beetle in the field of okra. The insignificant variation in the number of ants, spiders and lady bird beetles among the treatments might be due to the environmental and physiological reason.

Table 4 showed that the studied plant materials when used as a tool for management of sucking insects on okra affect the morphological traits and yield of the crop. The plant height, number of branch and leaf, length and width of leaf, and yield of the crop among the treatments varied from 51.0 to 86.2 cm, 0.9 to 4.8 plant^{-1}, 28.3 to 36.1 plant^{-1}, 6.3 to 12.3 cm, 5.9 to 11.1 cm and 1.5 to 2.9 t ha^{-1} and the results differed significantly ($p < 0.05$). All the treatments showed significantly higher results compared to control. Among the botanical treatments, garlic and neem leaf extracts enumerated statistically similar and higher plant height, number of branches, number of leaf, length and width of leaf, and yield of the crop. Amin *et al.* (2009) reported that the neem, biskatali, dholkalmi, garlic and chilli leaf extracts significantly suppressed the population of sucking insects in cotton field. Due to the effect of botanicals on sucking insect, cotton plants had a lower abundance and an infestation of jassid and the plants resulted higher yield (Siddiqua *et al*. (2016).

The findings indicated that the application of the plant materials reduced the abundance of the sucking insects and caused level of infestation. So, jassid and whitefly were retarded from sucking sap from the plant tissues. That is why the treated plants had longer height and higher number of branch, number of leaf, length and width of leaf, and increased yield.

Among the tested plant materials, neem and garlic leaf extracts showed comparatively better performance in reducing sucking insect abundance, and enhancing plant morphological traits as well as yield. So, these plant materials may be incorporated as a component in the IPM for the management of jassid and whitefly on okra.

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