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Biophysical and biochemical mechanism influencing shoot and fruit borer tolerance in brinjal genotypes

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ABSTRACT

Brinjal shoot and fruit borer, Leucinodes orbonalis, is an obnoxious pest causing fruit damage up to 92.50 per cent. This experiment aimed to ascertain the influence of biophysical and biochemical basis of tolerance to brinjal genotypes against L. orbonalis. An experiment was conducted during the summer season with fourteen selected brinjal genotypes at Bihar Agricultural University, Sabour (Bihar). Among the fourteen genotypes, six genotypes, namely, RB-2 X BRBL-01, BRBL-02 x BRBL-07, 71-19 x RB-2, Arka anand, BRBR-01 X RB-2 and BRBL-07 x BRBL-02 were found tolerant against L. orbonalis and their per cent fruit infestation ranged from 25.84 to 29.27%. Six genotypes were susceptible and their infestation ranged from 37.55 to 39.79%. Two genotypes were highly susceptible and their infestation was > 40%. The correlation study revealed that the calyx length had a positive and significant correlation. In contrast, trichome density and shoot thickness had a negative and significant correlation with shoot and fruit borer infestation (number and weight basis). Total sugar and anthocyanin content (both shoot and fruit) had positive and significant correlation with fruit infestation, whereas phenol and antioxidant content had significantly negative correlation with shoot and fruit infestation (number and weight basis). However, four genotypes, RB-2 X BRBL-01, BRBL-02 x BRBL-07, 71-19 x RB-2 and Arka anand were recorded with less shoot and fruit infestation, lower calyx length, more trichome density, low sugar content and high phenol content. These genotypes could be used as tolerant sources for shoot and fruit borer resistance in the breeding programme.

Key words: Biophysical, biochemical, *Leucinodes orbonalis*, Brinjal, Resistance

INTRODUCTION

Brinjal (*Solanum melongena* L.) is a widely grown vegetable of tropical and subtropical parts of the world. In Bihar, it is grown on 58.2 thousand hectares with a production of 1241 thousand metric tons. Bihar ranks fourth in the production of brinjal in the country with an average productivity of 21.32 MT/ha (NHB Database, 12). Brinjal is attacked by a complex of pests like sucking insects, defoliators, shoot and fruit borer and stem borer at different stages of the crop from nursery stage till harvesting. Among the insect pests infesting brinjal, the major one is shoot and fruit borer (SFB), *Leucinodes orbonalis* Guenee, which occurs throughout the year with a degree of variance in pest incidence. Up to 70% of crop gets lost due to attack of this pest (Jat and Pareek, 7). The losses caused by the pest vary from season to season because moderate temperature and high humidity that favour the population build-up of brinjal shoot and fruit borer (Bhushan *et al.,* 2). Repeated use of broad spectrum synthetic chemicals results in environmental contamination, bioaccumulation, pesticide residue in the produce and destruction of beneficial insects (Dadmal *et al*., 4). Hence, there is an urgent need to look into alternate and safe method of management of this pest. Host plant resistance (HPR) is one of the economically sound techniques for effective pest management. Therefore, identification of biophysical and biochemical characteristics from insect resistant/tolerant genotypes of brinjal is most practical.

MATERIALS AND METHODS

The present investigations were carried out at vegetable research plot of Bihar Agricultural University, Sabour during 2017 and 2018. The study area is situated at a latitude of 87º 2´ 54"E, longitude 25º 14´ 24"N and altitude 30 meter above sea level. The experimental materials for the present study consisted of fourteen brinjal genotypes namely, Arka anand, 71-19 × RB-2, BRBL-02 × BRBL-07, RB-2 × BRBL-01, BRBR-01 × RB-2, BRBL-07 × BRBL-02, RB-2 × Swarnmani, Muktakeshi × BRBL-02, Pusahybrid-6, Muktakeshi × RB-2, BRBL-09 × BRBL-11, Muktakeshi × BRBL-01, Muktakeshi × Swarnmani and Pusa hybrid-9. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Thirty days old seedlings of brinjal were transplanted with a spacing of 60 cm X 60 cm and twenty five plants per treatment

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were maintained. The crop was raised following all recommended agronomic practices except plant protection measures. Observations were recorded on ten randomly selected plants from each genotype in every replication. The observations on shoot infestation were taken at 15 days interval up to the fruiting stage. The fruits from each plot were harvested separately and numbers and weight of healthy and infested fruits per plot were counted. Grading of genotypes (0 = immune, 1-10 % infestation= resistant, 11-20 % infestation= fairly resistant, 21-30% infestation = tolerant, 31-40% infestation= susceptible, > 40% infestation= highly susceptible) was done as per classification by Khan and Singh (8).

For measuring fruit length at second, fourth and sixth picking, five randomly selected fruits were taken from each replication when it reached at edible maturity. The fruits were cut longitudinally and length was measured with the help of a measuring tape. Similarly fruit diameter at second, fourth and sixth picking, was measured with the help of slide caliper. Five plant parameters, viz. trichome density, shoot diameter, pericarp thickness, length of pedicel and length of calyx were studied for their role in expression of genotypes reaction to brinjal shoot and fruit borer.

In addition to these, the total sugar content of the pulp was determined by the method enumerated by Hedge and Horreiter (6), whereas, total anthocyanin and total phenol was estimated as per the methods described by Singleton *et al*. (20). The cupric ion reducing antioxidant capacity of eggplant was determined according to the method given by Apak *et al.* (1). The correlation analysis for all the biophysical and biochemical characters was worked out according to the method given by Miller *et al.* (11).

The data were subjected to analysis of variance (ANOVA) using SAS package and the means were separated by Least Significant Difference (LSD) test at 5% level of probability. The correlations between brinjal shoot and fruit borer infestation and morphological and biochemical parameters were worked out.

RESULTS AND DISCUSSION

Among the genotypes, minimum per cent shoot and fruit infestation (weight) was recorded on Arka anand (29.00% and 28.44%), 71-19 × RB-2 (27.99% and 25.84%) and BRBL-02 × BRBL-07 (27.94% and 27.91%) and it shows tolerance to Shoot and fruit borer (SFB) (Table 1), whereas, maximum shoot and fruit infestation (weight) was recorded on Muktakeshi × Swarnmani (56.07% and 61.16%) and Pusa hybrid- 9 (53.05% and 56.68%) which indicates susceptibility. It was followed by RB-2 × BRBL-01 (28.60 and 29.25%)

Table 1. Per cent shoot and fruit infestation by *L. orbonalis* in different brinjal genotypes (Pooled analysis of 2017 and 2018)

Genotypes	Per cent shoot damage	Per cent fruit damage (number)	Per cent fruit damage (weight)
RB-2 × Swarnmani	36.96 (37.42^{b})*	40.54 (39.54^{b})*	37.45 (37.71^{b})*
Muktakeshi × BRBL-02	33.81 (35.53^{bc})	35.96 (36.83^{b})	38.50 (38.34^{b})
Pusa hybrid – 6	40.33 (39.42^{b})	39.90 (39.17^{b})	39.00 (38.62^{b})
Arka anand	29.00 (32.57^{bcd})	29.65 (32.98^{bc})	28.44 (32.22^{c})
71-19 × RB-2	27.99 (31.90^{bcd})	27.59 (31.62^{bcd})	25.84 (30.52^{c})
Muktakeshi× RB-2	40.63 (39.58^{b})	39.66 (39.01^{b})	37.91 (37.98^{b})
BRBL-09 × BRBL 11	36.31 (37.03^{b})	38.04 (38.04^{b})	37.55 (37.77^{b})
BRBL-02 × BRBL-07	27.94 (31.90^{bcd})	23.58 (29.01^{bcd})	27.91 (31.87^{c})
BRBR-01 × RB-2	29.58 (32.92^{bcd})	36.98 (37.34^{b})	28.45 (32.21^{c})
RB-2 × BRBL-01	23.25 (28.83^{bcde})	28.60 (32.32^{bcd})	29.25 (32.73^{c})
BRBL-07 × BRBL-02	29.81 (33.04^{bcd})	27.35 (31.51^{bcd})	29.27 (32.71^{c})
Muktakeshi×Swarnmani	56.07 (48.49^{a})	54.93 (47.83^{a})	61.16 (51.46^{a})
Pusa hybrid- 9	53.05 (46.76^{a})	62.31 (52.14^{a})	56.68 (48.85^{a})
Muktakeshi × BRBL-01	38.28 (38.21^{b})	38.98 (38.62^{b})	39.79 (39.10^{b})
S.Em (±)	1.33	1.52	1.33
C.D (p=0.005)	3.87	4.41	3.85

*Figures in parentheses are arcsine transformed values; Means followed by a common letter are not significantly different at the 5% level by DMRT and BRBL-07 × BRBL-02 (29.81 and 29.27%). The present finding are in corroboration with the earlier findings of Khan and Singh (12), who reported that among 192 genotypes of brinjal, two of them EC305163 and IC090132 were immune to shoot and fruit borer, three genotypes were found resistance, 21 fairly resistant, 38 tolerant, 52 susceptible and rest 76 genotypes were highly susceptible to brinjal shoot and fruit borer. The brinjal varieties Jumki -1 and Jumki-2 were highly resistant, Islampuri -3, BL -34 and Muktakeshi were fairly resistant, Singnath long and Singnath - 4 were tolerant to brinjal shoot and fruit borer (Mannan *et al.,* 10).

The results revealed that the lowest pedicel and calyx length was noticed in the genotypes Arka anand (4.95 and 5.10 cm), 71-19 × RB-2 (4.53 and 5.90 cm) and BRBL-02 × BRBL-07 (5.06 and 6.05 cm) as compared to pedicel length recorded in BRBR-01 × RB-2 (6.63 cm), Muktakeshi × BRBL-02 (6.38 cm) and Muktakeshi × RB-2 (6.15 cm) (Table 2). However, the highest calyx length was noticed in Pusa hybrid- 9 (10.47 cm). The correlation study showed that pedicel length (r= 0.109) had positive and non-significant correlation with fruit infestation by shoot and fruit borer (Table 3). The present findings are in agreement with earlier findings (Patil *et al*., 15) who reported that the pedicel length had a positive correlation with the susceptibility to fruit borer. It is clearly demonstrated that the genotypes consisting of long pedicel were more susceptible to *L. orbonalis* than those with short pedicel because short pedicel provides shelter to the neonate larvae and helps the larva to bore the soft tissue. On the other hand, length of calyx exhibited highly significant and positive correlation with fruit infestation by SFB (r=**0.535). Similar results i.e., positive correlation of calyx length with susceptibility to fruit borer were also reported

Table 3. Correlation between biophysical characters of brinjal genotypes and infestation of brinjal shoot and fruit borer

Parameters	Correlations
Length of calyx (cm)	0.535**
Length of fruit (cm)	-0.163
Diameter of fruit (cm)	0.737**
Shoot thickness (cm)	-0.466**
Length of pedicel (cm)	0.109
Thickness of pericarp (cm)	-0.374*
Trichome density/cm^2	-0.580**

** Significant at 1 % level, * Significant at 5 % level

Table 2. Mean performance of biophysical characters of different brinjal genotypes (Pooled analysis of 2017 and 2018)

Genotypes	Length of pedicel (cm)	Length of calyx (cm)	Pericarp thickness (cm)	Fruit length (cm)	Fruit diameter (cm)	Shoot thickness (cm)	Trichome density (no. cm^{-2})
RB-2 ×Swarnmani	4.78^{ab}	6.98^{c}	0.47^{ab}	7.90^{abc}	6.98^{c}	0.39 (0.94)*	948.50 (30.80^{ab})*
Muktakeshi× BRBL-02	6.38^{a}	7.65^{c}	0.5^{ab}	7.3^{a-d}	7.65^{c}	0.40 (0.95)	949.17 (30.81^{ab})
Pusa hybrid – 6	4.75^{ab}	9.00^{b}	0.54^{a}	5.85^{a-e}	9.00^{b}	0.44 (0.97)	880.33 (29.67^{abc})
Arkaanand	4.95^{ab}	5.10^{de}	0.58^{a}	12.03^{a}	5.10^{c-f}	0.51 (1.00)	1097.50 (33.10^{ab})
71-19 × RB-2	4.53^{abc}	5.90^{d}	0.59^{a}	11.18^{a}	5.90^{cde}	0.48 (0.99)	1331.00 (36.34^{a})
Muktakeshi× RB-2	6.15^{a}	6.85^{c}	0.53^{a}	8.97^{abc}	6.85^{c}	0.46 (0.98)	892.17 (29.80^{abc})
BRBL-09 × BRBL 11	5.53^{ab}	6.38^{d}	0.54^{a}	9.48^{ab}	6.38^{cd}	0.40 (0.95)	1017.67 (31.90^{ab})
BRBL-02 × BRBL-07	5.06^{ab}	6.05^{d}	0.59^{a}	9.50^{ab}	6.05^{cd}	0.50 (1.00)	1128.00 (33.58^{a})
BRBR-01 × RB-2	6.63^{a}	6.95^{c}	0.60^{a}	8.00^{abc}	6.95^{c}	0.40 (0.95)	964.00 (31.05^{ab})
RB-2 × BRBL-01	4.95^{ab}	6.46^{d}	0.48^{ab}	9.65^{ab}	6.46^{cd}	0.43 (0.97)	1010.50 (31.77^{ab})
BRBL-07 × BRBL-02	5.00^{ab}	7.15^{c}	0.46^{ab}	9.33^{abc}	7.15^{c}	0.41 (0.96)	1034.00 (32.10^{ab})
Muktakeshi×Swarnmani	5.45^{ab}	8.87^{b}	0.44^{abc}	9.57^{ab}	8.87^{b}	0.38 (0.94)	739.00 (27.16^{a-d})
Pusa hybrid- 9	5.63^{a}	10.47^{a}	0.46^{ab}	9.97^{ab}	10.47^{a}	0.30 (0.89)	737.00 (27.14^{a-d})
Muktakeshi x BRBL-01	5.83^{a}	8.73^{b}	0.56 ^{a}	8.50^{abc}	8.73^{b}	0.40 (0.95)	840.33 (28.98^{abc})
S.Em (±)	0.35	0.28	0.02	0.59	0.28	0.01	1.04
C.D (p=0.005)	1.03	0.89	0.07	1.70	0.89	0.03	3.03

*Figures in parentheses are square root transformed; Means followed by a common letter are not significantly different at the 5% level by DMRT by other authors (Wagh *et al*., 21; Niranjana *et al*., 14). It is evident that the genotypes with long calyx were more susceptible than those with short calyx. Long calyx will help the neonate to hide and get in to the fruit relatively easily and cause more infestation.

Arka anand (0.58 cm), 71-19 × RB-2 (0.59 cm) and BRBL-02 × BRBL-07 (0.59 cm) recorded maximum pericarp thickness followed by BRBL-09 × BRBL 11 (0.54 cm) and Pusa hybrid- 6 (0.54 cm) (Table 2). Minimum pericarp thickness was recorded in Pusa hybrid- 9 (0.46 cm), BRBL-07 × BRBL-02 (0.46 cm) and Muktakeshi × Swarnmani (0.44 cm). Correlation study showed that pericarp thickness had significant and negative correlation with infestation of SFB (r=-0.374*) (Table 3). The present findings are in conformity with Chandrashekhar *et al.* (3), who reported highly significant and negative correlation between pericarp thickness and fruit infestation. Hence, it may be suggested that varieties with thick pericarp were less prone to fruit borer attack.

The genotype Arka anand, 71-19 × RB-2 and Pusa hybrid- 9 had the lowest fruit length of 12.03 cm, 11.18 cm and 9.97 cm respectively (Table 2) and it was followed by RB-2 × BRBL-01 (9.65), Muktakeshi × Swarnmani (9.57) and BRBL-02 × BRBL-07 (9.50) (Table 2). Correlation study revealed that fruit length (r= -0.163) had negative and non-significant correlation with fruit infestation by shoot and fruit borer (Table 3) as reported earlier by Gupta and Kauntey (5). It is evident that the genotypes with elongated shape fruit were less prone to fruit borer attack.

Among the genotype, Arka anand (5.10), 71-19 × RB-2 (5.90) and BRBL-02 × BRBL-07 (6.05) obtained minimum fruit diameter as compared to others and it was followed by RB-2 × BRBL-01 (6.46) and BRBR-01 × RB-2 (6.95) (Table 2). However, the maximum fruit diameter was noticed in Pusa hybrid- 9 (10.47), Pusa hybrid – 6 (9.00) and Muktakeshi × Swarnmani (8.87). Correlation study showed that fruit diameter (r=**0.737) had highly significant and positive correlation with fruit infestation by SFB (Table 3). Similar results were also reported by Naqvi *et al.* (12) who reported that the fruit diameter had significant positive correlation with fruit borer infestation. The present study clearly indicated that the genotypes with lower fruit infestation may be due to the presence of smaller fruit diameter and weight.

It is obvious from the data pertaining to shoot thickness (Table 2) that maximum shoot thickness was noted with Arka anand (0.51 cm), 71-19 × RB-2 (0.48 cm) and BRBL-02 × BRBL-07 (0.50 cm) which was at par with Muktakeshi× RB-2 (0.46 cm) followed by Pusa hybrid – 6 (0.44 cm), respectively. However, minimum shoot thickness was recorded in Pusa hybrid- 9 (0.30 cm) Muktakeshi × Swarnmani (0.38 cm) and Muktakeshi × Swarnmani (0.40 cm). Correlation study revealed that shoot diameter (-0.466**) had highly significant and negative correlation with shoot infestation by SFB (Table 3). Hence, the present study showed that the genotypes with less shoot thickness were more prone to shoot and fruit borer attack, in contrast to the previous reports (Naqvi *et al.,* 12; Wage *et al.,* 22).

Wide range of variation was observed with respect to trichome density (Table 2). Maximum trichome density was obtained in genotypes Arka anand (1097.50 cm^2), 71-19 × RB-2 (1033.00 cm^2) and BRBL-02 × BRBL-07 (1128.00 cm^2). This was statistically at par with BRBL-07 × BRBL-02 (1034.00 cm^2) followed by BRBL-09 × BRBL 11 (1017.67 cm^2) and RB-2 × BRBL-01 (1010.50 cm^2). However, the genotypes Pusa hybrid- 9 (737.00 cm^2) and Muktakeshi×Swarnmani (739.00 cm^2) had least number of trichomes. Correlation study indicated that trichome density (-0.580**) had negative and highly significant correlation with fruit infestation by SFB (Table 3). Our reports are in agreement with the findings of Wagh *et al.* (21) who reported that the density of trichome exhibited a strong and negative correlation (r = - 0.621) with respect to shoot infestation. The shoot infestation by *L. orbonalis* negatively, but not significantly correlated with number of trichomes on leaves. The present study clearly demonstrated that the genotypes with higher trichome density (inhibit the larval movement) were less susceptible to the infestation of shoot and fruit borer (Niranjana *et al.,* 14).

Data pertaining to phenol content (mg CE/100 g fw) of shoot and fruit are presented in Table 4. Genotype Arka anand (22.94 and 20.45), 71-19 × RB-2 (21.58 and 20.04) and BRBL-02 × BRBL-07 (22.65 and 20.36) contained maximum amount of shoot and fruit phenol, whereas, minimum amount of shoot and fruit phenol content was noticed in Pusa hybrid- 9 (14.11 and 15.34) and Muktakeshi×Swarnmani (17.09 and 17.63). Correlation study revealed that shoot and fruit phenol (r=--0.615** and -0.654**) had highly significant and negative correlation with fruit infestation by SFB (Table 5). Total phenols showed a significantly negative correlation with per cent fruit borer infestation (r = -0.49) on number basis and higher phenol contents with increased resistance to fruit borer. Hence, it is evident that the genotypes with high phenol content were less susceptible to the infestation of *L. orbonalis* (Jat and Parrek, 7; Chandrashekhar *et al.,* 3; Prasad *et al.,* 17). Phenols are the extremely abundant plant allelochemicals, often associated with feeding deterrence or growth inhibition of herbivores. Phenols in fairly large concentration could ward off insect pests because of their direct toxicity (Rameshkumar *et al*., 18).

The genotype Arka anand (16.41 and 3.54), 71-19 × RB-2 (16.89 and 4.74) and BRBL-02 × BRBL-07 (13.89 and 2.79) showed maximum shoot and fruit antioxidant content, whereas, the genotype Pusa hybrid- 9 (11.80 and 0.65) and Muktakeshi × Swarnmani (6.47 and 1.08) recorded minimum amount of shoot and fruit antioxidant content as compared to other genotypes (Table 4). Correlation study depicted that shoot antioxidant (r=-0.259) had non-significant and negative correlation and fruit antioxidant (r= -0.707**) had highly significant and negative correlation with fruit infestation on number basis by SFB (Table 5). The total antioxidant capacity showed negative and non-significant correlation with per cent fruit borer infestation on number (Shubham *et al.,* 19). Reports suggested that antioxidant activity has high insecticidal effects on young larvae and as the larvae grows, antioxidants have positive effects on larvae (Pedro *et al*., 16). Present results also depicted that the genotypes with high antioxidant content showed high insecticidal activity and therefore less per cent of shoot and fruit damage was recorded against those genotypes.

Among the genotypes, the minimum amount of shoot and fruit anthocyanin was recorded in Arka anand (14.12 and 11.72), 71-19 × RB-2 (11.59 and 10.66) and BRBL-02 × BRBL-07 (14.20 and 11.94) (Table 4). On the other hand, the genotypes Muktakeshi × Swarnmani (20.62 and 22.27) and Pusa hybrid- 9 (19.54 and 22.86) had maximum amount of shoot and fruit anthocyanin content than other genotypes. Correlation study revealed that shoot and fruit anthocyanin content (r=0.425** and 0.621**) had highly significant and positive correlation with fruit infestation on number basis (Table 5). However, the present findings are contradicted with earlier author (Shubham *et al.,* 19) as they reported total anthocyanin content of fruit exhibited significant negative correlation with per cent fruit borer infestation by number. This may be due to the differences in genotypes. Lev and Gould (9) suggested that anthocyanin act as an attractant to frugivores, as well as repellent against herbivores and parasites and present results portrayed that the genotypes with low anthocyanin content showed less attraction to *L. orbonalis* and also have repellency effect, therefore less damage were recorded against those genotypes.

The genotypes Arka anand (1.87), 71-19 × RB-2 (2.43) and BRBL-02 × BRBL-07 (2.15) had minimum amount of total sugar content in fruit which showed statistical parity with Muktakeshi× RB-2 (2.61), Pusa hybrid - 6 (2.62), BRBL-07 × BRBL-02 (2.72) and Muktakeshi× BRBL-02 (2.90) (Table 4). On the other

Table 4. Mean performance of four biochemical characters under different brinjal genotypes (Pooled analysis of 2017 and 2018)

Genotypes	Phenol (mg CE/100 g fw)		Antioxidant (µ mol TE/g)		Anthocyanin (mg/100g)		Total sugar (%)
	Shoot	Fruit	Shoot	Fruit	Shoot	Fruit	Fruit
RB-2 ×Swarnmani	18.95^{ab}	20.04^{a}	13.05^{abc}	2.05^{bcd}	16.54^{abc}	15.08^{b}	2.96^{a}
Muktakeshi× BRBL-02	17.23^{abc}	19.41^{a}	13.30^{abc}	2.35^{bcd}	17.54^{ab}	16.89^{b}	2.90^{a}
Pusa hybrid – 6	18.57^{abc}	18.13^{ab}	11.25^{a-d}	3.10^{b}	15.64^{abc}	15.84^{b}	2.62^{ab}
Arka anand	22.94^{a}	20.45^{a}	16.41^{a}	3.54^{b}	14.12^{a-d}	11.72^{bcd}	1.87^{ab}
71-19 × RB-2	21.58^{a}	20.15^{a}	16.89^{a}	4.74^{a}	11.59^{e}	10.66^{bcd}	2.43^{ab}
Muktakeshi× RB-2	19.43^{ab}	19.52^{a}	13.94^{ab}	2.22^{bcd}	18.46^{ab}	14.66^{b}	2.61^{ab}
BRBL-09 × BRBL 11	18.17^{abc}	18.74^{a}	12.03^{abc}	2.08^{bcd}	16.61^{abc}	12.67^{bc}	3.71^{a}
BRBL-02 × BRBL-07	22.65^{a}	20.36^{a}	13.97^{ab}	2.79^{bc}	14.20^{a-d}	11.94^{bcd}	2.15^{ab}
BRBR-01 × RB-2	21.07^{a}	19.24^{a}	13.31^{abc}	2.63^{bc}	16.46^{abc}	12.30^{bc}	2.96^{a}
RB-2 × BRBL-01	19.58^{ab}	19.28^{a}	12.96^{abc}	2.22^{bcd}	16.23^{abc}	14.56^{b}	2.88^{a}
BRBL-07 × BRBL-02	20.00^{ab}	19.72^{a}	11.96^{abc}	2.32^{bcd}	18.35^{ab}	15.85^{b}	2.72^{ab}
Muktakeshi×Swarnmani	17.09^{abc}	17.63^{ab}	6.47^{e}	1.08^{e}	20.62^{a}	22.27^{a}	3.76^{a}
Pusa hybrid- 9	14.11^{d}	15.34^{c}	11.05^{a-d}	0.65^{e}	19.54^{a}	22.86^{a}	3.90^{a}
Muktakeshi x BRBL-01	20.47^{ab}	18.66^{a}	11.80^{abc}	2.48^{bc}	14.47^{a-d}	13.23^{bc}	3.06^{a}
S.Em (±)	0.80	0.68	0.85	0.22	0.72	0.86	0.35
C.D (p=0.005)	2.33	1.97	2.47	0.65	2.11	2.49	1.02

Means followed by a common letter are not significantly different at the 5% level by DMRT

Table 5: Correlation between biochemical parameters of brinjal genotypes and infestation of brinjal shoot and fruit borer, *Leucinodes orbonalis*

	Shoot phenol	Fruit phenol	Shoot antioxidant	Fruit antioxidant	Shoot anthocyanin	Fruit anthocyanin	Total Sugar	Shoot infestation	Fruit infestation on weight basis	Fruit infestation on number basis
Shoot phenol	1									
Fruit phenol	0.627^{**}	1								
Shoot antioxidant	0.214^{NS}	0.261^{NS}	1							
Fruit antioxidant	0.570^{**}	0.532^{**}	0.250^{NS}	1						
Shoot anthocyanin	-0.444^{**}	-0.287^{NS}	-0.433^{**}	-0.409^{**}	1					
Fruit anthocyanin	-0.583^{**}	-0.490^{**}	-0.561^{**}	-0.549^{**}	0.532^{**}	1				
Total Sugar	-0.565^{**}	-0.454^{**}	-0.277^{NS}	-0.503^{**}	0.171^{NS}	0.470^{**}	1			
Shoot infestation	-0.671^{**}	-0.633^{**}	-0.327^{*}	-0.604^{**}	0.414^{**}	0.605^{**}	0.545^{**}	1		
Fruit infestation on weight basis	-0.698^{**}	-0.689^{**}	-0.371^{*}	-0.709^{**}	0.483^{**}	0.671^{**}	0.543^{**}	0.891^{**}	1	
Fruit infestation on number basis	-0.615^{**}	-0.654^{**}	-0.259^{NS}	-0.707^{**}	0.425^{**}	0.621^{**}	0.485^{**}	0.838^{**}	0.849^{**}	1

** Significant at 1 % level, * Significant at 5 % level

hand, maximum amount of total sugar content was recorded with Muktakeshi × Swarnmani (3.76) and Pusa hybrid- 9 (3.90). Correlation study illustrated that total sugar in fruit (r=0.485) had significant positive correlation with fruit infestation on number basis by SFB (Table 5). The present results are in agreement with the findings of earlier authors (Jat and Pareek, 7; Prasad *et al.,* 17) and they reported that total sugars were positively correlated with fruit infestation and higher concentration of sugars in brinjal fruits may act as feeding stimulant in the susceptible varieties (Rameshkumar *et al*., 18).

The brinjal genotypes namely Arka anand, 71-19 × RB-2, BRBL-02 × BRBL-07 and RB-2 X BRBL-01 with low shoot and fruit infestation, short pedicel and calyx length, minimum fruit diameter and higher trichome density, phenol and antioxidant content and low anthocyanin and total sugar content were tolerant to the infestation of *L. orbonalis*. These genotypes could be used as a utilized in the commercial exploitation against *L. orbonalis* in brinjal.

AUTHORS' CONTRIBUTION

Execution of field/lab experiments and data collection (PKP): Conceptualization of research, designing of the experiments (TS); Analysis of data and interpretation (NC)

DECLARATION

The authors declared that they do not have any conflict of interest.

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