

## Plant Extract for the Management of Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guenee)

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**Abstract:** An experiment was conducted at Research Field of Sher-e-Bangla Agricultural University, Bangladesh from November 2011 to June 2012 to study the effect of plant extracts for the management of brinjal (Singhnath) shoot and fruit borer (*Leucinodes orbonalis* Guenee) following Randomized Complete Block Design with three replications. Experiment consisted eight treatments viz. T<sub>1</sub>: Tamarind fruit extract, T<sub>2</sub>: Bon kolmi leaf extract, T<sub>3</sub>: Ata leaf extract, T<sub>4</sub>: Neem leaf extract, T<sub>5</sub>: Tobacco leaf extract, T<sub>6</sub>: Mahogany seed extract, T<sub>7</sub>: Aktara 25 WG and T<sub>8</sub>: Control. T<sub>4</sub> had higher on total shoots (16.0 plant<sup>-1</sup>), healthy shoots (15.7 plant<sup>-1</sup>), total fruits (25.3 plant<sup>-1</sup>), healthy fruits (23.0 plant<sup>-1</sup>), fruits weight (2.7 kg plant<sup>-1</sup>), healthy fruits weight (2.7 kg plant<sup>-1</sup>) and fruit yield (36.2 t ha<sup>-1</sup>). Lower infested shoot and fruits (0.33 and 2.3 plant<sup>-1</sup>, respectively) and percentage (2.2 and 9.3%, respectively) were also found in T<sub>4</sub> while infested fruits weight and its percentage had also lower (0.25 kg plant<sup>-1</sup> and 9.3%, respectively) in T<sub>4</sub>. Protection of shoot and fruit borer had higher over control (92.5 and 91.3%, respectively) and fruit yield increment over control had higher (61.7%) in T<sub>4</sub>. Among the all characters control treatment produced lower results in this study. Use of neem leaf extract was highly effective to reduce the shoot and fruit infestation as well as to get higher yield.

**Key words:** Brinjal • Plant extract • Shoot • Fruit borer

### INTRODUCTION

Brinjal (*Solanum melongena*) belongs to Solanaceae family, is widely used vegetable crops and popular in many countries [1]. In Bangladesh, brinjal is second most important vegetable crop next to potato in respect of acreage and production [2] and total annual production is 246000 tons and average yield is 6.4 t acre<sup>-1</sup> in 2010-11 [2]. Its yield potential is very low compared to other countries due to incidence of insect pests and diseases [3, 4, 5]. Yield loss due to pest is to the extent of 70-92% [6, 7, 8] and 85-90% [8, 9]. Among insect pests infesting brinjal, shoot and fruit borer [*Leucinodes orbonalis* (Guen.)] is major ones that damages tender shoots and fruits. Its larvae feed inside brinjal fruit and making fruit unfit for human consumption. A single larva is enough to damage 4-6 healthy fruits [10] and brinjal fruit damaged by this

pest is to a level of 31-86% in Bangladesh [11] which may reach up to 90% under severe conditions. Some farmers of Bangladesh spray frequently to protect their crop from borer [12] by common means of insecticidal control [1]. In the meantime, insect is becoming tolerant to chemicals and making it more difficult to control. Besides, chemical pesticides are very expensive and also threaten to health of farmers and consumers which also makes the vegetables poisonous, ecologically unsafe and economically unviable. Pesticide increases cost of production 40-50% in Bangladesh [12]. There is huge information for *L. orbonalis* including management by chemical methods [9, 13, 14, 15] but new generation of pesticide molecules have been claimed to be effective as well as safer for non-target organisms [9, 13, 14, 16]. Plant preparations such as powders, solvent extracts, essential oil and whole plants are being investigated for their

insecticidal activity including their action as fumigants, repellents, antifeedants, anti-oviposition and insect growth regulators [17, 18, 19]. Considerable efforts have been focused on plant derived materials, potentially useful as commercial insecticides [20, 21]. Hence, present investigation was planned to evaluate plant extracts regarding better yield by managing brinjal shoot and fruit borer.

## MATERIALS AND METHODS

An experiment was conducted at the research field in Sher-e-Bangla Agricultural University, Dhaka-1207, during the period from November 2011 to June 2012 to study on the use of plant extract for the management of brinjal shoot and fruit borer. The seed of Singhnath variety was collected from BARI, Joydebpur, Gazipur. The experiment comprised with eight treatments of plant extract viz. T<sub>1</sub>: Tamarind fruit extract @ 50 g L<sup>-1</sup> water (SN: *Tamarindus indica*); T<sub>2</sub>: Bon kolmi leaf extract @ 50 g L<sup>-1</sup> water (SN: *Ipomoea carnea*); T<sub>3</sub>: Ata leaf extract @ 50 g L<sup>-1</sup> water (SN: *Annona reticulata*); T<sub>4</sub>: Neem leaf extract @ 50 g L<sup>-1</sup> water (SN: *Azadirachta indica*); T<sub>5</sub>: Tobacco leaf extract @ 50 g L<sup>-1</sup> water (SN: *Nicotiana tabacum*); T<sub>6</sub>: Mahogany seed extract @ 50 g L<sup>-1</sup> water (SN: *Swietenia mahagoni*); T<sub>7</sub>: Aktara 25 WG @ 2 g L<sup>-1</sup> and T<sub>8</sub>: Control following Randomized Complete Block Design (RCBD) with three replications. The size of each unit plot was 3.0 m × 5.0 m; line to line and plot to plot distances were 1.0 m and 1.0 m respectively while plant to plant distance was 75 cm [22]. Seedlings were raised in plastic trays in the net house of the Department of Plant Pathology, SAU with proper care and management to ensure disease free healthy growth of seedlings [22]. For raising seedlings, soil was prepared by mixing soil with sand and well decomposed cow dung in the proportion of 2:1:1. Formalin solution (5%) was mixed with heaped soil uniformly @ 200 ml/cft. The soil heap was covered with black polythene sheet for 48 hours. The heap was uncovered and soil was spaded to remove the fume of formalin. After seven days of soil treatment, sterilized plastic trays (35 cm × 25 cm) were filled with sterilized soil. Cowdung (10000 kg ha<sup>-1</sup>), oilcake (500 kg ha<sup>-1</sup>), urea (140 kg ha<sup>-1</sup>), TSP (120 kg ha<sup>-1</sup>) and MP (100 kg ha<sup>-1</sup>) were applied and dose were calculated on the basis of fertilizer Recommendation Guide of BARC. Entire cowdung, oil cake, TSP and half dose of MP were applied during land preparation. Urea and remaining half dose of MP were applied in the installments as side dressing.

Fifteen healthy seedlings were transplanted in each plot. Data were collected on total number of shoots, number of healthy shoots, number of infested shoots, percentage of infested shoot, total number of fruits, number of healthy fruit, number of infested fruits, percentage of infested fruit, percent protection of fruit over control, total fruit weight, healthy fruit weight, infested fruit weight, percent of infested fruits in weight, yield and yield increase over control. Collected data were analyzed statistically using MSTAT-C computer package program and significance of difference was tested by Least Significant Differences (LSD) test at 5 % levels of probability [23].

## RESULT AND DISCUSSION

### Shoot Characteristics

**Total Number of Shoots:** various plant extracts were significantly affected on the producing of shoots/plant at harvest. More effective plant extracts to producing more shoots were found from T<sub>4</sub> (16.0/plant) followed by T<sub>5</sub> (14.7/plant) whereas minimum from T<sub>8</sub> (9.0/plant) which was statistically identical with T<sub>1</sub> (9.7/plant) (Table 1). These results indicated that neem leaf extract @ 50 g L<sup>-1</sup> water (T<sub>4</sub>) were more efficient to producing more shoot than that of other plant extract treatments.

**Number of Healthy Shoots:** Plant extracts were found significant effect on production of healthy shoots of brinjal plants. Among the plant extract treatments T<sub>4</sub> provided the maximum healthy shoots (15.7 plant<sup>-1</sup>), whereas the minimum from control (6.3 plant<sup>-1</sup>) which was statistically identical with T<sub>1</sub> (7.0 plant<sup>-1</sup>) (Table 1). These results indicated that neem leaf extract @ 50 g L<sup>-1</sup> water were more efficient to producing more healthy shoot than that of other plant extract treatments.

**Number of Infested Shoots:** The minimum infestation of shoots was found from T<sub>4</sub> (0.33/plant) followed by T<sub>5</sub> (0.7/plant) as well as the maximum from T<sub>1</sub> and T<sub>8</sub> (2.7/plant) (Table 1). Neem leaf extract @ 50 g L<sup>-1</sup> water were more effective to reduce shoot infestation. Significant variation among the effect of Pheromone trap, mechanical control and application of peak neem (neem based insecticide) regarding to shoot infestation [24]. Incase of conjugation of *T. chilonis* release and either shoot clipping + NSKE (4%) spray or endosulfan foliar spray @ 350 g ai ha<sup>-1</sup> reduced shoot infestation [25].

Table 1: Effect of plant extracts for management of shoot and fruit borer on shoot characteristics of brinjal <sup>x</sup>

Treatments	Number of shoots/plant			Shoot infestation (%)	Protection of shoot infestation over control (%)
	total	healthy	infested		
T <sub>1</sub>	9.7 fg	7.0 g	2.7 a	27.4 b	6.9
T <sub>2</sub>	10.0 ef	8.0 f	2.0 b	20.1 c	31.6
T <sub>3</sub>	10.7 e	9.0 e	1.7 c	15.8 d	46.5
T <sub>4</sub>	16.0 a	15.7 a	0.3 g	2.2 h	92.4
T <sub>5</sub>	14.7 b	14.0 b	0.7 f	4.6 g	84.4
T <sub>6</sub>	11.7 d	10.3 d	1.3 d	11.7 e	60.4
T <sub>7</sub>	12.7 c	11.7 c	1.0 e	7.9 f	73.2
T <sub>8</sub>	9.0 g	6.3 g	2.7 a	29.4 a	-
LSD0.05	0.7	1.0	0.2	1.9	-
CV%	2.6	5.5	6.7	7.2	-

<sup>x</sup>In a column mean values having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of significance

Table 2: Effect of plant extracts for management of shoot and fruit borer on fruit characteristics of brinjal <sup>x</sup>

Treatments	Number of fruits/plant			Fruit infestation (%)	Protection of fruit infestation over control (%)
	total	healthy	infested		
T1	16.7 f	12.0 e	4.7 b	28.0 b	27.9
T2	19.0 e	14.7 d	4.3 c	22.8 c	45.6
T3	22.3 d	18.7 c	3.7 d	16.4 d	67.2
T4	25.3 a	23.0 a	2.3 g	9.3 g	91.3
T5	23.7 b	21.0 b	2.7 f	11.4 f	84.3
T6	22.7 d	19.3 c	3.3 e	14.7 e	73.0
T7	23.3 c	20.7 b	2.7 f	11.6 f	83.6
T8	15.7 g	10.0 f	5.7 a	36.2 a	-
LSD0.05	0.2	1.3	0.3	0.9	-
CV%	1.7	4.2	2.1	2.6	-

<sup>x</sup>In a column mean values having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of significance

**Shoot Infestation:** The maximum shoot infestation was found from T<sub>8</sub> (29.4%), while the minimum from T<sub>4</sub> (2.2%) (Table 1). Neem leaf extract @ 50 g L<sup>-1</sup> water had less and control had maximum percentage of shoot infestation by *Leucinodes orbonalis* Guenee in this study. Significant variation among alternative IPM tools viz. pesticides against brinjal shoot and fruit borer was found while mass trapping + neem oil spray + shoot clipping gave significantly minimum shoot damage over untreated plots [26]. Different botanicals against pest complex of brinjal were evaluated where NSKE 5% recorded least shoot damage (15.61%) [27].

**Protection of Shoot over Control:** Among the plant extract treatments, more protection of shoot over control was found from T<sub>4</sub> (92.5%) followed by T<sub>5</sub> (84.4%), whereas T<sub>1</sub> gave the minimum protection (6.9%) protection over control against brinjal shoot borer (Table 1). Neem leaf

extract @ 50 g L<sup>-1</sup> water showed more significant on reduction of shoot damage than that of other treatments. Azad *et al.* [28] evaluated the effect of eight botanical extracts on pest control in brinjal and found that Marigold leaf extract was the best. Dutta *et al.* [24] found that simultaneous application of Trap and peak neem afforded 79.24% protection against shoot damage. Chatterjee [29] also found that application of azadex (neem based insecticides) was found most effective in reduction of shoot damage (76.59%).

#### Fruit Characteristics

**Total Number of Fruits:** The maximum number of fruits was found from T<sub>4</sub> (25.3 plant<sup>-1</sup>), while the minimum from control treatment (15.7 plant<sup>-1</sup>) (Table 2). Neem leaf extract @ 50 g L<sup>-1</sup> water were more effective for obtaining more fruits than that of other plant extract and it may be due to less infestation and more healthy shoots.

Table 3: Effect of plant extracts for management of shoot and fruit borer on yield related characteristics and yield of brinjal <sup>x</sup>

Treatments	Weight of fruits (kg/plant)		Weight of infested fruits		Fruit yield (t/ha)	Increase yield over control (%)
	total	healthy	plant	%		
T1	1.8 e	1.4 e	0.50 b	27.5 b	24.2 d	8.2
T2	2.0 d	1.7 d	0.46 c	22.8 c	27.1 c	21.3
T3	2.4 c	2.1 c	0.39 d	16.4 d	31.9 b	42.6
T4	2.7 a	2.6 a	0.25 g	9.3 g	36.2 a	61.7
T5	2.5 b	2.4 b	0.29 f	11.4 f	33.8 b	51.1
T6	2.4 c	2.2 c	0.36 e	14.7 e	32.3 b	44.7
T7	2.5 b	2.4 b	0.29 f	11.6 f	33.3 b	49.0
T8	1.7 f	1.2 f	0.61 a	36.2 a	22.4 d	-
LSD0.05	0.1	0.1	0.02	0.8	2.1	-
CV%	6.7	4.2	9.6	2.5	5.9	-

<sup>x</sup>In a column mean values having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of significance

**Number of Healthy Fruits:** The maximum healthy fruits were found from T<sub>4</sub> (23.0 plant<sup>-1</sup>) followed by T<sub>5</sub> (21.0 plant<sup>-1</sup>) and T<sub>7</sub> (20.7 plant<sup>-1</sup>), whereas the least number of healthy fruits was found from T<sub>8</sub> (10.0 plant<sup>-1</sup>) (Table 2). Neem leaf extract @ 50 g L<sup>-1</sup> water were more effective to manage the brinjal shoot and fruit borer as well as more fruits, lower infestation by shoot and fruit borer were found which ensure the more production of healthy fruits.

**Number of Infested Fruits:** The minimum number of fruits infestation was found from T<sub>4</sub> (2.3 plant<sup>-1</sup>) followed by T<sub>7</sub> and T<sub>5</sub> (2.7 plant<sup>-1</sup>), while the maximum from T<sub>8</sub> (5.7 plant<sup>-1</sup>) (Table 2) (Table 2).

**Fruits Infestation:** The minimum fruits infestation by *Leucinodes orbonalis* Guenee was found from T<sub>4</sub> (9.3%), while the maximum from T<sub>8</sub> (36.2%) (Table 2). Fruit infestation in control plot was maximum (84.32%) compared to endosulfan @ 350 g ai ha<sup>-1</sup> and neem seed kernel extract @ 4% (58.00 and 60.00%, respectively) (Satpathy *et al.*, 2005). Two indigenous plant products viz. seed extracts of *Annona squamosa* (Annonaceae) and *Strychnos nuxvomica* (Loganeaceae) were significant on fruit damage [30]. Different botanicals against pest complex of brinjal were evaluated where NSKE 5% recorded least fruit damage (35.6%) [27].

**Protection of Fruit Infestation over Control:** Fruit infestation by fruit borer (*Leucinodes orbonalis* Guenee) and their protection percentage over control were investigated as influence by various plant extracts. However more protection of fruits infestation over control was found from T<sub>4</sub> (91.3%) whereas minimum from T<sub>1</sub> (27.9%) (Table 2). Protection percentage were in sequentially T<sub>4</sub> > T<sub>5</sub> > T<sub>7</sub> > T<sub>6</sub> > T<sub>3</sub> > T<sub>2</sub> > T<sub>1</sub> (Table 2).

Application of Trap and peak neem afforded 47.70% protection against fruit damage [24]; use of trap + azadex (neem based insecticides) afforded 39.06% protection against fruit damage [29] and mass trapping + neem oil spray + shoot clipping gave significantly higher protection resulting in 38.0% improvement over untreated plots [26].

#### Fruit Weight Characteristics

**Total Weight of Fruits:** The maximum weight of total fruits was found from T<sub>4</sub> (2.7 kg plant<sup>-1</sup>) followed in sequence by T<sub>5</sub>, T<sub>7</sub>, T<sub>6</sub>, T<sub>3</sub> with an average weight of 2.5, 2.5, 2.4 and 2.4 kg plant<sup>-1</sup>, respectively and T<sub>5</sub>, T<sub>7</sub>, T<sub>6</sub> and T<sub>3</sub> were statistically identical. On the other hand, the minimum weight of total fruits was found from T<sub>8</sub> (1.7 kg plant<sup>-1</sup>) which was statistically identical with T<sub>1</sub> (1.8 kg plant<sup>-1</sup>) (Table 3). Neem leaf extract @ 50 g L<sup>-1</sup> water were more effective for obtaining the maximum production of fruits plant<sup>-1</sup>. This might be due to less infestation and more healthy shoots and fruits were originated under this treatment which ultimately increases fruits yield.

**Weight of Healthy Fruits:** The maximum weight of healthy fruits were obtained from T<sub>4</sub> (2.6 kg plant<sup>-1</sup>) followed by T<sub>5</sub> and T<sub>7</sub> (2.4 kg plant<sup>-1</sup>), whereas the minimum from T<sub>1</sub> (1.1 kg plant<sup>-1</sup>). Neem leaf extract @ 50 g L<sup>-1</sup> water were more effective to produced more healthy shoot and fruits which make sure the higher weight of healthy fruits.

**Weight of Infested Fruits:** The maximum weight of infested fruits was found from T<sub>8</sub> (0.61 kg plant<sup>-1</sup>) which was statistically similar with T<sub>1</sub> (0.50 kg plant<sup>-1</sup>) and T<sub>2</sub> (0.46 kg plant<sup>-1</sup>), whereas the minimum from T<sub>4</sub> (0.25 kg plant<sup>-1</sup>) followed by T<sub>5</sub> and T<sub>7</sub> (0.29 kg plant<sup>-1</sup>) (Table 3).

On the other hand, percentage of infested fruit weight of brinjal was also varied significantly among the plant extracts. The maximum infested fruit weight was found from  $T_8$  (36.2%) followed by  $T_1$  (27.5%), while the minimum from  $T_4$  (9.3%) followed by  $T_5$  (11.4%) and  $T_7$  (11.6%) (Table 3).

**Fruit Yield:** The maximum yield of brinjal was found from  $T_4$  (36.2 t ha<sup>-1</sup>) which was 61.7% higher yield over control.  $T_5$  (33.8 t ha<sup>-1</sup>),  $T_7$  (33.3 t ha<sup>-1</sup>),  $T_6$  (32.3 t ha<sup>-1</sup>) and  $T_3$  (31.9 t ha<sup>-1</sup>) were statistically identical and yielded after that  $T_4$ , whereas their yield increased rate was 51.1%, 49.0, 44.7 and 42.6%, respectively over control. The minimum fruit yield was found from  $T_8$  (22.4 t ha<sup>-1</sup>) which was statistically identical with  $T_1$  (24.2 t ha<sup>-1</sup>). On the other hand, the minimum yield increases over control was found from  $T_1$  (8.2%) (Table 3). Yield of brinjal showed the following ranking order in sequence  $T_4 > T_5 > T_7 > T_6 > T_2 > T_1 > T_8$  (control). These results revealed that neem leaf extract @ 50 g L<sup>-1</sup> water produced the maximum yield of brinjal which might be found due to the minimum shoot and fruits infestation by shoot and fruit borer (*Leucinodes orbonalis* Guenee) and the maximum healthy shoots and fruits as well as higher weight of total fruits plant<sup>-1</sup>. Out of eight botanical extracts, Neem leaves extract showed highest net production (591.91±175.00 g) compare to control plant (440.11±41.96 g) [28]. Neem cake was the most effective to produced higher yield (40.3 q ha<sup>-1</sup>) among five organic manures [31] and application of neem cake @ 20 q ha<sup>-1</sup> + foliar spray of quinalphos 0.05% was effective in reducing the fruit borer incidence (20.63%) and increased the yield (82.59 q ha<sup>-1</sup>) compared to control (27.7 q ha<sup>-1</sup>) [32].

## CONCLUSION

Neem leaf extract @ 50 g L<sup>-1</sup> water showed superior performance to manage brinjal shoot and fruit borer among all applied plant extract treatments. The maximum healthy shoots and fruits as well as higher yield of brinjal were also obtained in Neem leaf extract @ 50 g L<sup>-1</sup> whereas control treatment always showed least performance among the studied all traits. Finally, it could be concluded that use of Neem leaf extract @ 50 g L<sup>-1</sup> water would be highly effective to reduce the shoot and fruit infestation as well as to get higher yield of brinjal than that of other studied plant extract treatments. Further, study may be needed to ensuring the better performance of neem leaf extract @ 50 g L<sup>-1</sup> water against *Leucinodes orbonalis* Guenee and better yield.

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