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# BIOCHEMICAL AND BIOPHYSICAL CHARACTERISTICS OF BRINJAL FOR RESISTANCE TO SHOOT AND FRUIT BORER (*Leucinodes orbonalis* guenee)

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**ABSTRACT**
An experiment was carried out with six parents and thirty hybrids of brinjal at Tamil Nadu Agricultural University, Coimbatore to find the influence of biophysical and biochemical characters of brinjal on the infestation to shoot and fruit borer. Among the hybrids Sevathampatti local x Spiny local and Sevathampatti local x Seetipulam local was found least attacked by the borers recording minimum percentage of fruit infestation (14.68 percent) with maximum yield per plant of 3.27 kg per plant. Fruit infestation was positively but not significantly correlated with length of calyx (r = 0.314) whereas, yield per plant (r= -0.297), solasodine (r = -0.170) and phenol (r = -0.572) showed significantly negative correlation with fruit infestation and positive correlation with shoot infestation (r = 0.041), polyphenol oxidase (r = 0.011) and total sugars (r = 0.072). The cross Manaparai local x Spiny local, Sevathampatti local x Spiny local and Sevathampatti local x Seetipulam local recording maximum yield, less shoot and fruit infestation, lowest calyx length, low sugar, high polyphenol oxidase and high phenol could be used as resistant cultivar for further shoot and fruit borer resistance breeding programme.

**KEY WORDS:** Biophysical, biochemical, *Leucinodes orbonalis*, resistance.

## INTRODUCTION

Brinjal (*Solanum melongena* L.) is broadly cultivated as one of the most important vegetables in both subtropical and tropical regions of India. It is grown almost in all the districts of Tamil Nadu and extensively in Dindigul, Vellore, Theni and Madurai districts. In these districts consumers prefer purple coloured fruits than other coloured fruits. To meet the consumer's preference of these districts, it is necessary to develop purple fruited variety or hybrids coupled with borer resistance. Among the major pests infesting the crop, shoot and fruit borer is the most limiting factor distributed all over India, causing heavy yield loss upto 70(Jat and Pareek, 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 (HPR) is the economically sound technique for effective pest management. Developing brinjal hybrids/varieties with natural resistance to BSFB 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, the identification of biophysical characteristics from insect resistant genotypes is most practical significance. Earlier research findings was exposed that biochemical characters, such as total Sugars and free amino acids, were positively associated with fruit infestation, whereas, polyphenol oxidase and glycoalkaloids are negatively correlated with fruit borer attack. With this background, an experiment was made for collection and evaluation of genotypes with resistance against BFSB based on biophysical and biochemical basis of resistance.

## MATERIALS AND METHODS

The present investigation on influence of biophysical and biochemical characteristics of brinjal for shoot and fruit borer resistance was carried out in the college orchard, Department of vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2018 which is situated at 11° N latitude and 77° E longitude and at an elevation of 426.6 m above MSL. The experimental materials for the present study consisted of six parents namely Sevathampatti local, Marthandam local, Seetipulam local, Manaparai local, Spiny local and Karungal local and thirty hybrids were produced through full diallel mating design and evaluated in a randomized block design with two replications. Forty five days old seedlings were transplanted on the ridges adopting a spacing of 60 x 60 cm. Twenty five plants were maintained for each hybrid in each replication. Cultural practices were followed as per the package of practices recommended for Tamil Nadu. Five matured fruits per plant were randomly selected to measure the length of calyx with the help of a scale. The yield per plant was measured by deducting the yield of infested fruits from the total yield per plant. The per cent infestation of fruits on number basis was calculated by counting the infested and

healthy fruits separately from all the plants in each accession. Polyphenol oxidase activity was assayed as per the method described by Srivastava (1987). Folin-ciocalteau reagent method was followed for estimating the total phenols (Bray and Thrope, 1954). The total sugar was carried out based on the method by Hedge and Horreiter (1962). The solasodine content was estimated based on the method by Bakshi and Hamied (1972). The statistical analysis for mean performance as suggested by Panse and Sukhetme (1989) and correlation analysis for all the characters was given by Miller et al. (1958).

## RESULTS AND DISCUSSION

The analysis of variance showed significant difference among the genotypes for all the characters (data not given). The genotypic variance for all the characters was highly significant indicating wide variability for all the characters studied.

### Biophysical characters of brinjal genotypes in relation to shoot and fruit borer

Plants defend themselves against herbivores using their biophysical and structural features. In many cases, it is obvious that the biophysical characters of the host plant play an important role in conferring resistance to fruit borer. Major biophysical characters of eggplant fruits in relation to BFSB infestation is given in Table 1.

**TABLE 1.** Biophysical characters of brinjal genotypes in relation to fruit and shoot borer

| Parents / Hybrids | Calyx Length (cm) | Yield per plant (kg) | Shoot Infestation (%) | Fruit Infestation (%) |
|---|---|---|---|---|
| P1 | 3.69 | 2.61 | 11.35 | 19.97 |
| P2 | 4.27 | 3.09 | 10.66 | 23.62 |
| P3 | 4.08 | 2.90 | 10.03 | 25.02 |
| P4 | 4.24 | 1.93 | 11.29 | 24.58 |
| P5 | 3.59 | 2.76 | 10.87 | 26.22 |
| P6 | 3.77 | 2.48 | 11.00 | 24.38 |
| P1xP2 | 3.96 | 2.93 | 12.60 | 19.11 |
| P1xP3 | 4.30 | 2.89 | 12.10 | 14.68 |
| P1xP4 | 3.94 | 2.69 | 11.54 | 30.31 |
| P1xP5 | 3.83 | 2.75 | 9.57 | 25.01 |
| P1xP6 | 4.13 | 3.12 | 11.92 | 23.08 |
| P2xP1 | 4.12 | 2.66 | 12.81 | 19.05 |
| P2xP3 | 4.28 | 2.95 | 10.59 | 18.15 |
| P2xP4 | 4.07 | 3.16 | 12.97 | 18.84 |
| P2xP5 | 3.40 | 2.69 | 11.38 | 20.06 |
| P2xP6 | 3.75 | 2.85 | 11.99 | 17.24 |
| P3xP1 | 4.13 | 2.35 | 10.80 | 25.77 |
| P3xP2 | 4.18 | 1.95 | 20.51 | 22.25 |
| P3xP4 | 3.86 | 2.30 | 12.04 | 24.11 |
| P3xP5 | 4.20 | 2.91 | 16.38 | 25.41 |
| P3xP6 | 3.84 | 2.67 | 10.86 | 21.86 |
| P4xP1 | 4.16 | 2.78 | 10.38 | 29.10 |
| P4xP2 | 3.23 | 3.10 | 17.83 | 29.28 |
| P4xP3 | 3.80 | 2.41 | 10.59 | 30.17 |
| P4xP5 | 4.20 | 3.27 | 10.94 | 22.27 |
| P4xP6 | 4.45 | 2.60 | 12.26 | 25.08 |
| P5xP1 | 3.54 | 2.88 | 11.70 | 25.81 |
| P5xP2 | 4.00 | 3.18 | 11.54 | 30.18 |
| P5xP3 | 3.89 | 2.53 | 12.32 | 21.19 |
| P5xP4 | 3.76 | 2.59 | 10.83 | 18.13 |
| P5xP6 | 3.97 | 2.63 | 11.89 | 19.43 |
| P6xP1 | 3.99 | 2.46 | 14.45 | 21.43 |
| P6xP2 | 4.03 | 1.98 | 12.08 | 20.66 |
| P6xP3 | 4.16 | 2.65 | 10.94 | 17.96 |
| P6xP4 | 3.21 | 2.47 | 15.74 | 20.33 |
| P6xP5 | 4.30 | 2.26 | 12.66 | 22.83 |
| Mean | 3.95 | 2.68 | 12.20 | 22.85 |
| SED | 0.287 | 0.180 | 0.956 | 0.176 |
| CD (0.5%) | 0.815 | 0.512 | 2.719 | 0.500 |
| Correlation coefficient (r) | 0.314 | -0.297 | | |

P1- Sevathampatti local, P2- Marthandam local, P3- Seetipulam local, P4- Manaparai local, P5- Spiny local , P6-Karungal local

Calyx are the most important morphological component which has strong association with pest infestation. The results revealed that the lowest calyx length (3.21 cm) was observed in the Karungal local x Manaparai local. The highest calyx length was recorded in Manaparai local x Karungal local (4.45 cm). The fruits having short calyx were more resistant than those with long calyx. The correlation analysis showed that fruit infestation was

positively but not significantly correlated with calyx (r = 0.314) of fruit. 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. The present findings are in agreement with Wagh *et al.* (2012) and Niranjana *et al.* (2015), they also observed that the calyx length had positive correlation with susceptibility to fruit borer.

The fruit yield per plant which is free of infection by the fruit borer is the most important parameter in brinjal. It describes the profit of the grower and it is decided mainly by the percentage of infestation by fruit and shoot borer. Lesser the fruit infestation better would be the yield per plant. The highest yield per plant was recorded in the hybrids Manaparai local x Spiny local (3.27 kg) followed by Spiny local x Marthandam local (3.18 kg). The highest yield is due to less infection by the borer. The hybrid Sevathampatti local x Manaparai local is highly affected by the borer and highly susceptible to the pest. Brinjal genotypes with higher yield possess relatively higher genetic tolerance to shoot and fruit infestation. The similar results were recorded by Praneetha (2002). The results showed significantly negative correlation with marketable yield per plant (r= -0.297). This indicated decrease in yield with low infestation.

The shoot borer infestation affects the growth of the plant as well as yield. The hybrids Sevathampatti local x Spiny local showed less shoot infestation percentage (9.57 percent) followed by Manaparai local x Sevathampatti local (10.38 percent) and the parent Seetipulam local recorded higher shoot infestation of 10.03 percent. The very low shoot infestation attributed due to genetic and environmental effect. The results of the present study are in confirmation with the findings of Humayun Javed *et al.* (2011) and Navqi *et al.* (2009). Shoot infestation had significantly positive correlation (r = 0.041) with fruit infestation. The highest shoot infestation led to more fruit infestation leading to decrease in the crop yield.

**Biochemical characters of brinjal genotypes in relation to shoot and fruit borer**

Many biochemical factors are known to be associated with insect pest resistance in crop plants. In many cases, it is obvious that the biochemical constituents like, total phenols, flavonols and enzymes are more important than other morphological and physiological factors, in conferring non-preference and antibiosis. Some biochemical constituents may also act as feeding stimuli for insects.

The highest total sugars content (5.26 g g-1FW) was recorded in highly susceptible hybrid Spiny local x Seetipulam local, while lowest (2.63 g g-1FW) Table 2. was recorded in resistant cross Sevathampatti local x Spiny local infestation had significant positive correlation with total sugars (r = 0.072). Since sugar is considered one of the vital nutrients in plants, the difference in the relative amount of sugars between different genotypes with differential susceptibilities to fruit borer indicate that these compound might act as phago-stimulants to BFSB feeding on eggplant. The present results are in agreement with the findings of Jat and Pareek (2003), Elanchezhyan *et al.* (2009) and Prasad *et al.* (2014), who reported that total sugars were positively correlated with fruit infestation. Higher concentration of sugars in eggplant fruits may act as feeding stimulant in the susceptible varieties.

The discoloration in brinjal fruit is attributed to high polyphenol oxidase activity. The highest PPO activity was recorded in the resistant cross Seetipulam local x Manaparai local (1.24 Changes in OD min-1g-1) and the lowest was recorded in the susceptible hybrid Marthandam local x Sevathampatti local (0.246 Changes in OD min-1g-1). The result of present study suggested that the hybrid having high PPO activity showed resistant reaction to borer attack with significant positive correlation with PPO activity (r =0.011). These findings are in agreement with the findings of Doshi *et al.* (1998) and Khorsheduzzaman *et al.* (2010).

The glycoalkaloid contents in the Indian commercial cultivars vary from 0.37 to 4.83 mg/100 g fresh weight. Generally, a bitter taste and off flavour of brinjal fruits may be produced by higher content of glycoalkaloids. The lowest solasodine content was found in Karungal local x Manaparai local (0.023%) and the highest solasodine content was measured in Spiny local x Seetipulam local (0.047 %). Similar trend was observed by Dhruve *et al.* (2014). The fruit infestation had significantly negative correlation with solasodine content (r = -0.170). Similar correlation for glycoalkaloid content was observed by Doshi *et al.* (1998).

The lowest phenol content (0.89 mg g-1) was recorded in the hybrid Manaparai local x Seetipulam local and it was high in resistant cross, Spiny local x Karungal local (1.74 mg g-1), which recorded lowest infestation. 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 insects pests because of their direct toxicity. The genotype with high phenols content showed low percentage infestation, indicating its role in imparting resistance against this pest. Total phenols showed a significantly negative correlation with per cent fruit borer infestation (r = -0.572). The present results are in agreement with Asati *et al.* (2002), Jat and Parrek (2003), Chandrashekhar *et al.* (2009), Elanchezhyan *et al.* (2009) and Prasad *et al.* (2014) who reported higher phenol contents with increased resistance to fruit borer.

Hence, the combination of biophysical and biochemical traits can be used as an effective and reliable selection criterion to select resistant genotype. In general, with high yield, low sugar and high phenols and polyphenol oxidase activity may be used in hybridization programme to develop cultivars with resistance to *L. orbonalis*. The crosses Sevathampatti local x Spiny local and Sevathampatti local x Seetipulam local identified as resistant can be utilized in the commercial exploitation for development in brinjal.

**TABLE2.** Biochemical characters in relation to shoot and fruit borer infestation

| Parents / Hybrids | Total Sugars (mg/g) (FW) | Polyphenol Oxidase (Changes in OD/min/g of sample) | Solasodine (%) | Total Phenol (mg $g^{-1}$) |
|---|---|---|---|---|
| P1 | 3.10 | 0.864 | 0.037 | 1.48 |
| P2 | 3.48 | 1.072 | 0.039 | 1.30 |
| P3 | 3.83 | 0.900 | 0.032 | 1.47 |
| P4 | 4.09 | 0.478 | 0.039 | 1.40 |
| P5 | 3.60 | 0.324 | 0.027 | 1.53 |
| P6 | 2.88 | 0.538 | 0.037 | 1.39 |
| P1xP2 | 3.87 | 0.666 | 0.033 | 1.15 |
| P1xP3 | 3.25 | 1.109 | 0.038 | 1.52 |
| P1xP4 | 3.41 | 0.883 | 0.027 | 1.62 |
| P1xP5 | 2.63 | 0.655 | 0.037 | 1.20 |
| P1xP6 | 3.92 | 0.464 | 0.036 | 1.60 |
| P2xP1 | 3.52 | 0.246 | 0.043 | 1.46 |
| P2xP3 | 3.77 | 1.038 | 0.029 | 1.42 |
| P2xP4 | 4.18 | 0.982 | 0.040 | 1.68 |
| P2xP5 | 3.95 | 0.340 | 0.030 | 1.19 |
| P2xP6 | 3.96 | 0.477 | 0.033 | 1.28 |
| P3xP1 | 3.31 | 0.558 | 0.027 | 1.45 |
| P3xP2 | 3.03 | 0.872 | 0.036 | 1.28 |
| P3xP4 | 3.51 | 1.240 | 0.045 | 1.50 |
| P3xP5 | 3.79 | 0.479 | 0.038 | 1.24 |
| P3xP6 | 3.58 | 0.252 | 0.038 | 1.40 |
| P4xP1 | 3.98 | 0.564 | 0.027 | 1.19 |
| P4xP2 | 3.50 | 0.860 | 0.029 | 1.06 |
| P4xP3 | 3.34 | 0.676 | 0.035 | 0.89 |
| P4xP5 | 4.16 | 0.577 | 0.034 | 1.71 |
| P4xP6 | 4.19 | 0.998 | 0.040 | 1.51 |
| P5xP1 | 4.93 | 0.679 | 0.037 | 1.16 |
| P5xP2 | 4.61 | 0.845 | 0.029 | 1.41 |
| P5xP3 | 5.26 | 0.794 | 0.047 | 1.39 |
| P5xP4 | 4.99 | 0.590 | 0.026 | 1.45 |
| P5xP6 | 4.52 | 0.837 | 0.033 | 1.74 |
| P6xP1 | 4.48 | 0.662 | 0.039 | 1.46 |
| P6xP2 | 4.23 | 0.880 | 0.027 | 1.72 |
| P6xP3 | 3.69 | 0.951 | 0.029 | 1.23 |
| P6xP4 | 3.84 | 1.041 | 0.023 | 1.64 |
| P6xP5 | 4.18 | 0.656 | 0.032 | 1.70 |
| Mean | 3.85 | 0.723 | 0.034 | 1.41 |
| SED | 0.382 | 0.008 | 0.005 | 0.201 |
| CD (0.5%) | 1.087 | 0.023 | 0.014 | 0.570 |
| Correlation coefficient (r) | 0.072 | 0.011 | -0.170 | -0.572 |

P1- Sevathampatti local, P2- Marthandam local, P3- Seetipulam local, P4- Manaparai local, P5- Spiny local, P6-Karungal local

## CONCLUSION

The brinjal hybrids Sevathampatti local x Spiny local and Sevathampatti local x Seetipulam local with low shoot and fruit infestation, short calyx of fruit, high yield, low sugar and high polyphenols and PPO activity was resistant to the infestation of *L. orbonalis*. These resistant crosses can be used as a utilized in the commercial exploitation against *L. orbonalis* in brinjal.

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