Study on Morphological Characteristics of Leaves, Shoots and Fruits of Selected Brinjal Varieties/Lines Influencing Brinjal Shoot and Fruit Borer Infestation

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Abstract

Morphological characteristics of leaves, shoots and fruits of 5 brinjal varieties/lines viz., BL 099, BARI Brinjal-6, BL 117, BL 072, BARI Brinjal-1 and wild Solanum torvum were studied at the experimental farm and laboratories of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur during the period from September 2004 to April 2005 in a randomized block design with three replications. Higher number of leaves (195.50 plant⁻¹) invites higher shoot and fruit infestation which was found positively correlated (r² = 0.55). Higher leaf area (63.53cm²/leaf and leaf trichome (256.7/25mm²) had lower shoot and fruit infestation which was found negatively correlated (R²=0.65). Among the morphological characteristics of shoots viz., number of shoot, diameter and length of top inter node have a positive correlation (R²=0.69, 0.85, 0.44) and number of prickles and trichome on shoot have a negative correlation (R²=0.22, 0.70) with BSFB infestation on brinjal shoot. The morphological characters of fruits like fruit per plant, calyx length, fruit length, diameter, shape and color have significant effect on BSFB infestation. Diameter of fruit, weight of fruit has a positive correlation (R²=0.14, 0.10) and length of fruit (R²=0.36) and calyx (R²=0.79) have a negative effect on BSFB attacking brinjal fruit.

1. Introduction

The brinjal shoot and fruit borer (BSFB), Leucinodes orbonalis (Guenee) is the key pest of brinjal (Solanum melongena) in Bangladesh (Alam 1969, Chattopadhyay 1987) and India (Tewari and Sandana 1990) and also a major pest in other countries of the world (Dhanker 1988). The fruit infestation by this pest in Bangladesh may be as high as 67% (Annon. 1991). The yield loss 86% in Bangladesh (Ali et al., 1996) and 95% in India (Naresh et al., 1986) was estimated. The pest management practices in brinjal crop include spraying of different insecticides commonly which cause several pesticide related problem such as toxic residue in fruits, lethal effect on the beneficial arthropod and pollution of the environment (Luckmann and Metcalf, 1975). The brinjal growers used to spray may spray insecticide almost every day or alternate day in the field with as many as 84 sprays in a growing seasons (Annon. 1994). The use of host plant resistance against a pest is an important component of integrated pest management which is environmentally safe and could be economical also. Resistance may be due to antixenosis or non preference and appears to have a biochemical basis, although non-preference for some cultivars has been attributed to histological factor such as compact vascular bundles in a thick layer (Panda et al., 1971). It is desirable to look for antixenosis due to morphological properties of the plant or tolerance to withstand damages caused by pest attack. Varieties with some morphological bases may provide resistance tolerance of the brinjal plant against BSFB. The relationship between the level of pest infestation and morphological characteristics of brinjal leaves, shoots and fruits has not been substantively studied in Bangladesh.

In the light of the above scenario the present study was undertaken with the following specific objectives:

- to identify the morphological character of brinjal leaves, shoots and fruits of some selected varieties and
- to observe the relationship between morphological characters of brinjal leaves, shoots and fruits and the level of BSFB infestation.

2. Materials and Methods

The experiment was conducted with 6 selected brinjal varieties/
lines viz., BL 099, BARI Brinjal-6, BL 117, BL 072, BARI Brinjal-1(s) and wild *Solanum torvum* at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur and the Laboratories of Entomology and Crop Botany Department of BSMRAU Gazipur during the period from September 2004 to April 2005 in a randomized block design with three replications. The crop was grown following the recommended practices except application of insecticide. The individual plot size was 3x3 m. The seedling were transplanted at spacing of 1 m between lines and 60 cm between plants.

Five plants were randomly selected in each plot for recording data. The leaf character studied included the no. of leaves per plant, leaf area cm², no. of trichome and character. Leaf area was measured from three 3/4th leaves by leaf area meter (GA-5) and leaf trichome were counted from upper and lower 25 mm² area of the same leaves under stereo binocular microscope and leaf trichome character was also studied visually at the same time.

The shoot character studies included the no. of shoot per plant, length of top internode, diameter of top internode, no. of prickles per twig and no. of shoot trichome. Since the borer prefer the internode of top shoot of brinjal plant, 5 shoot from each varieties/lines were selected and the length was measured with a scale and diameter was measured with a digital slide calipers and trichome of three top internode were counted from 25 mm² under microscope. The no. of prickles on the shoot and leaves were counted per twig from the top 20 cm of the shoot.

The fruit character studies included no. of fruits per plant, length of fruit, diameter of fruit, calyx length, shape of fruit and color of fruit. The length of fruit measured with a scale from three 3/4th leaves by leaf area meter (GA-5) and leaf trichome were counted from upper and lower 25 mm² area of the same leaves under stereo binocular microscope and leaf trichome character was also studied visually at the same time.

The fruit length was left on each end. Color and shape of fruit were observed visually.

Percentage of insect infestation by number and weight being an important criterion for evaluating the performance of brinjal varieties against *Leucinodes orbonalis* Guenee. The number and weight of the infested and healthy brinjal fruits per plot were recorded at each harvest. The number of healthy and infested shoot also collected at every seven days interval for the calculation of percent shoot infestation. All the data were analyzed statistically by using MSTAT-C software.

Linear regression analysis was also performed to explore the relationships between different morphological parameter of brinjal leaf, shoot and fruit with shoot and fruit infestation by BSFB.

### Table 1.1: Morphological characteristics of brinjal leaves of some selected resistant and susceptible varieties/lines influencing brinjal shoot and fruit borer infestation during winter 2004

<table>
<thead>
<tr>
<th>Variety/line</th>
<th>Number of leaves per plant</th>
<th>Leaf area cm²</th>
<th>Leaf trichome character</th>
<th>Number of trichome per 25 mm²</th>
<th>% shoot infestation</th>
<th>% fruit infestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL-099(R)</td>
<td>108.50b</td>
<td>24.637c</td>
<td>Erect, pinkish color</td>
<td>206.7b</td>
<td>2.73c</td>
<td>21.92cd</td>
</tr>
<tr>
<td>BARI Brinjal-6(R)</td>
<td>92.65b</td>
<td>53.52ab</td>
<td>Not erect, densely hairy, light green</td>
<td>256.7a</td>
<td>3.82bc</td>
<td>39.19b</td>
</tr>
<tr>
<td>BL-117(R)</td>
<td>90.85b</td>
<td>36.28c</td>
<td>Slightly erect, lightly hairy, green</td>
<td>135.0c</td>
<td>5.38ab</td>
<td>32.79bc</td>
</tr>
<tr>
<td>BL-072(R)</td>
<td>98.35b</td>
<td>27.53c</td>
<td>Slightly erect, hairy, green</td>
<td>140.0c</td>
<td>5.01ab</td>
<td>35.32bc</td>
</tr>
<tr>
<td>BARI Brinjal-1(S)</td>
<td>195.50a</td>
<td>40.09bc</td>
<td>Smooth, small, not erect, thinly hairy</td>
<td>116.7c</td>
<td>6.73a</td>
<td>64.13a</td>
</tr>
<tr>
<td><em>Solanum torvum</em> (R)</td>
<td>63.85c</td>
<td>63.53a</td>
<td>Erect, sparsely hairy, green</td>
<td>221.0ab</td>
<td>1.81c</td>
<td>13.33d</td>
</tr>
</tbody>
</table>

R= Resistant  S= Susceptible; Figures in the same column accompanied by the same letter(s) are not significantly different at 5% level as per Least Significant Difference test (LSD). Values are means of three replications.
those of BL 099 (2.73 and 21.92%) and BARI brinjal 6 (3.82 and 39.19%) (Table 1.1). The increasing number of leaves in a plant generally create a shady micro-environment which might be favourable for egg laying by BSFB female and encourage more hatching of BSFB eggs. The percent shoot and fruit infestation was found positively correlated ($R^2=0.55$ and 0.78) (Figure 1.1).

3.2. Leaf area

Significantly the highest leaf area was found in *Solanum torvum* (63.53 cm$^2$) which was statistically similar to that of BARI Brinjal-6 (53.52 cm$^2$) and the lowest leaf area was found in BL099 (25.37 cm$^2$) which is similar to that of Bl117 (38.28 cm$^2$), BL072 (27.53 cm$^2$), and BARI brinjal-1 (40.09 cm$^2$). (Table 1.1). Leaf area is negatively correlated ($R^2=0.04$ and 0.16) with

![Graphs showing the relationship between number of leaf per plant, leaf area cm$^2$, number of trichome per 25 mm$^2$ with percent shoot and fruit infestation of brinjal by brinjal shoot and fruit borer.]

Figure 1.1: Relationship between, number of leaf per plant, Leaf area cm$^2$, number of trichome per 25 mm$^2$ with percent shoot and fruit infestation of brinjal by brinjal shoot and fruit borer.
percent shoot and fruit infestation (Figure 1.1).

3.3. Number of leaf trichome

Significantly the highest number of trichome (256.7) was observed in BARI Brinjal-6 which is statistically similar to those of \( S. \) torvum. The lowest number of trichome was found in variety BARI Brinjal-1 (116.7) which is also statistically similar to those of BL117 (135.0) and BL072 (140.0) (Table 1.1). The percent shoot and fruit infestation was found negatively correlated (\( R^2=0.65 \) and 0.30) with the number of leaf trichome (Figure 1.1).

3.4. Leaf trichome character

Errect and densely populated trichome found in varieties BL099, BARI Brinjal-6 and \( S. \) torvum had lower fruit (21.92%, 39.19%, 13.33%) and shoot (2.73%, 3.82%, 1.81%) infestation. On the other hand smooth with non errect, thinly populated trichome recorded in BL072, BL117, BARI Brinjal-1 had higher shoot (5.01, 5.38, 6.73%) and fruit (35.32, 32.79, 64.13%) infestation (Table 1). Number of leaves, leaf area, trichome no. and character of brinjal varied in different varieties/lines. Higher number of leaves had higher shoot and fruit infestation, and lower leaf area and thin leaf trichome faced higher shoot and fruit infestation and was found negatively correlated. From this result it may be concluded that the leaf character of brinjal variety had a significant role on egg laying by BSFB and its hatching to new larvae. Hazra et al. (2004) conducted almost similar type of study to determine factors of resistance in brinjal against BSFB and found no correlation with number of leaves, leaf area and percent infestation. Ishaque and Chowdahary’s (1984) may be related to some extent with the present study who observed that susceptible varieties of brinjal had larger leaf area. There was a high positive correlation between the leaf area of the varieties and the degree of susceptibility. They also found less susceptible varieties had thick and closely placed leaf trichome.

The effect of shoot morphological character of brinjal under different variety/line have been recorded and presented in Table 1.2

3.5. Number of shoot per plant

Significantly the highest number of shoot per plant was recorded in BARI Brinjal-1 (31.17) which was statistically similar to BL072 (26.84), BL117 (26.00) and BARI Brinjal-6 (24.67) and lowest number of shoots per plant obtained from \( Solanum \) torvum (13.67) which is also statistically similar to that BL099(14.67) (Table 1.2). A positive relationship (\( R^2=0.69 \)) was observed between number of shoot and percent shoot infestation was found (Figure 1.2).

3.6. Length of top internode

The brinjal variety, BARI Brinjal-1 produce highest top internode (3.83) which was significantly different from other variety/line. The smaller length of top internode was measured from BL099 (2.77) and BARI Brinjal-6 (2.77) (Table 1.2). Positive correlation (\( R^2=0.44 \)) was observed between the length of top internode and percent shoot infestation (Figure 1.2).

3.7. Diameter of top internode

\( Solanum \) torvum a wild species of brinjal produce highest diameter of top internode (5.96 mm) which was statistically similar similar to that of BL072 (4.76 mm), BL117 (5.14 mm) and BARI brinjal-6 (5.68 cm) and the lowest diameter was recorded from BL099 (4.15 mm) which was again statistically similar to that of BARI Brinjal-1 (4.34 mm) (Table 1.2). There was a positive correlation (\( R^2=0.85 \)) existed in between diameter of top internode and percent shoot infestation. (Figure 1.2)

3.8. Number of prickles

The number of prickle was lowest (1.67) on the shoot and leaves of the variety BARI brinjal-1 while the highest number of prickles (32.67) recorded from BL099 (Table 1.2). The number of prickles was negatively correlated (\( R^2=0.21 \)) to shoot infestation (Figure 1.2). The level of infestation was increased

<table>
<thead>
<tr>
<th>Variety/line</th>
<th>Number of shoot per plant</th>
<th>Length of top internode (cm)</th>
<th>Diameter of top internode (mm)</th>
<th>No. of prickles per twig (upper 20 cm)</th>
<th>No. of trichome per 25mm²</th>
<th>Shoot infestation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL-099(R)</td>
<td>14.67bc</td>
<td>2.77b</td>
<td>3.15b</td>
<td>32.67a</td>
<td>156.70b</td>
<td>7.91c</td>
</tr>
<tr>
<td>BARI brinjal-6(R)</td>
<td>24.67abc</td>
<td>2.77b</td>
<td>3.68b</td>
<td>12.00b</td>
<td>186.70b</td>
<td>6.23c</td>
</tr>
<tr>
<td>BL-117(R)</td>
<td>26ab</td>
<td>3.3ab</td>
<td>5.14a</td>
<td>4.67b</td>
<td>53.33c</td>
<td>11.25b</td>
</tr>
<tr>
<td>BL072(R)</td>
<td>26.84a</td>
<td>2.70a</td>
<td>5.76a</td>
<td>13.00b</td>
<td>63.33c</td>
<td>14.18b</td>
</tr>
<tr>
<td>BARI brinjal-1(S)</td>
<td>31.17a</td>
<td>3.83a</td>
<td>5.96a</td>
<td>1.67b</td>
<td>50.00c</td>
<td>17.49a</td>
</tr>
<tr>
<td>( Solanum ) torvum(R)</td>
<td>13.67c</td>
<td>2.83b</td>
<td>3.34b</td>
<td>13.00b</td>
<td>145.00b</td>
<td>3.27d</td>
</tr>
</tbody>
</table>

R=Resistant   S=Susceptible; Figures in the same column accompanied by the same letter(s) are not significantly different at 5% level as per Least Significant Difference test (LSD) Values are means of three replications.

Table 1.2: Shoot characters of brinjal of some selected resistant and susceptible varieties at 50 days after transplanting (DAT) influencing brinjal shoot and fruit borer infestation during winter 2004
3.9. Number of trichome

The highest number of trichome (186.70) were recorded from BARI Brinjal -6 which was statistically different from other varieties. The lowest number of trichome was obtained from BARI Brinjal-1 (50.00) which was statistically similar to those of BL072 (63.33) and BL 117 (53.33). BL 099 and Solanum torvum produce the second highest number of trichome on shoot 156.70 and 145, respectively. (Table 1.2). The number of trichomeon shoot was negatively correlated ($R^2$=0.70) to percent shoot infestation by BSFB. (Figure 1.2).

Number of shoot per plant, length and diameter of top internode, number of prickles per twig, number of trichome per 25mm$^2$, with percent shoot infestation of brinjal by brinjal shoot and fruit borer.

With the decrease in number of prickles on leaf and shoot.

The highest number of trichome (186.70) were recorded from BARI brinjal -6 which was statistically different from other varieties. The lowest number of trichome was obtained from BARI Brinjal-1 (50.00) which was statistically similar to those of BL072 (63.33) and BL 117 (53.33). BL 099 and Solanum torvum produce the second highest number of trichome on shoot 156.70 and 145, respectively. (Table 1.2). The number of trichomeon shoot was negatively correlated ($R^2$=0.70) to percent shoot infestation by BSFB. (Figure 1.2).

Number of shoot per plant, length and diameter of top internode, number of prickles and trichome on shoot were differed significantly in different varieties/lines of brinjal. Higher number of shoot give a shady environment which is favourable for BSFB egg laying and hatching and also ensure profuse supply of food. Larger the diameter and length of shoot also provide higher the amount of food for BSFB larva. But higher number of prickles and trichome can interfere with the crawling of the newly hatched larvae. From this result it is opined that among the morphological characters of shoot viz., number of shoot, diameter and length of top internode have a positive role and number of prickles and trichome on shoot have a negative role for BSFB infestation on brinjal shoot (Table 2 and Figure 2). To support the results of present studies the work of Hazra et al. (2004) may be explained. They worked with terminal shoot of brinjal plant, thickness of terminal shoot along with other morphological characters of
variety BARI brinjal-1 showed long fruit (5.97 cm) (Table 1.3). A negative correlation (R²=0.36) was observed with number of fruit per plant and percent fruit infestation by BSFB (Figure 1.3).

3.10. Number of fruit per plant

The mean number of fruits harvested from different brinjal varieties/lines ranged from 2.25 to 49.25 per plant. The variety BARI brinjal-6 produces the lowest number of fruit (2.25) which was statistically similar to those of BL 117 (7.92), BL072 (10.00), BARI Brinjal-1 (14.08) and highest from Solanum torvum (49.25) (Table 1.3). A negative correlation (R²=0.35) was observed with fruit infestation (Figure 1.3).

3.11. Length of fruit

Solanum torvum had very small fruit (0.65 cm) and BL 117 had long fruit (5.97 cm) (Table 1.3). Correlation between length of fruit and the level of fruit infestation was found negative (R²=0.35) (Figure 1.3).

3.12. Diameter of fruit

The fruit diameter of different brinjal varieties ranged from 0.6 to 7.58 cm. The variety BARI brinjal-6 had large diameter (7.58 cm) and followed by BL 072 (4.35 cm) and the Solanum torvum had 0.6 cm diameter (Table 1.3). Fruit diameter was found positively correlated (R²=0.14) to fruit infestation (Figure 1.3).

3.13. Calyx length

Highest calyx length was observed in BL 099 (1.33 cm) which was statistically similar to BARI Brinjal-6 (1.72 cm), BL117 (1.30 cm), and BL 072(1.06). Lowest calyx length recorded from S. torvum (0.28 cm). Variety BARI brinjal-1 showed medium calyx length (0.80 cm) (Table 1.3). There was a negative correlation (R²=0.79) between the calyx length of fruit and rate of fruit infestation (Figure 1.3).

3.14. Shape of fruit

It was observed that round and small shaped brinjal fruits had significantly less infestation (13.33%) followed by long and oval shape fruit (BL099, BL117, BL072 and BARI brinjal-6). Brinjal variety, BARI Brinjal-1 with oblong size fruit had the highest infestation (64.13%) (Table 1.3)

3.15. Weight of fruit

The highest weight per fruit was observed in the variety BARI brinjal-6 (34.33 gm) and was followed by BL072 (25.00 gm), BL117 (17.33 gm) and the lowest from S. torvum (0.05 gm) (Table 1.3). Weight of fruit showed positive correlation (R²=0.10) with fruit infestation (Figure 1.3).

3.16. Color of fruit

The color of fruits were purple green, light green, violet and green. It was observed that S. torvum with green color fruit were significantly less susceptible and violet color (pink) fruit of BARI Brinjal-1 was highly susceptible followed by light green fruit of BARI Brinjal-6 fruit (Table 1.3)

Number of fruit per plant, calyx length, fruit length, diameter, shape, color and weight of fruit of different brinjal varieties varied significantly. Higher number of fruit per plant ensure the sufficient food availability for BSFB and plant also compensate its fruit damage by producing higher number of fruit. BSFB larvae do not bore the calyx of brinjal fruit. So long calyx of

Table 1.3: Characters of three days old brinjal fruit of some selected resistant and susceptible varieties/lines influencing fruit infestation by brinjal shoot and fruit borer during winter 2004

<table>
<thead>
<tr>
<th>Variety/line</th>
<th>No. of fruit per plant</th>
<th>Length of fruit (cm)</th>
<th>Diameter of fruit (cm)</th>
<th>Calyx length (cm)</th>
<th>Shape of fruit</th>
<th>Weight of fruit (g)</th>
<th>Color of fruit</th>
<th>% Fruit infestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL-099(R)</td>
<td>21.25b</td>
<td>5.54a</td>
<td>1.65d</td>
<td>1.33a</td>
<td>Long</td>
<td>7.53d</td>
<td>Purple with Greenish</td>
<td>21.92cd</td>
</tr>
<tr>
<td>BARI brinjal-6(R)</td>
<td>2.25c</td>
<td>3.03b</td>
<td>7.58a</td>
<td>1.27a</td>
<td>Oval</td>
<td>34.33a</td>
<td>Light green</td>
<td>39.19b</td>
</tr>
<tr>
<td>BL-117(R)</td>
<td>7.92c</td>
<td>5.97a</td>
<td>2.63c</td>
<td>1.30a</td>
<td>Long</td>
<td>17.33c</td>
<td>Light purple</td>
<td>32.79bc</td>
</tr>
<tr>
<td>BL-072(R)</td>
<td>10.00bc</td>
<td>2.36b</td>
<td>4.35b</td>
<td>1.06ab</td>
<td>Oval</td>
<td>25.00b</td>
<td>Light green white stripe</td>
<td>35.32bc</td>
</tr>
<tr>
<td>BARI brinjal-1(S)</td>
<td>14.08bc</td>
<td>2.82b</td>
<td>2.63c</td>
<td>0.80b</td>
<td>Oblong</td>
<td>9.50d</td>
<td>Violet</td>
<td>64.13a</td>
</tr>
<tr>
<td>Solanum torvum(R)</td>
<td>49.25a</td>
<td>0.65c</td>
<td>0.6e</td>
<td>0.28c</td>
<td>Round</td>
<td>0.05e</td>
<td>Green</td>
<td>13.33d</td>
</tr>
</tbody>
</table>

R=Resistant  S= Susceptible; Figures in the same column accompanied by the same letter(s) are not significantly different at 5% level as per Least Significant Difference test (LSD) Values are means of three replications.
tender fruit act as a barrier for BSFB infestation. Fruit length and diameter is negatively correlated. However long, light (weighted) fruit with short diameter provide less food than round, large diameter heavy weighted fruit. Color has a role to find out the host by BSFB. From this result it may be opined that the fruit morphological character like fruit per plant, calyx length, fruit length, diameter, shape and color have significant effect on BSFB infestation. Some of these characters was studied by other workers. Hazra et al. (2004) observed long and wide calyx and heavy weighted fruit were highly correlated to susceptibility of shoot and fruit borer infestation. Malik et al. (1986) showed negative correlation between fruit diameter and fruit length to BSFB infestation. Daoder (1986) highlighted that fruit diameter may not always have positive correlation to fruit infestation. Mishra et al. (1988) reported that the oval, thin and elongated fruits are resistance to BSFB. Lal et al. (1976) found that fruit color had no impact on the level of fruit infestation. However, Grewal and Dilbagh (1995) observed that green color fruits were less susceptible while the dark purple and the white color were more susceptible. The result of the present study are thus similar to those reported by the above workers.

4. References


