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Full Research Article

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}) inviteshigher shoot and fruit infestation which was found positively correlated (r^2= 0.55). Higher leaf area (63.53cm^2/leaf and leaf trichom (256.7/25mm^2) had lower shoot and fruit infestation which was found negatively correlated (R^2 =0.65). Among the morphological characteristics of shoots viz., number of shoot, daimeter and length of top inter node have a positive correlation (R^2=0.69, 0.85, 0.44) and number of prickles and trichome on shoot have a negative correlation (R^2 =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 (R^2=0.14, 0.10) and length of fruit (R^2=0.36) and calyx (R^2=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 substsntially studied in Bangladesh.

In the light of the above senerio 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 3×3 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 cm^2, no. of trichome and character .Leaf area was measured from three $3^{rd}/4^{th}$ leaves by leaf area meter (GA-5)and leaf trichome were counted from upper and lower 25 mm^2 area of the same leaves under sterio binocular microscope and leaf trichome character was also studied vusially 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 mm^2 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 randomly selected 3 days old 5 fruits from three replications. The same fruits were used to measure their diameter by measuring the circumference of the fruits from two points on each end of the middle of the fruit in such a way that $1/4^{th}$ of 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.

3. Results and Discussion

Morphological characters of brinjal leaves, shoots and fruits of 6 lines/varieties were evaluated for their antixenosis against BSFB. Different varieties of brinjal had different morphological characteristics. Effect of these characteristics on percent shoot and fruit infestation and determine the particular factor (s) that might be associated with BSFB infestation in brinjal. The effect of leaf morphological character of brinjal under different varieties/line have been recorded and analyzed and presented in Table 1.1

3.1. Number of leaves per plant and percent shoot and fruit infestation

The highest number of leaves per plant was recorded in the variety BARI Brinjal-1(195.50) which is statistically different from those of other line/varieties. Lowest no. of leaves per plant was found in wild brinjal *Solanum torvum* (63.85). In case of percent shoot and fruit infestation it was observed that BARI brinjal-1 with highest number of leaves had the highest shoot (6.73%) and fruit (64.13%) infestation. On the other hand *Solanum torvum* had the lowest number of shoot (1.81%)and fruit (13.33%) infestation which was statistically similar to

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

Variety/line	Number of leaves per plant	Leaf area cm^2	Leaf trichome character	Number of tric-home per 25 mm^2	% shoot infestation	% fruit infestation
BL-099(R)	108.50b	25.37c	Erect, pinkish color	206.7b	2.73c	21.92cd
BARI brinjal-6(R)	92.65b	53.52ab	Not erect, densely hairy, light green	256.7a	3.82bc	39.19b
BL-117(R)	90.85b	36.28c	Slightly erect, lightly hairy, green	135.0c	5.38ab	32.79bc
Bl-072(R)	98.35b	27.53c	Slightly erect, hairy, green	140.0c	5.01ab	35.32bc
BARI brinjal-1(S)	195.50a	40.09bc	Smooth, small, not erect, thinly hairy	116.7c	6.73a	64.13a
Solanum torvum(R)	63.85c	63.53a	Erect, sparsely hairy, green	221.0ab	1.81c	13.33d

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 precent 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 cm2)and the lowest leaf area was found in BL099 (25.37 cm2) which is similar to that of Bl117(38.28cm2), BL072 (27.53 cm2), and BARI brinjal-1 (40.09 cm2).(Table 1.1). Leaf area is negatively correlated (R2=0.04 and 0.16)with

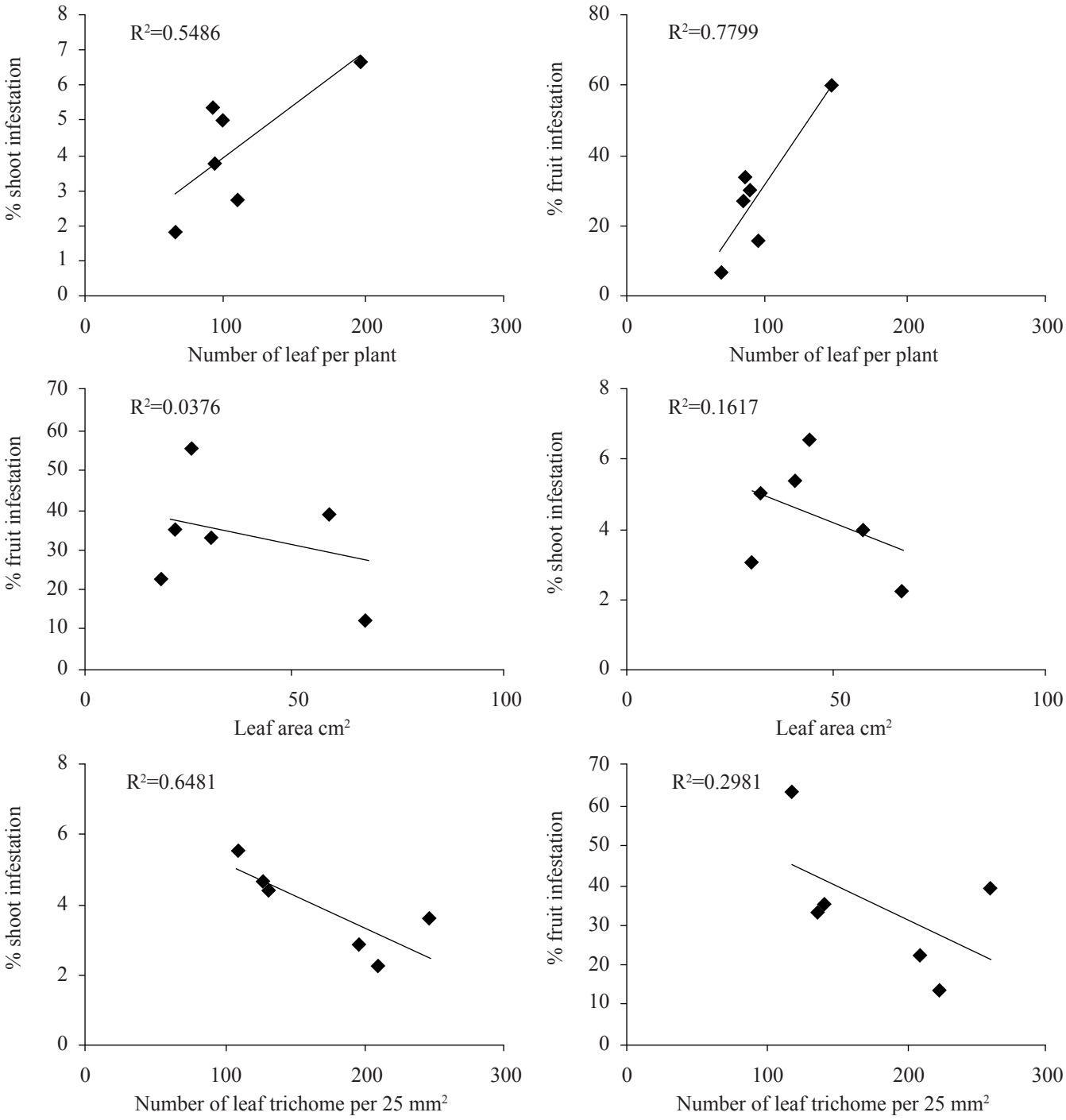

Figure 1.1: Relationship between, number of leaf per plant, Leaf area cm^2, number of trichome per $25mm^2$ with percent shoot and fruit infestation of brinjal by brinjal shoot and fruit borer.

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 densly 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 lying 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) (Table1.2). A positive relationship (R^2=0.69) 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 BL 099 (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 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

Variety/line	Number of shoot per plant	Length of top inter- node (cm)	Diameter of top inter- node(mm)	No. of prickles per twig (upper 20 cm)	No. of trich- ome per 25mm^2	Shoot infes- tation (%)
BL-099(R)	14.67bc	2.77b	3.15b	32.67a	156.70b	7.91c
BARI brinjal-6(R)	24.67abc	2.77b	3.68b	12.00b	186.70a	6.23c
BL-117(R)	26ab	3.3ab	5.14a	4.67b	53.33c	11.25b
Bl-072(R)	26.84a	2.70b	5.76a	13.00b	63.33c	14.18b
BARI brinjal-1(S)	31.17a	3.83a	5.96a	1.67b	50.00c	17.49a
Solanum torvum(R)	13.67c	2.83b	3.34b	13.00b	145.00b	3.27d

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.

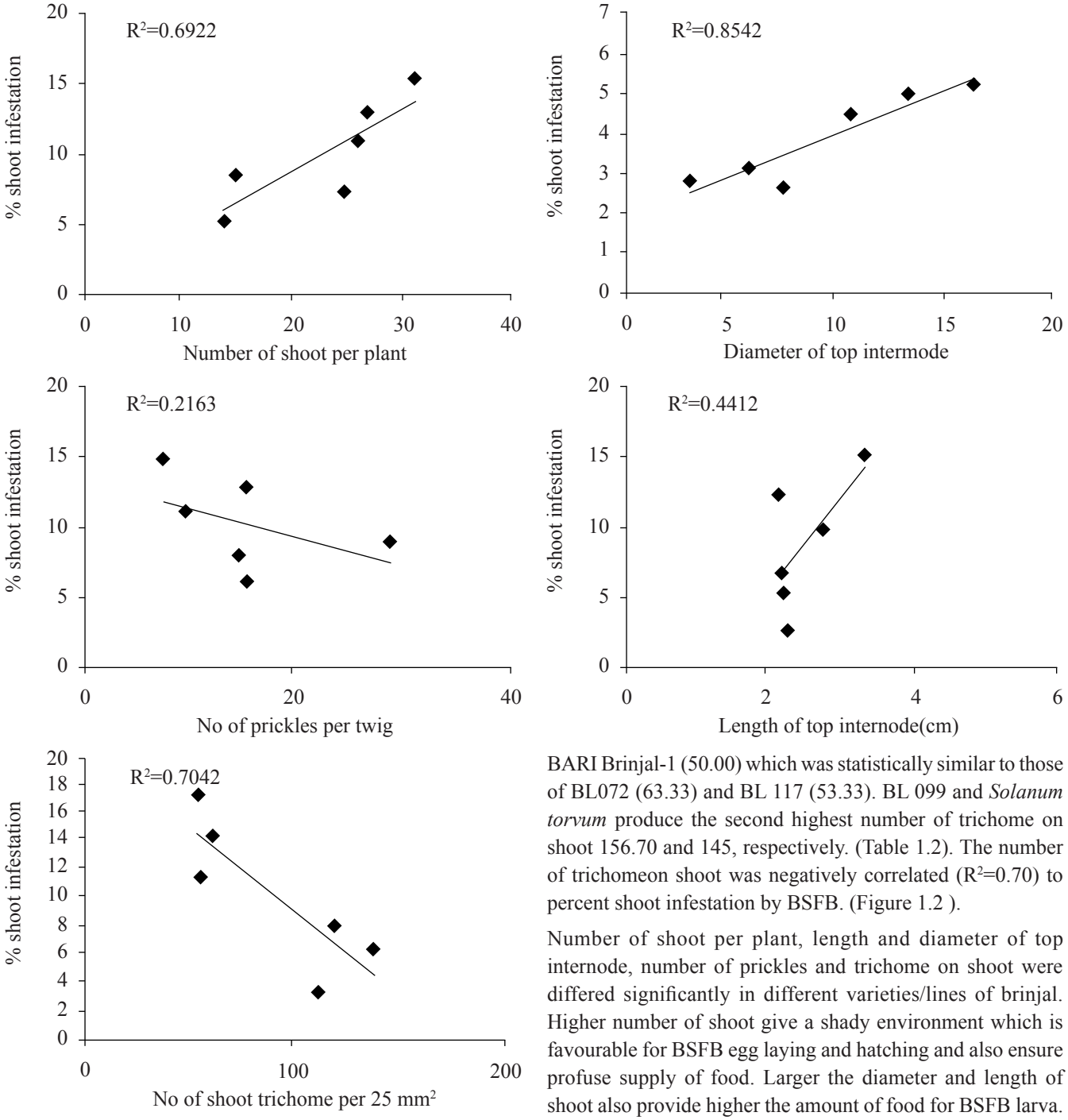

Figure 1.2: Relationship between number of shoot per plant, length of top internode, diameter of top internode, number of prickles per twig, number of trichome per 25mm², with percent shoot infestation of brinjal by brinjal shoot and fruit borer.

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

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 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

brinjal to determine resistance factor of brinjal against BSFB. They found that thick terminal shoot were highly correlated with susceptibility to shoot and fruit borer infestation. On the other hand Ishaque and Chowdhary (1984) observed that top internode of the less susceptible varieties had thick and closely packed trichome. The present study indicated that there was a negative correlation between the number of trichome and degree of infestation by BSFB. The role of prickles of brinjal plants in imparting resistance to borer attack was reported earlier by several author (Chelliah and Srinabashan 1983, Malik et al. 1986, Ali 1994). Prickles on the stem and leaves of brinjal plant can play an important role as physical barrier against the brinjal shoot and fruit borer.

The effect of fruit morphological character of brinjal in different varieties/lines have been determined to see its affect on BSFB infestation and presented in table 1.3

3.10. Number of fruit per plant

The mean number of fruits harvested from in 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 (R^2=0.36)was observed with number of fruit per plant and percent fruit infestation by BSFB (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(R^2=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(R^2=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) (Table1.3). There was a negative correlation (R^2=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 (R^2=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 the *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 color 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

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

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.

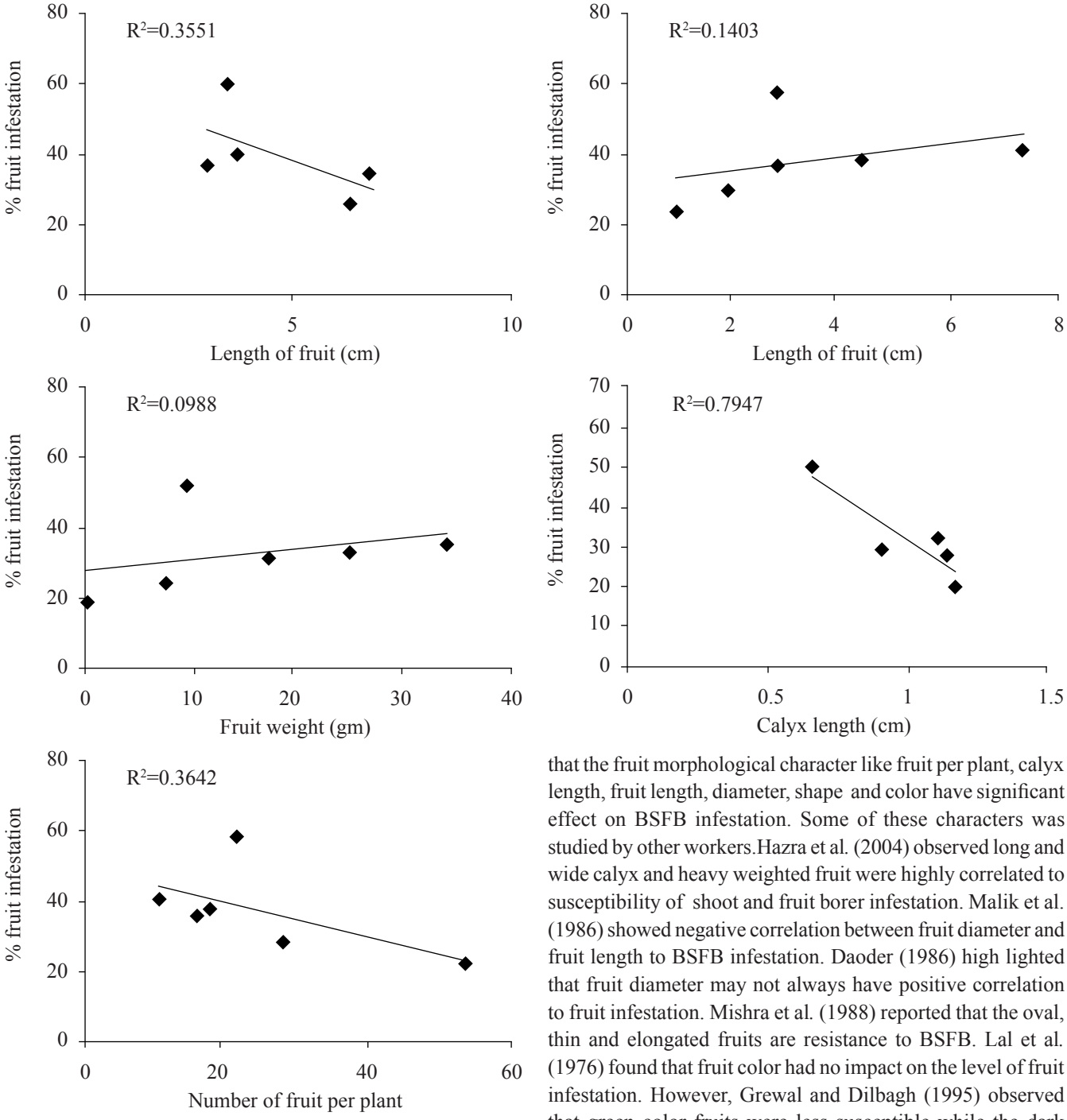

Figure 1.3: Relationship between number of fruit per plant, length of fruit, diameter of fruit, calyx length, and weight of fruit and with percent fruit infestation of brinjal by brinjal shoot and fruit borer.

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) high lighted 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.

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