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Physicomorphic Mechanism of Resistance in Brinjal Genotypes against Shoot and Fruit Borer, *Leucinodes orbonalis* (Guenee)

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ABSTRACT: Development of brinjal hybrids/varieties with natural resistance to brinjal shoot and fruit borer is one of the effective and eco-friendly alternate methods for combating the pest. The biophysical and morphological characteristics of shoot and fruits are correlated with attraction, feeding and oviposition of the pest. Therefore, identification of biophysical characteristics from insect resistant genotypes is most practical significance. Physicomorphic characters responsible for resistance in brinjal genotypes towards the effective management of shoot and fruit borer was investigated during kharif 2017-18 at college of Horticulture, Venkataramannagudem using sixty genotypes and three check cultivars. Mean shoot thickness recorded was in the range of 0.23 to 0.63 cm, trichome density of leaf lamina/cm^2 353.50 to 758.05, trichome density of shoot/cm^2 243.70 to 560.60, plant height 51.87 to 102.75 cm, plant spread 69.17 to 112.41 cm, number of branches 5.80 to 9.20, fruit length 3.21 to 13.67 cm, fruit diameter 2.61 to 7.26 cm, pedicel length 3.28 to 6.44 cm, calyx length 1.64 to 3.74 cm. The mean per cent shoot infestation ranged from 9.18 to 36.27 and fruit infestation ranged from 11.04 to 45.83 per cent. Genotype IC 136061 recorded with lowest shoot thickness (0.23 cm), highest trichome density of leaf lamina/cm^2 (758.05), highest trichome density of shoot/cm^2 (560.60), low plant height (78.36 cm), medium plant spread (83.67 cm), moderately high number of branches/plant (7.40), medium fruit length (3.09 cm), lowest fruit diameter (2.61 cm), lowest calyx length (1.64 cm) played a significant role to express the plant resistance against shoot and fruit borer with lowest shoot infestation (9.18%) and fruit infestation (11.04%). Highest shoot thickness (0.63 cm), lowest trichome density of leaf lamina/cm^2 (353.50), lowest trichome density of shoot/cm^2 (243.70), medium plant height (84.90 cm), high plant spread (96.89 cm), highest number of branches/plant (9.20), high fruit length (8.64 cm), highest fruit diameter (7.26 cm), high calyx length (3.74 cm) were responsible to receive highest shoot infestation (36.27 %), fruit infestation (45.83%). Hence the genotype IC 136061 could be promoted for further levels of evaluation to transform this genotype into a commercially cultivable variety.

Keywords: Physicomorphic meachanism of resistance, Brinjal genotypes, *Leucinodes orbonalis.*

INTRODUCTION

Brijnal is native of India and extensively grown in all South East Asian countries. The brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee) is the most destructive pest in major brinjal cultivating countries of South Asia with the yield loss up to 60-80 per cent (Kaur *et al.*, 2010). Since the larvae inhabit inside the plant shoots or fruits, management of this pest becomes difficult (Alam *et al*., 2003). Chemical control is widely used means of managing the pest. Repeated use of broad spectrum synthetic chemicals results in environmental contamination, pesticide residue in the produce and destruction of beneficial insects. Heavily sprayed and freshly harvested brinjal can be dangerous to our health. Hence, there is an urgent need to look alternate and safer method.

Host plant resistance is the economically sound technique for effective pest management. Developing brinjal varieties with resistance to shoot and fruit borer is one of the effective and eco-friendly alternate methods for combating the pest. The morphological and biophysical characteristics of shoot and fruits are associated with attraction, feeding and oviposition of the pest. Therefore, identification of important biophysical characteristics from insect resistant genotypes is most practical significance.

Oatman, (1959) believed that thick pubescence on the leaves of Elokeshi, black beauty, Giant banaors and H-

165 make them limited attractive to the grown-up moth (*Leucinodes orbonalis*) to deposit their eggs and that the newly hatched larvae cannot bore easily into their fruit. Srinivasan and Basheer (1962) observed that the brinjal varieties Coimbatore, H-128 (Cluster White), H-129 (IC-1855), and H-158 (Gudiatham) were tolerant to shoot & fruit borer and the tolerance was due to toughness of skin and pulp of the fruit. Panda *et al*., (1971) found that larval entry in the resistant varieties is impaired by thick cuticle, thin pithy stem & pointed unicellular trichomes. Webster, (1975) found that the mechanical resistance factors like the solidness of stem, tissue's thickness, anatomical adoptions, and structures for the protection of the plants have proven resistance against shoot and fruit borer in brinjal.

Ali, (1994) reported that the brinjal varieties with hair and prickle characteristics on leaves, stems, fruit stalks resulted in lower percentage infestation of fruit as compared to those without hair and prickles for brinjal shoot and fruit borer. Hossain *et al.,* (2002) observed that the key characteristics of resistant by tolerant varieties were the brinjal genotypes with thick cuticle, large and dense collenchymatous area (hypodermis), compact parenchyma cells in the cortical tissue, a small area in the cortical tissue, more vascular bundles with smaller spaces in the interfascicular region, & compact arrangement of lignified vascular tissue cells and small pith.

Chandrashekhar *et al.,* (2009) observed that the brinjal resistant genotype, HLB-12 manifested 29% less damage against BR-112 which demonstrated 42-61.5% damage as highly susceptible variety and the resistance was positively attributed to pericarp and mesocarp thickness and compactness of seed ring.

Genotypes or varieties having thick cuticle, thick collenchymatous area (hypodermis), compact parenchyma cells in cortical tissue, small area in the cortical tissues, more vascular bundles with narrower spaces in the interfascicular region, and compact arrangement of vascular tissue with lignified cells and small pith were the main characters of resistant/tolerant varieties whereas susceptibility of brinjal genotypes or varieties are attributed to anatomical characters like thinner cuticle and collenchyma area (hypodermis), loose parenchyma cells in the cortical region, larger spaces between vascular bundles i.e. interfascicular region and large pith, less number of trichomes, soft parenchymatous cells in the interfascicular region (Vrunda *et al*., 2021).

An understanding of different physicomorphic characters involved in attributing resistance are essential to the plant breeder in the development of resistant varieties against shoot and fruit borer. Hence, the present investigation was carried out to identify the brinjal genotypes for resistance against shoot and fruit borer on the basis physicomorphic characters.

MATERIAL AND METHODS

The present investigation was conducted at college of Horticulture, Venkataramannagudem during kharif 2017-18 with sixty genotypes and three check cultivars in augmented block design. The seedlings were transplanted in the main field at 35-40 DAS in a single row of 5m length with a spacing of 70 cm × 60 cm. The checks were planted in a randomized manner after every eight test genotypes in each block. Recommended agronomic package of practices were adopted for raising the crop excluding the plant protection measures. Five plants were tagged in each genotype and checks at random to record the data on various parameters.

Five randomly selected shoots per plant in each genotype were selected to measure the shoot thickness at 2.5 cm below the tip of shoot at 30, 60, 90 and 120 days after transplantation and the average thickness of shoot was worked out (Naqvi *et al*., 2009). The number of trichomes cm^{-2} of the leaf lamina were counted by taking sample of 1 cm^2 size from randomly tagged five plants in each genotype at 30, 60, 90 and 120 days after transplantation. The trichomes on lower surface of leaf were counted under stereo binocular microscope and their average was worked out (Naqvi *et al*., 2009).

The number of trichomescm^{-2} of the shoot were counted by taking a piece of 1 cm^{-2} shoot at 2.5 cm below the tip of shoot of randomly tagged five plants in each genotype at 30,60,90 and 120 days after transplantation. The outer rind of the shoot was cut open to count the number of trichomes under stereo binocular microscope and their average was worked out (Naqvi *et al*., 2009). Height of the selected plants was measured with the help of meter scale at maximum fruiting stage and the average was worked out. Total number of branches arising from the basal node of primary/secondary shoots of each tagged plant was counted at maximum fruiting stage and the average was worked out. Spread of the selected plants was measured with the help of meter scale tape at maximum fruiting stage and the average was worked out.

Five mature fruits of marketable size from each plant were selected. Length of fruits was measured in cm with the help of standard scale and average length was worked out (Naqvi *et al*., 2009). Diameter of the selected fruits was measured in centimetres at the centre of the fruit with the help of Verniercaliper and average was worked out for each genotype (Naqvi *et al*., 2009). Pedicel length was measured with the help scale from point of attachment to the base of calyx (Naqvi *et al*., 2009). Length calyx was measured in centimeters with the help of scale from the base of calyx up to the tip.

The shoot infestation was recorded by counting the healthy as well as infested shoots (withered tender shoots) from randomly tagged plants of each genotype and checks at fortnightly intervals from 15 days after transplantation to final harvest. Mean per cent shoot infestation of each genotype was calculated. Data on fruit infestation was recorded from the randomly tagged plants of each genotype at each harvest. The per cent fruit infestation was worked out on number basis.

Statistical Analysis

Statistical analysis after appropriate transformation of data was undertaken (Gomez and Gomez, 1976). Data was analysed through statistical analysis software for augmented design (Rathore *et al*., 2004) using the mean values of all physicomorphic characters of shoot and fruit.

Analysis of variance (ANOVA):

Augmented design analysis was carried out according to the statistical procedure developed (Rathore *et al.* 2004). The following definitions and relations hold:

c = Number of check cultivars = 3

v = Number of tested genotypes = 60

b = Number of blocks = 8

n = v / b = Number of tested genotypes per block = 8

p = c + n = Number of plots per block = 11

N = bc + v = b (c + n) = total number of plots in the experiment = 88.

The total number of blocks is determined by the need to have at least 10 degrees of freedom for error in the analysis of data on various parameters. This, in turn, is determined by the number of check varieties (c) used in the trial. In the analysis of variance of check varieties, the experimental error has (b-1) (c-1) degrees of freedom.

The first step of the analysis is to construct a two- way ANOVA using the data of check varieties across blocks, consequently, the resulted mean square error is used to adjust the tested genotypes mean for the block effect. Also, the resulted mean square error is used to estimate four orders of least significant differences LSD as follows:

1. LSD to compare between two check variety means = t 0.05 (2 MSE /b) 0.5 (ci-cj).

2 LSD to compare between adjusted mean of two tested genotypes in the same block = t 0.05 (2 MSE) 0.5 (BiVi-BiVj).

3. LSD to compare between adjusted mean of two tested genotypes in different blocks = t 0.05 (2 MSE (c + 1)/c) 0.5 (Vi-Vj).

4. LSD to compare between adjusted mean of tested genotype and a check variety mean = t 0.05 (MSE (b+1) (c+1)/ bc) 0.5 (Vi-Vj)

Where, for all LSD values, tabulated t value has (b1) (c-1) degrees of freedom (df).

RESULTS AND DISCUSSION

The observations presented in Table 1 with regard to shoot thickness, trichome density of leaf lamina/cm², trichome density of shoot/cm², plant height (cm), number of branches, plant spread (cm), fruit length (cm), fruit diameter (cm), pedicel length (cm), calyx length(cm) of different brinjal genotypes indicated that the mean shoot thickness recorded was in the range of 0.23 to 0.63 cm, trichome density of leaf lamina/cm² 353.50 to 758.05, trichome density of shoot/cm² 243.70 to 560.60, plant height 51.87 to 102.75 cm, plant spread 69.17 to 112.41 cm, number of branches 5.80 to 9.20, fruit length 3.21 to 13.67 cm, fruit diameter 2.61 to 7.26 cm, pedicel length 3.28 to 6.44 cm, calyx length 1.64 to 3.74 cm.

The genotype IC 136061 recorded with lowest shoot thickness (0.23 cm), highest trichome density of leaf lamina/cm² (758.05), highest trichome density of shoot/cm² (560.60), lowest fruit diameter (2.61 cm), medium fruit length (3.09 cm), lowest calyx length (1.64 cm), low plant height (78.36 cm), medium plant spread (83.67 cm), moderately high number of branches/plant (7.40).

Highest shoot thickness (0.63 cm), lowest trichome density of leaf lamina/cm² (353.50), lowest trichome density of shoot/cm² (243.70), highest fruit diameter (7.26 cm), high fruit length (8.64 cm), high calyx length (3.74 cm)medium plant height (84.90 cm), high plant spread (96.89 cm), highest number of branches/plant (9.20) was recorded with Dommeru Local. In the remaining genotypes and check cultivars, the observations for all the parameters were in the range between IC 136061 (moderately resistant) and Dommeru Local (highly susceptible).

The mean per cent shoot infestation ranged from 9.18 to 36.27. The genotype IC 136061 recorded the lowest shoot infestation (9.18%) where as Dommmeru Local recorded with highest shoot infestation (36.27 %). The mean fruit infestation ranged from 11.04 to 45.83 per cent. Genotype IC 136061 recorded with lowest fruit infestation (11.04%) and Dommeru Local recorded with highest fruit infestation (45.83%).

As it was cited earlier, there were four LSD values to compare the significant differences among tested genotypes and three check cultivars allowing all possible comparisons to be made to select the elite genotypes.

A. Comparison among the three check cultivars

The data on mean shoot thickness, trichome density of leaf lamina/cm², trichome density of shoot/cm², fruit length (cm), fruit diameter (cm), pedicel length (cm), calyx length(cm), plant height (cm), number of branches, plant spread of the three check cultivars indicated that Dommerulocal recorded with highest mean shoot thickness (0.66 cm), lowest trichome density of leaf lamina/cm² (353.50), lowest trichome density of shoot/cm² (243.70), highest fruit diameter (7.26 cm), high fruit length (8.64 cm), high pedicel length (6.84 cm), high calyx length (3.74 cm) medium plant height (84.90 cm), high plant spread (96.89 cm), highest number of branches/plant (9.20) followed by Tadepalligudem Local (0.59 cm), (360.70), (274.85), (3.72), (5.68), (3.94), (2.93), (81.29 cm), (7.00), (81.32 cm) and Bhagyamathi (0.36 cm), (635.95), (522.55), (3.91), (3.17), (3.92), (2.00), (76.97), (6.20) and (80.93). Dommeru local showed significant differences in shoot thickness, trichome density of leaf lamina/cm², trichome density of shoot/cm², fruit diameter, fruit length, calyx length, plant height in pair wise comparisons with other two checks. Significant difference between Tadepalligudem local and Bhagyamathi was not observed for plant height, number of branches per plant and plant spread. Bhagyamathi with low shoot infestation (16.81%) and fruit infestation (18.25%) differed significantly with Dommere Local (33.53%, 45.83%) and Tadepalligudem Local (31.79%, 43.41%).

Table 1: Physicomorphic characters of different brinjal genotypes in relation to shoot and fruit borer, *Leucinodes orbonalis* infestation during kharif 2017-18.

Sr. No.	Block No.	Genotype	Mean Shoot thickness (cm)	Trichome density of leaf lamina/cm^{-2}	Trichome density of shoot/cm^{-2}	Plant height (cm)	Number of branches	Plant spread (cm)	Fruit length (cm)	Fruit diameter (cm)	Pedicel length (cm)	Calyx length (cm)	Percent shoot infestation	Percent fruit infestation
1.	1	IC 136148	0.27	742.85	559.25	67.36	5.60	79.89	6.06	4.93	3.53	1.75	11.97 (20.24)	14.79 (22.61)
2.	1	IC 135912	0.28	729.40	552.00	72.03	6.80	79.34	6.16	5.95	3.51	1.82	13.02 (21.15)	15.83 (23.44)
3.	1	IC 136299	0.29	723.70	554.00	69.23	8.00	74.47	4.71	5.36	3.86	1.80	15.36 (23.07)	15.83 (23.44)
4.	1	Pb. Shree	0.45	524.45	432.15	76.84	6.60	72.76	7.75	6.48	4.54	2.23	21.53 (27.64)	26.04 (30.68)
5.	1	IC 136096	0.41	543.45	473.05	68.73	6.80	92.43	5.08	5.02	4.74	2.43	20.43 (26.87)	24.16 (29.44)
6.	1	IC 136017	0.40	565.35	479.95	51.87	6.60	70.46	6.59	5.89	3.65	2.45	20.87 (27.18)	22.29 (28.17)
7.	1	IC 089888	0.36	584.35	490.45	79.66	7.60	85.42	6.02	4.56	5.02	2.18	18.55 (25.51)	21.04 (27.30)
8.	1	IC 144515	0.34	592.90	500.10	65.34	7.40	81.96	4.14	3.32	5.91	2.16	19.71 (26.36)	20.41 (26.86)
9.	2	IC 136231	0.34	583.65	499.90	62.44	7.20	88.18	9.84	5.04	4.98	2.00	18.19 (25.24)	19.37 (26.11)
10.	2	IC 136451	0.37	579.30	489.35	66.15	6.20	85.65	4.83	5.93	6.44	3.33	19.77 (26.40)	32.08 (34.50)
11.	2	IC 144525	0.31	613.40	507.10	68.15	7.20	80.66	7.13	4.97	4.00	1.95	17.95 (25.06)	19.58 (26.26)
12.	2	Swarnamani	0.40	523.95	439.10	83.07	7.40	91.13	7.23	6.02	4.27	2.03	21.87	25.41 (30.27)
13.	2	IC 136455	0.51	407.50	396.00	82.71	8.80	99.77	5.13	5.78	4.49	3.45	26.78 (31.16)	33.33 (35.26)
14.	2	IC 136308	0.45	499.15	406.40	90.22	8.40	88.95	5.09	4.76	5.13	2.18	23.46 (28.97)	27.25 (31.46)
15.	2	IC 136296	0.28	709.05	543.70	91.09	8.60	91.11	3.12	3.23	4.42	2.10	15.36 (23.08)	16.83 (24.22)
16.	2	IC 136041	0.28	718.80	549.85	88.64	7.60	89.94	5.46	4.23	4.19	2.00	15.00 (22.78)	15.83 (23.44)
17.	3	IC 136290	0.48	497.70	400.70	84.53	7.80	112.41	4.83	5.51	4.50	2.04	23.66 (29.10)	29.58 (32.94)
18.	3	Anamalika	0.54	414.40	394.05	102.75	8.60	100.65	4.66	5.35	5.05	2.77	23.31 (28.87)	33.75 (35.51)
19.	3	DBR-08	0.51	434.75	391.90	84.93	8.40	95.18	8.23	5.38	4.64	2.71	26.35 (30.88)	32.50 (34.75)
20.	3	BVB-71-1	0.48	416.55	396.75	73.39	7.00	85.77	5.93	4.83	4.40	3.15	26.61 (31.05)	33.33 (35.26)
21.	3	P.Bindu	0.56	408.35	391.00	90.71	8.40	89.86	5.78	4.20	4.50	3.56	25.86 (30.56)	33.54 (35.39)
22.	3	JB-02	0.43	505.25	408.70	88.40	7.40	86.11	7.00	5.65	4.27	2.12	23.07 (28.70)	26.87 (31.22)
23.	3	AB-02	0.60	390.05	359.75	82.27	7.40	85.87	4.14	4.66	4.16	2.98	27.59 (31.69)	38.95 (38.62)
24.	3	A. Kurmakar	0.56	405.40	381.25	78.78	7.00	79.67	6.01	5.44	4.94	2.19	27.04 (31.33)	37.08 (37.51)
25.	4	KS 331	0.44	489.15	400.40	67.33	6.00	69.17	4.95	6.55	4.10	2.95	23.56 (29.04)	30.00 (33.21)
26.	4	Aryana	0.38	566.90	489.70	92.68	8.60	99.46	3.42	2.94	5.08	2.20	19.55 (26.24)	21.41 (27.56)
27.	4	DRNKV-104-43	0.56	396.00	372.15	91.92	8.80	91.22	5.17	3.81	5.11	2.87	19.55 (26.24)	38.75 (38.49)
28.	4	Green long	0.60	365.05	274.50	73.42	8.20	75.00	13.67	3.42	5.37	3.87	29.27 (32.75)	42.50 (40.68)
29.	4	IVBL-116-131	0.57	396.30	377.25	78.29	7.40	80.98	4.20	5.27	4.52	2.45	26.91 (31.25)	37.91 (38.00)
30.	4	VR-02	0.59	364.80	289.25	71.71	6.40	86.71	5.21	5.81	4.69	2.48	27.83 (31.84)	42.08 (40.44)
31.	4	JB-03-06	0.39	549.00	484.55	87.20	7.20	85.36	4.89	4.16	6.07	2.08	19.55 (26.24)	23.12 (28.74)
32.	4	IC 136260	0.56	416.05	390.35	91.81	7.20	82.21	5.06	5.70	4.32	2.55	24.37 (29.58)	35.00 (36.27)
33.	5	JB-64	0.46	459.15	400.15	76.42	6.60	80.57	6.41	6.01	5.43	2.52	24.97 (29.98)	30.83 (33.73)
34.	5	IC 136309	0.36	510.55	417.05	71.04	5.80	78.68	4.98	5.14	4.83	2.17	22.40 (28.25)	26.66 (31.09)
35.	5	BH-02	0.46	446.35	401.35	72.55	6.20	75.21	9.01	5.18	4.77	2.85	23.40 (28.93)	31.66 (34.24)

36.	5	IC 136306	0.41	535.70	451.35	83.24	8.60	85.45	8.41	5.55	5.82	3.04	20.58 (26.98)	25.62 (30.41)
37.	5	IC 203589	0.33	672.95	536.30	81.67	6.20	87.20	4.55	3.33	3.79	2.29	15.57 (23.24)	16.66 (24.09)
38.	5	IC 215021	0.60	393.95	332.30	81.39	6.80	80.75	10.00	4.45	5.32	2.76	25.48 (30.32)	39.33 (38.84)
39.	5	IC 137751	0.35	625.55	509.80	81.23	6.60	88.72	4.71	4.98	4.12	2.11	17.01 (24.36)	18.95 (25.81)
40.	5	IC 154517	0.30	701.35	552.40	87.24	7.20	94.92	10.91	4.67	4.19	1.95	15.83 (23.44)	16.66 (24.09)
41.	6	IC 136292	0.40	542.60	467.00	76.35	7.00	80.43	7.70	5.66	4.78	2.00	19.81 (26.43)	25.41 (30.27)
42.	6	IC 213564	0.46	489.35	405.90	76.37	7.40	79.63	6.30	4.84	5.41	3.27	22.52 (28.33)	27.91 (31.89)
43.	6	JB-15	0.48	483.15	397.55	79.61	8.20	85.88	5.30	4.34	5.49	2.42	23.14 (28.75)	30.38 (33.44)
44.	6	IC 136258	0.47	492.45	398.20	85.98	8.60	89.99	4.70	5.42	3.73	2.75	24.16 (29.44)	30.41 (33.47)
45.	6	IC 136222	0.52	422.25	404.75	85.99	7.20	87.13	4.84	5.24	4.96	2.20	25.64 (30.42)	32.50 (34.75)
46.	6	IC 136189	0.36	574.75	491.15	80.97	8.00	87.44	4.52	4.27	4.60	2.26	18.84 (25.72)	21.66 (27.74)
47.	6	IC 136249	0.46	496.65	409.90	66.35	6.80	77.16	10.18	4.68	4.92	2.11	21.20 (27.42)	27.50 (31.62)
48.	6	IC136293	0.59	378.90	309.00	82.30	8.20	91.02	5.00	5.12	5.57	3.18	27.06 (31.34)	41.25 (39.96)
49.	7	IC 136251	0.48	486.10	407.65	79.37	7.80	80.22	7.10	6.51	4.62	2.86	21.41 (27.56)	29.54 (32.92)
50.	7	A. Nidhi	0.30	691.10	535.65	81.46	7.20	85.87	8.41	4.96	4.05	1.90	14.09 (22.05)	17.29 (24.57)
51.	7	Jaware Brinjal	0.43	536.25	462.35	77.38	7.40	87.87	5.77	5.97	5.50	2.05	20.76 (27.10)	26.25 (30.82)
52.	7	IC 136307	0.47	516.85	427.80	77.01	6.80	87.97	6.94	3.92	4.66	2.15	21.01 (27.28)	26.24 (30.81)
53.	7	BLR-24	0.39	595.70	506.30	76.53	8.00	84.42	5.47	3.78	5.96	2.18	16.41 (23.90)	20.83 (27.15)
54.	7	S.Pratibh	0.35	643.65	513.05	79.55	7.40	85.00	5.08	4.04	3.94	2.10	16.65 (24.08)	18.00 (25.10)
55.	7	JB-07	0.33	667.10	541.70	76.74	8.00	83.82	5.96	3.75	3.85	1.90	16.15 (23.70)	17.25 (24.54)
56.	7	**IC 136061**	**0.23**	**758.05**	**560.60**	**78.36**	**7.40**	**83.67**	**3.09**	**2.61**	**3.80**	**1.64**	**10.81 (19.19)**	**13.55 (21.60)**
57.	8	DRNKV-02-104	0.47	500.10	415.85	80.90	7.40	78.35	4.58	3.89	5.44	2.18	22.69 (28.45)	26.95 (31.27)
58.	8	IC 136589	0.54	442.05	404.50	82.00	6.00	69.96	7.30	5.57	3.69	2.38	25.14 (30.09)	32.08 (34.50)
59.	8	A. Abhilamb	0.57	411.45	388.15	78.30	8.20	77.69	5.19	3.31	4.60	2.82	27.10 (31.37)	34.16 (35.76)
60.	8	IC 136311	0.58	408.10	378.80	82.78	7.40	81.65	4.95	4.99	4.68	2.96	26.18 (30.77)	35.83 (36.77)
Check-1		Dommeru Local-SC-1	0.63	353.50	243.70	84.90	9.20	96.89	8.62	7.26	6.43	3.74	33.53 (35.38)	45.83 (42.61)
Check-2		Tadepalli gudem Local-SC-2	0.57	360.70	274.85	81.29	7.00	81.32	5.68	3.72	3.94	2.93	31.79 (34.32)	43.41 (41.21)
Check-3		Bhagyamathi-RC	0.36	635.95	522.55	76.97	6.20	80.93	3.91	3.17	3.92	2.00	16.81 (24.20)	18.25 (25.29)
	Ci-Cj	CD	0.05	56.00	37.00	0.53	1.60	1.60	0.53	0.020	0.33	0.37	1.60	2.10
		SEm	0.02	18.38	12.02	0.18	0.54	0.54	0.18	0.07	0.11	0.12	0.54	0.70
	BiVi-BiVj	CD	0.14	159.00	106.00	1.51	4.60	4.60	1.51	0.57	0.93	1.04	4.60	6.0
		SEm	0.05	52.33	34.65	0.49	1.54	1.54	0.49	0.19	0.30	0.34	1.54	2.05
	Vi – Vj	CD	0.17	195.00	130.00	1.85	5.70	5.70	1.85	0.70	1.14	1.28	5.70	7.00
		SEm	0.06	63.64	42.43	0.61	1.88	1.88	0.61	0.23	0.37	0.42	1.88	2.33
	Ci – Vj	CD	0.12	140.00	94.00	1.33	4.10	4.10	1.33	0.51	0.82	0.92	4.10	5.10
		SEm	0.04	45.96	30.41	0.44	1.35	1.35	0.44	0.17	0.27	0.30	1.35	1.69

Ci – Cj (Critical difference between two control treatments), BiVi – BiVj (Critical difference between two augmented treatments in the same block), Ci – Vj (Critical difference between control treatment and augmented treatment) Vi – Vj (Critical difference between two augmented treatments in different blocks).

B. Comparison among the tested genotypes in the same block

Pb. Shree (0.45cm) showed significant difference in shoot thickness in pair wise comparison with IC 136148 (0.27cm), IC 135912 (0.26 cm) and IC 136299 (0.24 cm); IC 136148, IC 136912, IC 136299 differed significantly with other genotype for trichomes on leaf lamina; significant difference was not observed among genotypes for trichomes on shoot; All the genotypes differed significantly with IC 136017 for plant height; significant difference was not observed among genotypes for number of branches per plant; IC 136096, IC 089888, IC 14515 differed significantly with other genotypes for plant spread; Pb. Shree differed significantly with IC 136299, IC 144515 for fruit length; All the genotypes differed significantly with IC 144515 for fruit diameter; IC 089888, IC 144515 differed significantly with IC 136148. IC 135912, IC 136299, IC 136017 for pedicle length; significant difference was not observed among genotypes for calyx length in the first block. IC 136148, IC 135912 and IC 136299 with low shoot and fruit infestation differed significantly with other genotypes in the block.

Among the eight genotypes, IC 136455 and IC 136308 showed significant difference in shoot thickness with other genotypes; IC 136296, IC 136041 differed significantly with other genotype for trichomes on leaf lamina; significant difference was not observed among genotypes for trichomes on shoot; Al the genotypes exhibited significant difference in plant height with each other; significant difference was not observed among genotypes for number of branches per plant; IC 144515 differed significantly with other genotypes for plant spread; IC 136296 differed significantly with other genotypes for fruit length; All the genotypes differed significantly with each other for fruit diameter; All the genotypes differed significantly with IC 136451 for pedicel length; IC 136455, IC 136451 with more calyx length differed significantly with other genotypes in the second block. IC 144525, IC 136296 and IC 136041 low shoot and fruit infestation differed significantly with other genotypes in the block.

AB 02 showed significant difference in shoot thickness with AB 02; significant difference was not observed among genotypes for trichomes on leaf lamina and trichomes on shoot; Al the genotypes exhibited significant difference in plant height with BVB 71-1; significant difference was not observed among genotypes for number of branches per plant; A. Kurmakar differed significantly with other genotypes for plant spread; DBR -8, BVB-71-1, P. Bindu, JB-02, A. Kurmakar differed significantly with AB-02, Anamalika for fruit length; IC 136290, Anamalika, DBR-08, JB-02, A. Kurmakar differed significantly with other genotypes for fruit diameter; significant difference was not observed among genotypes for pedicel length; P.Bindu differed significantly with IC 36290, JB-02, A. Kurmakar for calyx length in the third block. Significant difference was not observed among the genotypes for shoot infestation but JB 02 differed significantly with AB 02 for fruit infestation in the block.

In pair wise comparison of the genotypes, Aryana and JB 02 showed significant difference in shoot thickness with other genotypes; Aryana and JB 03-06 showed significant difference with Green Long and VR- 02 for trichomes on leaf lamina and trichomes on shoot; Al the genotypes exhibited significant difference for plant height with BVB 71-1; significant difference was not observed among genotypes for number of branches per plant; All the genotypes differed significantly with KS 331 for plant spread; Green Long with highest fruit length doddered significantly with other genotypes for fruit length; IVBL-116-131, VR 02, 1C 136260 differed significantly with other genotypes for fruit diameter; JB 03-06 showed significant difference in pedicle length in pair wise comparison with IVBL-116-131, VR 02, 1C 136260; significant difference was not observed among genotypes for pedicel length; Green Long differed significantly with other genotypes for calyx length in the fourth block. Aryana, DRNKV-104-43, JB 03-06 differed significantly with other genotypes for shoot as well as fruit infestation in the block.

Observations on pair wise comparison of the genotypes, IC 215021 showed significant difference for shoot thickness with other genotypes; IC 215021 exhibited significant difference with IC 137751, IC 154517 for trichomes on leaf lamina and with IC 137751, IC 154517, IC 203589, IC 136306 for trichomes on shoot; All the genotypes exhibited significant difference for plant height with IC 136309 and BH 02;significant difference was not observed among genotypes for number of branches per plant; IC 136309 and BH 02 differed significantly with other genotypes for plant spread; IC 136309, IC 203589, IC 137751 differed significantly with other genotypes for fruit length; IC 203589 differed significantly with other genotypes for fruit diameter; IC 203589 differed significantly with JB 64, IC 136309, IC 136306, IC 215021 for pedicle length; IC 154517 showed significant difference with IC 136306 for calyx length in the fifth block. IC 203589, IC 137751, IC 154517 differed significantly with other genotypes for shoot as well as fruit infestation in the fifth block.

Observations on pair wise comparison of the genotypes, IC 136293 showed significant difference for shoot thickness with other genotypes; IC 136189, IC 136292 exhibited significant difference with other genotypes for trichomes on leaf lamina and trichomes on shoot; Al the genotypes exhibited significant difference for plant height with IC 136249; significant difference was not observed among genotypes for number of branches per plant; IC 136249 differed significantly with JB-15, IC 136258, IC 136222, IC 136189, IC 136293 for plant spread; IC 136249 differed significantly with other genotypes for fruit length; IC 136189 differed significantly with IC 136292, IC 136258, IC 136222, IC136293 for fruit diameter; IC 136258 differed significantly with IC 213564, JB 15, IC136293 for pedicle length; IC 213564, IC 136293 showed significant difference with other genotypes for calyx length in the sixth block. IC 136189, IC 136292 differed significantly with JB-15, IC 136258, IC 136222 and IC136293 for shoot and fruit infestation in the sixth block.

Among the genotypes in seventh block, IC 136251, Jawarebrinjal, IC 136307, BLR 24 showed significant difference for shoot thickness with other genotypes; IC 136251showed significant difference with A. Nidhi, BLR 24, S. Pratibh, JB 07, IC 136061 for trichomes on leaf lamina and trichomes on shoot; S. Pratibh differed with BLR-24, JB -07 for plant height; significant difference was not observed among genotypes for number of branches per plant and plant spread; IC 136061 differed significantly with other genotypes for fruit length and fruit diameter; Jaware Brinjal, BLR 24 differed significantly with other genotypes for pedicle length; IC 136251 showed significant difference with IC 136061 for calyx length. IC 136061, JB 07, S. Pratibh, BLR 24 and N. Nidhi differed significantly with other genotypes in the seventh block for shoot and fruit infestation.

Significant difference for shoot thickness, trichomes on leaf lamina, trichomes on shoot, plant height, number of branches per plant, plant spread among the genotypes was not observed; IC 136589 showed significant difference with other genotypes for fruit length; DRNKV-02-104, A. Abhilamb differed significantly with genotypes for fruit diameter; IC 136589 differed significantly with other genotypes for pedicle length; Significant difference among the genotypes was not observed for calyx length. DRNKV-02-104 differed significantly with other genotypes for shoot and fruit infestation in the eighth block.

C. Comparison among the tested genotypes in different blocks

Highly significant differences were observed between genotypes belong to different blocks for various parameters. Pb. Shree-IC 136061, Green Long-IC 136296, AB 02-IC 136148, IC 136293-IC 154517,VR 02-IC 136299 for shoot thickness; IC 136148-Anamalika, IC 136041-Green Long, IC 154517-IC 136293, IC 136061-A.Ahilamb, JB 07-VR 02, IC 203589-IC 136260, IC 136299-BVB-71-1 for trichomes on leaf lamina; IC 136148-Green Long, IC 136041-VR 02, A. Ndhi-IC 136260, IC 203589- IC136293, IC 136061- DRNKV-104-43 for trichomes on shoot; IC 089888- IC 136451, DRNKV-02-104-Pb.Shree, IC 136258- IC 136251, IC 136260- BH-02, DRNKV-104-43- IC 144515. Anamalika- IC 136041 for plant height; IC 136096- IC 144525, Swarnamani- Green long, IC 136290- BH-02, IC 136307- IC 136249, S.Pratibh-IC 136589, IC 154517- A. Nidhi, IC 136258-IC 136251, VR-02- BH 02, Aryana -A. Kurmakar, IC 136290-KS 331, Anamalika-IC 136017 for plant spread; IC 136589- IC 136061, IC 136306-JB-03-06, IC 154517-IC 136260, Green long-AB-02, JB-02-IC 136296, Pb. Shree- IC 144525, IC 136231-IC 136299 for fruit length; IC 136589- IC 136061, JB-03-06-IC 203589, KS 331-JB-07, IC 136292- IC 144515, Pb. Shree-IC 136296, KS 331-JB-15, IC 136251-IC 136189, IC 136589-BLR-24 for fruit diameter; BLR-24-IC 136589, JB-15- IC 203589, JB-03-06- AB-02, IC 136451- IC 135912, IC 136306 - -IC 136258, DRNKV-104-43- IC 136148, IC 144515-IC 144525 for pedicel length; IC 136451-IC 136148, IC 136455- IC 136299, P. Bindu - IC 144525, Green long-IC 135912, IC136293 -IC 136061 for calyx length.

IC 136148- Green long, IC 136231-JB-64, JB-03-06-A. Kurmakar, S. Pratibh-JB-15, IC 136189-IVBL-116-131, IC 136061-KS 331, IC 136299- Swarnamani, IC 089888- AB-02 in pair wise comparison between genotypes from two different blocks differed significantly for shoot as well as fruit infestation.

D. Comparison among the tested genotypes and three check cultivars

Tested genotypes and checks exhibited significant difference in pair wise comparison. Dommeru Local and Tadepalliudem Local differed significantly with all genotypes in first block, seven genotypes second block, four genotypes in third block, three genotypes in fourth block, seven genotypes in fifth block, six genotypes in sixth block, all genotypes in seventh block and one genotype in eighth block for shoot thickness; Differed significantly with all genotypes for trichomes on leaf lamina in the first block, seven genotypes in second block, two genotypes in third block, two genotypes in fourth block, five genotypes in fifth block, three genotypes in sixth block, seen genotypes in seventh block and one genotype in eighth block for trichomes on leaf lamina.

All genotypes in first, second and third blocks, six genotypes in fourth block, seven genotypes in fifth block, six genotypes in sixth block, all genotypes in seventh and eight blocks differed significantly for trichomes on shoot; significant difference with all the genotypes in all the blocks was observed for plant height; significant difference was observed for number of branches per plant in comparison with genotypes from all the blocks; with regard to plant spread, significant difference was observed with all genotypes of the first block, seven genotypes of the second block, seven genotypes of third block, seven genotypes in fourth block, seven genotypes in fifth block, all the genotypes in sixth, seventh and eighth blocks.

For fruit length, Dommeru Local an Tadepalligudem Local showed significant difference with seven genotypes in first and second blocks, all the genotypes in third block, seven genotypes in fourth, fifth, sixth and seventh blocks, three genotypes from eighth block; for fruit diameter it showed significant difference with all genotypes in first, second, third, fourth, fifth blocks, seven genotypes in sixth block, all genotypes in seventh and eighth blocks; In connection with pedicel length, Dommeru Local and Tadepalligudem Local differed significantly with seven genotypes in the first block, seven genotypes in second block, all the genotypes in the third block, seven genotypes in the fourth block, six genotypes in the fifth block, five genotypes in the sixth block, six genotypes in the seventh block and all the genotypes in the eighth block; For calyx length, they showed significant difference with all the genotypes in the first block, seven genotypes in the second block, six genotypes in the third block, five genotypes in the fourth block, five genotypes in the fifth block, four genotypes in the sixth block, seven genotypes in the seventh block and two genotypes in the eight block. As Dommeru local and Tadepalligudem local are recorded with more shoot and fruit infestation, they differed significantly with majority of the tested genotypes for shoot as well as fruit infestation.

Bhagyamathi- a resistant check exhibited non significant response in pair wise comparison with all genotypes in first block, seven genotypes second block, five genotypes in third block, two genotypes in fourth block, five genotypes in fifth block, three genotypes in sixth block, all genotypes in seventh block and one genotype in eighth block for shoot thickness. Non significant difference was observed with all genotypes for trichomes on leaf lamina in the first, second block, two genotypes in third block, two genotypes in fourth block, five genotypes in fifth block, three genotypes in sixth block, all genotypes in seventh block and one genotype in eighth block for trichomes on leaf lamina; all genotypes in first block, one genotype in second block, significant difference with all genotypes in third block, non significant difference with six genotypes in fourth block, four genotypes in fifth block, six genotypes in sixth block, six genotypes in seventh block and significant difference with all genotypes in eighth block for trichomes on shoot.

Significant difference with seven genotypes in first block, second block, third block, fourth block, seven genotypes in fifth block, six genotypes in sixth block, five genotypes in seventh block and all the genotypes in eighth block for plant height; non significant difference was observed for number of branches per plant in comparison with genotypes from all the blocks; with regard to plant spread, significant difference was observed with two genotypes of the first block, seven genotypes of the second block, all genotypes of third block, four genotypes in fourth block, three genotypes in fifth block, six genotypes in sixth block, three genotypes in seventh block and one genotype in eighth block.

For fruit length, Bhagyamathil showed significant difference with seven genotypes in first block, four genotypes in second block, and second blocks, five genotypes in third block, one genotype in fourth block, five genotypes in fifth bock, four genotypes in sixth block, six genotypes in seventh block, one genotype from eighth block; for fruit diameter it showed significant difference with all genotypes in first, second, third, fourth, fifth blocks, seven genotypes in sixth block, all genotypes in seventh and one genotype in eighth block; with regard to fruit diameter Bhagyamathi differed significantly with seven genotypes in first block, seven genotypes in second block, all genotypes in third block, six genotypes in fourth block, seven genotypes in fifth block, all genotypes in sixth block, seven genotypes in seventh block and three genotypes in eight block; for pedicel length, Bhagyamathi differed significantly with three genotypes in the first block, three genotypes in second block, two genotypes in the third block, four genotypes in the fourth block, four genotypes in the fifth block, six genotypes in the sixth block, two genotypes in the seventh block and one genotype in the eighth block; For calyx length, significant difference was not observed with first block genotypes, one genotypes in the second block, two genotypes in the third block, two genotypes in the fourth block, one genotype in the fifth block, two genotypes in the sixth block, non-significant difference with seventh and eighth block genotypes. Significant difference for shoot and fruit infestation was not observed with all genotypes in first block, six genotypes in second block, differed significantly with all the genotypes in third block, five genotypes in fourth block, five genotypes in fifth block, six genotypes in sixth block, four genotypes in seventh block and all genotypes in eighth block.

The present findings are in agreement with Kassi *et al*., (2019). Out of the five aubergine cultivars assessed for their susceptibility or resistance against shoot and fruit borer revealed that Round Brinjal 86602 suffered less damage by the borer due to the presence of more hair density on leaf lamina, leaf midrib, fruit crown and therefore hairs had significant role towards non-preference for fruit infestation on different parts of the plant.

Calyx is the most important morphological component which has strong association with pest infestation. Fruits having short calyx were more resistant than those with long calyx and it clearly demonstrated that genotypes consisting of long calyx were more susceptible than those with short calyx helping the neonate larvae to hide and get easily into the fruit through the soft tissue below the calyx (Rameshkumar *et al*., 2019).

Laichattiwar *et al*., (2018) reported that the number of hairs and hair length on leaf lamina, midrib and leaf veins decreases the population of sucking pests due to non-preference (i.e. antixenosis), similarly, with the increase of the leaf area and moisture content the population of sucking pests increases.

Shukla *et al*., (2017) observed that round fruits having higher fruit girth were more prone to infestation compared to long fruits with more fruit length and less fruit girth. Trichome density of the leaves also determined the ovipositional preference of the adults and leaves with higher trichome density exhibited lower infestation of the insect; In okra, morphological traits such as trichome density and length had significant negative effect against two spotted spider mite *T. urticae* (Jayabal *et al*., 2017). According to Ali *et al.*, (2016) jassids do not prefer hairiness or even long hairs on the leaf surface indicating that there may be oviposition hindrances.

The brinjalgermplasm with low shoot thickness, short pedicel and calyx of fruit with higher trichome density were less susceptible to the infestation of *Leucinodes orbonalis* (Niranjana *et al*., 2015).

The present investigations are in agreement with the findings by Amin *et al*., (2014) who reported that the higher leaf area ($63.53 cm^2$/leaf) and leaf trichome ($256.7/25\ mm^2$) had lower shoot and fruit infestation. Wagh *et al*., (2012) also reported that the mean trichome density of leaf surface recorded in different brinjal genotypes ranged from 458.67 to 1192.67 per cm^2 and maximum trichome density was found in less susceptible genotypes.

The present findings were in line with Javed *et al*., (2011) which state that the trichomes and hairs on different parts of the plant seem to have a significant role towards non preference for fruit infestation.

It was observed that the higher plant height, stem diameter, third leaf width and more number of leaves increased infestation of shoot and fruit borer. More leaves and higher third leaf width may be suitable for oviposition and thick stem associated with succulent, thin cuticle and soft parenchymatous cells may be suitable to bore easily by young larvae. On the other hand, higher number of branches plant-1 reduced infestation because it may be reduced stem diameter (Ahmed *et al*., 2009).

Shinde *et al*., (2009) announced that the per cent invaded fruits had remarkable positive relationship with per cent damaged fruit weight, mean fruit weight, fruit length, calyx length and fruit development. The per cent pervaded shoots had critical positive relationship with shoot thickness.

The earlier results reported by Naqvi *et al.*, (2008) specify the trichome density in the range of 550.5 to 1068.5 per cm^2, the leaf area ranged 68.8- 22.9 cm^2 and leaf thickness ranged 0.343- 0.157 mm from thirteen (13) brinjal varieties were responsible for low shoot infestation.

Hossain *et al.*, (2002) reported that less number of trichomes may be responsible for the susceptibility of brinjal plant to shoot and fruit borer infestation. Ghosh and Senapati (2001) reasoned that the PK-123 and Pant cultivars of brinjal were slightest susceptible to *Leucinodes orbonalis* because of their generally intense skin, hard to semi-hard mash and tight to semi-tight settlement of seeds, though Pusa Purple Long and Pundiburi were most susceptible cultivars because of their thin, long fruits, delicate fruit skin and mash and inexactly composed seeds.

Sridhar *et al*., (2001) reported that three wild types of brinjal *viz*, *S. khasianum, S. viarum and S. incanum* were observed to be resistant to fruit invasion (0.5 to 10.0 %). More, it was watched that in genotypes with comparatively long fruits and firmly arranged seeds, the incidence of this pest was less.

From the above investigations, it was observed that among sixty genotypes and three checks evaluated for their physicomorphic resistance response, IC 136061 identified as an elite genotype which recorded the lowest shoot infestation as well as fruit infestation. Less thickened shoot, more number of trichomes on leaf lamina and shoot, medium plant height, plant spread, medium fruit length, low fruit diameter, low pedicel and calyx lengths contributed to confer resistance against shoot and fruit borer which was revealed through lowest shoot and fruit infestation than other tested genotypes.. From the present studies, it was concluded that the genotype IC 136061 showed moderate resistance response against shoot and fruit borer infestation and could be promoted for further levels of evaluation to transform this genotype into a commercially cultivable variety.

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