Ecofriendly management of Fruit borer (*Helicoverpa armigera*) on Tomato

ABSTRACT

The experiment was conducted under the central farm of Sher-e-Bangla Agricultural University, Dhaka in order to assess the efficacy of some promising botanicals against tomato fruit borer (*Helicoverpa armigera*). There were seven treatments used in a randomized complete block design (RCBD) with three replications. The treatments were T_1 (Neem leaf extract @ 5ml/L), T_2 (Datura seed extract @ 5ml/L), T_3 (Garlic bulb extract @ 5ml/L), T_4 (Mehagany seed extract @ 5ml/L), T_5 (Black pepper seed extract @ 5ml/L), T_6 (Alamonda leaf extract @ 5 ml/L) and control. Lowest number of tomato fruit borer infested fruits in early, mid and late fruiting stage was 2.67, 5.63 and 4.48 fruits plot^{-1} respectively and was obtained from the plots which were treated by neem leaf extract. On the other hand, the highest infested fruits 11.33, 16.28, and13.55 fruits/plot were obtained at early, mid and late fruting stage respectively from control treatment. However, interms of healthy fruits /plot and weight of healthy fruits /plot, highest yield 2449 gm/plot, 3103 gm/plot and 2908 gm/plot at early, mid and late respectively was obtained from the plots which were treated by neem leaf extract.

Key words: Tomato, Botanicals, Fruit borer, Management.

1. INTRODUCTION

Tomato (*Lycopersicum esculentum* L.) belongs to the family Solanaceae and is one of the major vegetable crops being grown throughout the world. The origin of tomato is tropical America [1]. Its ripe fruits are consumed as fresh vegetable and also in the form of various processed products. The fruit is a good source of vitamin C and A. Tomato is the most commonly and extensively grown vegetable all over the country. In Bangladesh, the yield of tomatoes is not enough satisfactory in comparison with other tomato growing countries of the World [2] and [3]. Tomato production now covers 73151.55 acres area with yield 442299.60 metric ton [4]. The low tomato production in Bangladesh is due to a variety of

restricting factors. The attack of insect pests from planting to fruiting is a significant reason in low production of tomato which is very low to fulfill the demand of the country. Tomato is susceptible to insect pests and all parts of the plant including leaves, stems, flowers, and fruits are subjected to attack by the pest. This crop is mainly attacked by tomato fruit borer, tomato leaf miner, tomato fruit worm, tomato aphid, stink bugs, leaf-footed bugs, hornworm and whitefly, etc. Tomato fruit borer, *Helicoverpa armigera* is highly destructive causing serious damage [5].The fruiting stage of the crop and the time of plantation govern the incidence of fruit borer [6]. Fruit and seed maturation have been substantially impeded as a result of the severe infestation, and seed viability has also been affected. Fruit borer larvae dig into the young fruit and feed on the interior tissue, creating a tunnel inside the fruit, when the tomato plant is in the fruiting stage. As a result, the fruit starts to fall off. The larvae burrow into the fruit and feed on the interior tissues, causing the fruit to become misshapen and so have a low market value. Tomato fruit borer damage can also be responsible for decreasing the seed viability compared to undamaged fruit [7]. Larvae can be found only by opening the infested fruit [8]. It has been reported that fruit borer found to cause a yield loss of 35% to 37.79% fruit [9]. Tomato fruit borer is a versatile and widely distributed polyphagous insect, belonging to the family Noctuidae of the order Lepidoptera. It has been reported to infest 181 cultivated and uncultivated plant species in India, distributed in 45 families [10]. They bore circular holes and thrust only a part of their body inside the fruit and eat the contents. If the fruit is bigger in size, it is only partly damaged by the caterpillar but later it is invariably invaded by fungi bacteria and spoiled completely. The farmers of Bangladesh usually control this pest by the application of chemical insecticides because they are available, very easy to apply on plants and most importantly, these chemicals give very quick results. The presence of residues of chemical insecticides in market samples of tomato has been reported [11]. To avoid such problems due to indiscriminate use of insecticides, utilization of biorational insecticides is 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 (such as humans, animals, and natural enemies) and the environment [12] .

Use of botanical extract against pest control is however as a recent approach to insect management and it has drawn the special attention of the Entomologist all over the world. In Bangladesh, only a few attempts have been made to evaluate botanical extracts against insects [13]. Many researchers reported botanical extracts having pesticidal properties and thus having potential to control insect

pests.Weekly spray application of the extract of neem seed kernel has been found to effective against *Helicoverpa armigera* [13]. The leaf extract of neem tested against the leaf caterpillar of brinjal, *Selepa docilis* Bult. at 5% concentration had a high antifeedent activity [14]. In light of the above back ground, this research work has been undertaken to know the efficacy of different botanicals against fruit borer of tomato and the effect of different botanicals on yield and yield contributing characters 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 to assessing the efficacy of some botanicals against tomato fruit borer. 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. In terms of climate, the experimental site is under the subtropical climate and its climatic conditions are characterized by low temperature and scanty rainfall during the winter i.e. rabi season. Soil of the experimental site belongs to "The Modhupur Tract", AEZ-28.

2.2 Planting materials

In order to conduct the experiment, BARI Tomato-15 was collected. Seeds were collected from Bangladesh Agricultural Research Institute (BARI), Gazipur.

2.3 Treatments of the experiment

Seven treatments were used in this experiment including control.

Table 1. List of botanicals and their doses

Treatment No.	Botanicals	Scientific name	Dose
T_1	Neem leaf extract	*Azadirachta indica*	5ml/L
T_2	Datura seed extract	*Datura stramonium*	5ml/L
T_3	Garlic bulb extract	*Allium sativum*	5ml/L
T_4	Mehagany seed extract	*Swietenia mahagoni*	5ml/L

T_5	Blackpepper seed extract	*Piper nigrum*	5ml/L
T_6	Alamonda leaf extract	*Allamanda cathartica*	5ml/L
T_7	Control	Water	

2.4 Experimental design and layout

The experimental field was designed in a single factor randomized complete block design (RCBD) with three replications, where the experimental site was divided into three blocks allocating the replications to assemble homogeneous soil conditions. Every block was divided into seven-unit plots as treatments. Raised bunds were used as identifiers for treatment demarcation. However, the total numbers of experimental plots were 7X3=21. Each plot size was 3.6m×1.6m. Eventually, 0.5 m and 0.5 m distance were maintained between two blocks and two plots respectively.

2.5 Seed bed preparation and seed sowing

The stubble were removed from seed bed and Farm Yard Manure and fine sand were added. Eventually, the seed bed was brought to fine tilth. Lines were drawn 10 cm apart, over the length of the seedbed. The seeds were sown thinly spaced on the lines and pressed gently. The seeds were covered with fines sand and straw. The seed beds were watered twice a day to ensure sufficient moisture for germination. After germination the straw was removed.

2.6 Main field preparation and seedling transplanting

The seedlings were transplanted to the field 3 to 6 weeks after sowing. A week before transplanting, seedlings were hardened by reducing the application of water, further 12-14 hours before they were taken out of the seedbed were thoroughly watered again to avoid excessive damage to the roots. Seedlings of 15-25 cm tall with 3-5 true leaves were selected for transplanting. Transplanting was done in the afternoon to reduce the transplanting shock. The plants were watered immediately once they had been transplanted. Spacing between plants and rows was maintained as per recommendation of Bangladesh Agricultural Research Institute (BARI). The common spacing is 50 cm between plants and 75 cm between rows. The holes for the plants were made deep enough so that the lowest leaves were at ground level. The soil was pressed firmly around the root, and watered around the base of the

plant to settle the soil.

2.7 Manure and fertilizer

To get high yields, tomatoes need to be fertilized. There were two groups of crop nutrients: organic manures and chemical fertilizers. Well decomposed cow dung was applied at the time of final land preparation. As suggested by the Bangladesh Agricultural Research Institute, fertilizers N, P, K in the form of Urea, TSP, MoP and S, Zn, and B in the form of gypsum, zinc sulphate and borax were applied.

Table2. Amount of manure and fertilizer used in the experiment

Name of Fertilizer and manure	Total Amount (Kg/dec.)	Last plough (Kg/dec.)	Before transplanting (Kg/dec.)	15 DAT	35 DAT
Cowdung/FYM	40	40	-	-	-
Urea	2.0	-	0.7	0.7	0.6
TSP	1.6	1.6	-	-	-
MoP	0.8	0.4	-	0.40	0.40
Gypsum	0.38	0.38	-	-	-
Boric acid	0.3	0.3	-	-	-
Zinc sulphate	0.03	0.03	-	-	-

2.8 Intercultural operation

Soon after the seedling establishment various intercultural operations were done in the main field. Surface irrigation was done as per necessity. When the plant developed 6-7 branches with tomatoes, the plants were stopped from growing further by breaking off the growing tip. The small side-shoots were removed and only one main stem remained. The fruit clusters grew along this main stem. Nipping enhanced the quality and size of the fruits. Staking or trellising tomato plants with bamboo poles, wood stakes, or other sturdy material provides support and keeps the fruit and foliage off the ground. Frequent weeding, and pesticide spraying was done in order to protect the plants from different abiotic and biotic stresses.

2.9 Data collection

Data recording on the fruit infestation by tomato fruit borer

Total number of fruits and infested fruits of five randomly selected plants per plot were recorded at each harvest and continued up to the last harvest. 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. In the similar way, the number of healthy fruits per plot was selected. In order to determine the weight of healthy fruits, collected healthy fruits were measured by a weighing machine in the laboratory.

2.10 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 was estimated by Tukey's HSD Test at 5% level of probability.

3. RESULTs AND DISCUSSION

3.1 Effect of botanicals on fruit infestation and weight of tomato fruit during early fruiting stage

Table 3. 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 fruit / plot	Increase over control (%)	Weight (gm) of healthy fruits /plot	Increase over control (%)
Neem leaf extract (T_1)	2.67 f	76.43	48.33 a	70.59	2449 a	75.30
Datura seed extract (T_2)	9.67 b	14.65	34.00 e	20.01	1653 e	18.32
Garlic bulb extract (T_3)	8.33 c	26.47	37.33 d	31.76	1816 d	29.99
Mehagany seed extract (T_4)	5.33 e	52.95	45.66 b	61.17	2237 b	60.12
Black pepper seed extract (T_5)	6.67 d	41.12	42.66 c	50.58	2018 c	44.45

Alamonda leaf extract (T_6)	10.33 b	8.82	31.66 e	11.75	1498 f	7.22
Untreated (T_7)	11.33 a	-	28.33 f	-	1397 f	-
LSD $_{0.05}$	**1.23**	-	**2.54**	-	**121.179**	-
CV(%)	**11.48**	-	**13.74**	-	**13.66**	-

In a column means having similarletter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

Fruit infestation

Tomatoes exhibit synchronous maturity of fruits which means several pickings are required to harvest. In this study, tomato plants started fruit setting 40-45 days after planting and harvesting was continued upto 100-110 days after planting. Different treatments showed different degrees of infestation induced by tomato fruit borer. Highest fruit infestation 11.33/ plot) was obtained from control treatment (untreated). It showed significant variation from all other treatments of the present experiment. The lowest number (2.67fruits/plot) of infested fruit obtained from T2 which was significantly different from any other treatments in the experiment. This treatment showed 76.43% decrease of fruit infestation over control. Fruit borer infestation was then followed by T4 (5.33 infested fruits/plot) and it was also significantly different from other treatments of the experiment. Subsequently, it showed 52.95% decrease over absolute treatment. Number of infested fruit was then followed by T5 (6.67 fruits/ plot) which significantly differed from other experimental treatments. It showed a 41.12% decrease of fruit infestation over control treatment. Later on, T3 showed 8.33 fruit infestation/plot by fruit borer during the early fruiting stage of tomato plants and 26.47% reduction of fruit infestation was exhibited compared to control treatment. However, it was significantly different from any other treatments used in the experiment. Infested fruit numbers were then followed by T2 (9.67 fruits per plot) and T6 (10.33 fruits/plot). Though numerically different, there is no significant variation between T2 and T6. However, they showed 14.65% and 8.82% decrease of infestation over control respectively. However, like above; neem based biopesticide was highly effective against borer infestation. Our results show uniformity with previous studies. [15] 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. [16] also reported satisfactory control of *H. armigera* on pigeon pea with neem oil (Azadirachtin 0.3%). [17] also reported that neemactin (0.00075%) and neem gold (0.00045%) were very effective in reducing larval population of *H.*

armigera on tomato.

Healthy fruits

Highest number (48.33 fruits/plot) of healthy fruit was obtained from T1 which was significantly different from any other treatments in the experiment. This treatment showed 70.59% increase of healthy fruits over control treatment. Number of healthy fruits was then followed by T4 (45.66 fruits per plot) and it was also significantly different from other treatments of the experiment. Subsequently, it showed 61.17% increase over absolute treatment. Number of healthy fruits was then followed by T5 (42.66 fruits per plot) which significantly differed from other experimental treatments. It showed 50.58% increase over control treatment. Later on, T3 showed 37.33 healthy fruits per plot during the early fruiting stage of tomato plants in the experiment and 31.76% increase in the number of healthy fruits was exhibited compared to 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. [15] 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. Highest number of healthy fruits obtained from neem treatment may be attributed to the holistic contribution of neem oil on the plant health. The secondary metabolites originated from neem have an immense impact on crop protection. For example, ethanol extracts of *A. indica* showed fungal toxic properties against *Alternaria brassicola* and *F. oxysporum* [18]. [19] reported that ethanol leaf extract of *A. indica* was highly inhibitory to *Phaeoisariopsis personate*, the causal agent of late leaf spot of groundnut. Double effect in controlling pest and disease led to the highest number of healthy fruits in tomato plants when treated by neem oil treatment.

Weight of healthy fruits

Weight of healthy fruits is positively related with the number of healthy fruits obtained from the experimental plots. Each fruit weighed around 45-60 gm thus the total weight of collected fruits from per plot was determined. In the current experiment, the weight of healthy fruits varied in different treatments. The highest weight (2449 gm/plot) of healthy fruits obtained from T1 which was significantly different from all other treatments. This treatment showed 75.30% increase of weight over control treatment. Weight of healthy fruits was then followed by T4 (2237 gm per plot) and it was also significantly different from other treatments of the experiment. Subsequently, it showed 60.12% increase over control. Weight of healthy fruits was then followed by T5 (2018 gm per plot) which significantly differed from other experimental treatments. It showed 44.45%

increase of weight over the control treatment. Later on, T3 showed 1816 gm healthy fruits per plot during the early fruiting stage of tomato plants in the experiment and 29.99% increase in the weight of healthy fruits was exhibited compared to the control treatment. It was also significantly different from any other treatments used in the experiment. Subsequently, weight of healthy fruits obtained from T2 was 1653 g per plot which showed 18.32% increase of weight over control treatment. Lowest weight of healthy fruits (1397 gm/plot) was obtained from control treatment (untreated). Eventually, there was no significant difference between T6 and control treatment (Table 3). [20] also reported that Neem seed kernel extract (NSKE @ 5%) was found most effective in reducing the larval 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 fruit infestation and yield attributes of tomato plants during mid fruiting stage

Fruit infestation

Mid fruit bearing stage of tomato was prolonged from 60- 70 days after planting. Different treatments showed different degrees of infestation induced by tomato fruit borer. The lowest number (5.63 fruits/plot) of infested fruit was obtained from T1 which was significantly different from all other treatments. This treatment showed 65.41% decrease of fruit infestation over control treatment. Fruit borer infestation was then followed by T4 (8.33 infested fruits/plot) and it was also significantly different from other treatments. Subsequently, it showed 48.83% decrease of fruit infestation over control. Number of infested fruit was then followed by T5 (10.67 fruits/ plot) which showed 34.45% decrease of fruit infestation over control. Number of 12.33 fruit infestation per plot by fruit borer during the mid fruiting stage of tomato plants was found in T_3 and 24.87% reduction of fruit infestation was exhibited compared to control treatment. However, there was no significant difference between T3 and T5. Infested fruit numbers were then followed by T2 (13.33 fruits /plot) and T6 (14.67 fruits/plot) and no significant variation was found between T2 and T6. However, they showed 18.12% and 9.88% decrease of infested fruit over control respectively. Highest fruit infestation (16.28 /plot) was obtained from control treatment (untreated). It showed no significant variation from T6 (Table 4)

Healthy fruit

Statistically significant variations were found among different treatments. Highest number (63.32 fruits/plot) obtained from T1 which was significantly different from all other treatments and showed 48.98% increase of healthy fruit over control. Number of healthy fruits was then followed by T4 (59.28 fruits/plot) and it was also significantly different from other treatments. It showed 39.48% increaseof healthy fruit over control. Number of healthy fruits was then followed by T5 (54.68 fruits per plot) which was significantly differed from other treatments. It showed 28.65% increase of healthy fruits over control . T3 showed 50.56 healthy fruits per plot during the mid fruiting stage of tomato plants and 18.96% increase of of healthy fruits were exhibited compared to control .

However, it was significantly different from any other treatments. Healthy fruits number was then followed by T2 (46.67 fruits/plot) and showed 9.81% increase of healthy fruit over control. Further, from T6 we obtained 31.66 fruits per plot with 11.75% increase over control. Lowest number of healthy fruits per plot (42.50 /plot) was obtained from control (untreated) and showed significant variation from all other treatments (Table 4).

Table 4. Effect of botanicals against fruit borer at mid fruit bearing stage of tomato

Treatment	Number of infested fruit/ plot	Decrease over control (%)	Number of healthy fruit /plot	Increase over control (%)	Weight(gm) of healthy fruits /plot	Increase over control (%)
Neem leaf extract (T_1)	5.63 f	65.41	63.32 a	48.98	3103 a	56.01
Datura seed extract (T_2)	13.33 bc	18.12	46.67 e	9.81	2179 e	9.55
Garlic bulb extract (T_3)	12.23 cd	24.87	50.56 d	18.96	2448 d	23.07
Mehagany seed extract (T_4)	8.33 e	48.83	59.28 b	39.48	2864 b	43.99
Black pepper seed extract (T_5)	10.67 d	34.45	54.68 c	28.65	2606 c	31.02
Alamonda leaf extract (T_6)	14.67 ab	9.88	44.21 f	4.02	2115 e	6.33
Untreated (T_7)	16.28 a	-	42.50 g	-	1989 f	-
$LSD_{0.05}$	**1.42**	-	**1.36**	-	**117.77**	-
CV(%)	**6.99**	-	**9.08**	-	**12.67**	-

In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

Weight of healthy fruits

Since the weight of healthy fruits is positively related with the number of healthy fruits obtained from the experimental plots, the weight of healthy fruits varied in different treatments. The highest weight (3103 gm/plot) of healthy fruits obtained from T1 which was significantly different from others treatments. This treatment showed 56.01% increase over control. Weight of healthy fruits was then followed by T4 (2864 gm/plot) and it was also significantly different from other treatments. It showed 43.99% increase of weight over control. Weight of healthy fruits was then followed by T5 (2606 gm/plot) which was significantly differed from other treatments. Weight of healthy fruits obtained from T2 was 2179 gm per plot which showed 9.55% increase of weight over control. Lowest weight of healthy fruits (1989 gm/plot) was obtained from control (Table 4).

3.3 Effect of botanicals against fruit infestation and yield attributes of tomato plants during late fruiting stage

Fruit infestation

The late fruit bearing stage was prolonged from 85-100 days after planting. At late fruit bearing stage, lowest number (4.48fruits/plot) of infested fruit obtained from T1 which was statistically similar to T4 and different from all other treatments. T_1 showed 66.93% decrease of fruit infestation over control. T3 showed 8.77 fruit infestation per plot by fruit borer during the late fruiting stage of tomato plants and 35.27% reduction of fruit infestation was exhibited compared to control treatment. However, there was no significant difference between T3 and T5. Highest fruit infestation (13.55 / plot) was obtained from control. It showed significant variation from other treatments (Table 5).

Healthy fruits

Highest number (59.35fruits/plot) of healthy fruit obtained from T1 which was significantly different from all other treatments and showed 82.72% increase of healthy fruits over control and followed by T4 (55.23 fruits /plot) and it was also significantly different from other treatments of the experiment. It showed a 70.04% increase of healthy fruits over control. Number of healthy fruits was then followed by T5 (50.78 fruits/plot) which was significantly differed from other treatments. It showed 56.34% 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 5).

Weight of healthy fruits

The highest weight (2908 gm/plot) of healthy fruits obtained from T1 which was significantly different from all other treatments. This treatment showed 88.83% increase of weight over control. Weight of healthy fruits was then followed by T4 (2746 gm/ plot) and it was also significantly different from other treatments and showed 78.31% increase of weight over control. Weight of healthy fruits was then increase of weight over the control. Lowest weight of healthy fruits per plot (1540 gm/ plot) was obtained from control (untreated). Significant difference found between T7 and other treatments (Table 5). [21] studied on Neem gum nano formulation (NGNF), a novel biopesticide prepared from the Neem gum extract (*Azadirachta indica*) (NGE) and was evaluated for its antifeedant, larvicidal and pupicidal activities against *Helicoverpa armigera* (Hub.) and *Spodoptera litura* (Fab.) at 100 ppm. The NGNF showed significant (100%) antifeedant, larvicidal and pupicidal activities against *H. armigera* and *S. litura*.

Table 5. Effect of botanicals against fruit borer at late fruiting stage of tomato

Treatment	Number of infested Fruit/ plot	Decrease over control (%)	Number of healthy fruit/plot	Increase over control (%)	Weight (gm) of healthy fruits/ plot	Increase over control (%)
Neemleafextract (T_1)	4.48 d	66.93	59.35 a	82.72	2908 a	88.83
Daturaseedextract (T_2)	10.35 b	23.61	42.67 e	31.37	1948 e	26.49
Garlicbulbextract (T_3)	8.77 c	35.27	46.50 d	43.16	2209 d	43.44
Mehaganyseed extract (T_4)	5.24 d	61.32	55.23 b	70.04	2746 b	78.31
Blackpepperseed extract (T_5)	7.68 c	43.32	50.78 c	56.34	2415 c	56.81
Alamondaleaf extract (T_6)	11.72 b	13.50	37.34 f	14.96	1726 f	12.07
Untreated (T_7)	13.55 a	-	32.48 g	-	1540 g	-
$LSD_{0.05}$	**1.74**	-	**2.07**	-	**114.05**	-
CV(%)	**11.5**	-	**12.51**	-	**12.9**	-

In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

CONCLUSION

From the above discussion, it may be concluded that, among the botanicals neem leaf extract @ 5gm/L gave the best performance and decrease 76.43%, 65.41% and 66.93% infested fruits at early fruit stage, mid fruting stage and late fruiting stage respectively. Lowest performance was observed in T_5 and decrease 8.82%, 9.88% and 13.50% infested fruit at early, mid and late fruiting stage. Interms of healthy fruits /plot and weight of healthy fruits /plot, highest yield 2449 gm/plot, 3103 gm/plot and 2908 gm/plot at early, mid and late respectively was obtained from the plots which were treated by neem leaf extract.

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