International Journal of Advanced Biochemistry Research 2025; SP-9(8): 592-598

International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(8): 592-598
www.biochemjournal.com
Received: 14-06-2025
Accepted: 17-07-2025

Shubhangi R Kshirsagar
Master of Science, Department of Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola, Maharashtra, India

Dr. Vandana D Mohod
Assistant Entomologist, AICRP on Post-Harvest Engineering and Technology, Post Graduate Institute, Dr. PDKV, Akola, Maharashtra, India

Dr. Indira B Soneji
Assistant Research Biochemist, AICRP on Post-Harvest Engineering and Technology, Dr. PDKV, Akola, Maharashtra, India

Janhavi G Dose
Ph.D. Scholar, Department of Entomology, Post Graduate Institute, Dr. PDKV, Akola, Maharashtra, India

Dr. NS Satpute
Associate Professor, Post Graduate Institute, Dr. PDKV, Akola, Maharashtra, India

Corresponding Author:
Shubhangi R Kshirsagar
Master of Science, Department of Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola, Maharashtra, India

Biochemical characterization of brinjal (*Solanum melongena* L.) genotypes in response to shoot and fruit borer (*Leucinodes orbonalis guenée*) infestation

Shubhangi R Kshirsagar, Vandana D Mohod, Indira B Soneji, Janhavi G Dose and NS Satpute

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i8Sj.5211

Abstract
A comprehensive biochemical assessment was conducted to elucidate the basis of host plant resistance in brinjal (*Solanum melongena* L.) genotypes against shoot and fruit borer (*Leucinodes orbonalis guenée*). Twenty genotypes exhibiting variable responses to pest infestation were analyzed for key biochemical traits, specifically total phenolic content and total soluble sugars, in both shoot and fruit. Variations in biochemical constituents, showed a clear correlation with pest incidence. Elevated cocentration of total phenolic compounds were recorded in the resistance genotypes AKBR-20-21, AKBR-20-05, AKBR-20-03, and AKBR-20-06. Among them, AKBR-20-03 recorded the highest phenol content in shoots (2.07 mg/g), followed by AKBR-20-05 (1.72 mg/g) and AKBR-20-21 (1.60 mg/g). The remaining genotypes showed intermediate phenol levels. The lowest phenol content in shoots was recorded in the genotype Aruna (0.41 mg/g), while in fruits, the minimum was observed in AKBR-20-02 (0.38 mg/g) and the maximum in AKBR-20-10 (2.00 mg/g). Regarding total sugar content, AKBR-20-12 recorded the highest level in shoots (11.80%), which was statistically at par with AKBR-20-07 (11.07%). The lowest sugar content in shoots was observed in AKBR-20-06 (4.20%). In fruits, the maximum total soluble sugar (TSS) was recorded in AKBR-20-20 (11.94%) and the minimum in AKBR-20-03 (3.20%). The genotypes AKBR-20-02, AKBR-20-08, AKBR-20-13, AKLB-9, AKBR-20-23, and AKBR-20-20 showed the highest shoot infestation levels of 2.71%, 2.67%, 2.53%, 2.54%, 2.43%, and 2.43%, respectively. Correlation analysis revealed a significant negative correlation between phenol content in shoots and fruit borer infestation. However, phenol content in fruits showed a negative but non-significant correlation with fruit borer infestation. In contrast, total soluble sugar content in both shoots and fruits exhibited a significant positive correlation with shoot and fruit borer infestation.

Keywords: Biochemical, resistance, brinjal, shoot and fruit borer

Introduction

Brinjal is a major solanaceous vegetable crop, widely cultivated and highly valued for its nutritional and economic significance. It ranks among the top vegetables globally due to its high yield potential and broad adaptability. Nutritionally, brinjal is characterized by its low caloric content (24-25 kcal per 100 g), making it suitable for individuals with diabetes, hypertension, and obesity. It is primarily composed of water, with moderate amounts of protein, dietary fibre, and negligible fat. The fruit is a rich source of essential nutrients and bioactive compounds, including minerals, antioxidants, vitamins, and proteins (Matsubara *et al.*, 2005) [17]. Per 100 g of edible portion, brinjal contains approximately 0.7 mg iron, 13.0 mg sodium, 213.0 mg potassium (Nonnecke, 1989) [21], 12.0 mg calcium, 26.0 mg phosphorus, 5.0 mg ascorbic acid (vitamin C), and 0.5 IU of vitamin A, contributing to its status as a health-promoting food (Tindall, 1978) [30]. Its high potassium content (~200 mg per 100 g) further enhances its dietary value, especially for cardiovascular health. Globally, brinjal is cultivated over an area of approximately 61.0 million hectares, with a production of 59.3 million tonnes during 2022-23. Major brinjal-producing countries include China, India, Japan, and several nations in Europe. Due to its productivity and nutritional richness, brinjal is often referred to as the “King of Vegetables.”

The crop is believed to have originated in India, with China recognized as its secondary center of origin (Thomson and Killey, 1957) [29]. India ranks second in terms of vegetable production in the world. In India, the total area under Brinjal is 7.3 lakh hectares with an annual production of 128.01 lakh M T with productivity of 19.1 M T ha-1. In India, (National Horticulture Board, Ministry of Agriculture & Farmers Welfare, Government of India). West Bengal is the top brinjal-producing state in India, followed by Maharashtra and Bihar. Other notable brinjal-producing states include Odisha, Karnataka, Uttar Pradesh, and Andhra Pradesh. In Maharashtra, Brinjal is cultivated in an area of 1.68 thousand ha, with an annual production of 276.66 thousand metric tonnes It is largely grown in Pune, Jalgaon, Ahmednagar, Nashik, Aurangabad, and Satara districts of Maharashtra.

The shoot and fruit borer (*Leucinodes orbonalis*) has emerged as a major constraint in brinjal (*Solanum melongena L.*) cultivation, with yield losses ranging from 54-60% as reported by Krishnaiah (1980) [14], and up to 70-80% according to Mishra *et al.* (2014) [18]. Furthermore, the pest has been shown to cause substantial degradation of nutritional quality, including up to 80% reduction in vitamin C content (Mainali, 2014) [16]. Although Dar *et al.* (2015) [3] evaluated integrated management strategies for *L. orbonalis*, chemical control remains the most commonly adopted method. While synthetic insecticides can significantly reduce pest infestation, their indiscriminate use poses serious environmental and human health hazards, and leads to ecological imbalances, bioaccumulation, and biomagnification of toxic residues (Onekutu *et al.*, 2014) [22]. Given these challenges, it is imperative to identify and utilize sustainable, eco-friendly approaches such as host plant resistance (HPR). A comprehensive understanding of the morphological and biochemical traits associated with resistance is essential prior to initiating breeding programs. Morphological traits linked to resistance have been previously reported (Dar *et al.*, 2014) [4], and biochemical defense mechanisms are equally critical for identifying potential donor genotypes for resistance breeding. The incorporation of HPR into breeding strategies offers a viable pathway to developing high-yielding, pest-resistant cultivars of brinjal.

Therefore, the present investigation was undertaken to evaluate the biochemical profiles of twenty brinjal genotypes, with the objective of identifying biochemical markers associated with resistance or susceptibility to *L. orbonalis*.

Materials and Methods: A field experiment was conducted on chilli and vegetable research unit Dr. PDKV Akola by using a Randomized Block Design (RBD) with two replications and twenty treatments. Twelve brinjal genotypes were evaluated for their resistance to the shoot and fruit borer (*Leucinodes orbonalis Guenee*). Fifty-day-old seedlings were transplanted at a spacing of 60 × 60 cm (both row-to-row and plant-to-plant) during the cropping period from July 2024 to February 2025 at the Chilli and Vegetable Research Unit, Dr. PDKV, Akola. All recommended agronomic practices, except for plant protection measures, were followed in accordance with the crop production guide for horticultural crops. In each replication, ten plants were randomly tagged and observed weekly for infestation by the shoot and fruit borer, starting from the 15th day after transplanting (DAT) and continuing until harvest. Damaged shoots were removed after every observation. For fruit infestation, the number and weight of both healthy and infested fruits were recorded, and the percentage of fruit damage was calculated. Based on the percentage of fruit infestation, the genotypes were rated using the scale proposed by Subramanyam and Butani (1981) [28]. Susceptibility classification was also carried out using the method suggested by Ali *et al.* (2014) [1]. The percentage data generated from the experiment were analyzed using square root and arcsine (angular) transformations for statistical analysis. Total phenol content in shoots and fruits was estimated using the Folin-Ciocalteu reagent method as described by Bray and Thorpe (1954) [2]. Soluble sugar content in shoots and fruits was determined using the Anthrone method, following the procedure of Dubois *et al.* (1956) [9].

Phenols

A 0.5 g sample of shoot or fruit was taken and ground using a pestle and mortar in the presence of 10 ml of 80% ethanol. The homogenate was then centrifuged at 10,000 rpm for 20 minutes. The resulting supernatant was collected, and the remaining residue was re-extracted using five times the volume of 80% ethanol. This extract was again centrifuged at 10,000 rpm, and the supernatants from both extractions were pooled together and evaporated to dryness. The dry residue was then dissolved in 5 ml of distilled water. Aliquots ranging from 0.2 ml to 2 ml were taken into separate test tubes, and 0.5 ml of Folin-Ciocalteu Reagent (FCR) was added to each. After allowing the reaction to proceed for 3 minutes, 2 ml of 20% sodium carbonate (Na_2CO_3) solution was added, and the contents were mixed thoroughly. The test tubes were then placed in boiling water for exactly 1 minute and subsequently cooled. Absorbance was measured at 650 nm using a spectrophotometer, with a reagent blank as the control. A standard curve was prepared using different concentrations of catechol. The concentration of phenols in the test samples was then estimated from this standard curve and expressed as milligrams of phenols per gram of sample. The standard graph was plotted with catechol concentration on the X-axis and absorbance on the Y-axis (Figure 1), from which the total phenol content of the samples was calculated.

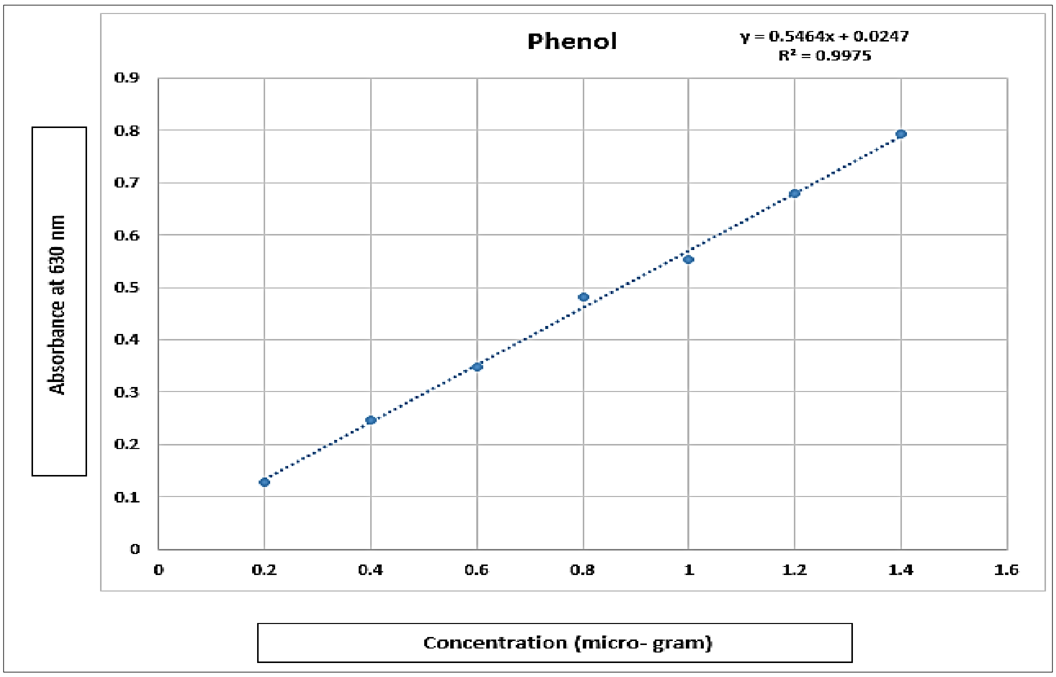

Fig 1: Standard curve for phenol estimation in brinjal: A standard curve (absorbance vs. concentration) was developed using the Folin-Ciocalteu reagent method, as described by Bray and Thorpe (1954) [2].

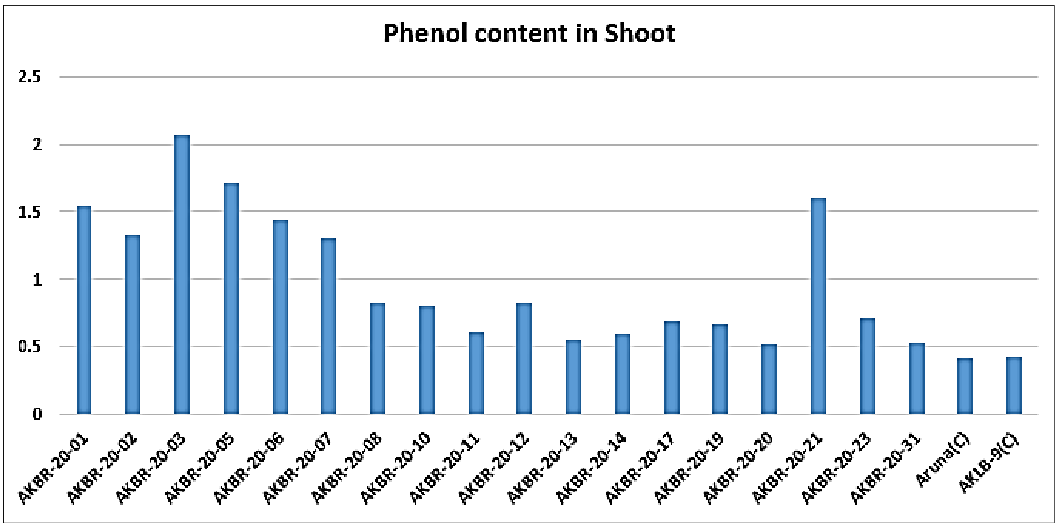

Fig 2: Biochemical parameter (Phenol content in shoots) of different genotypes of brinjal

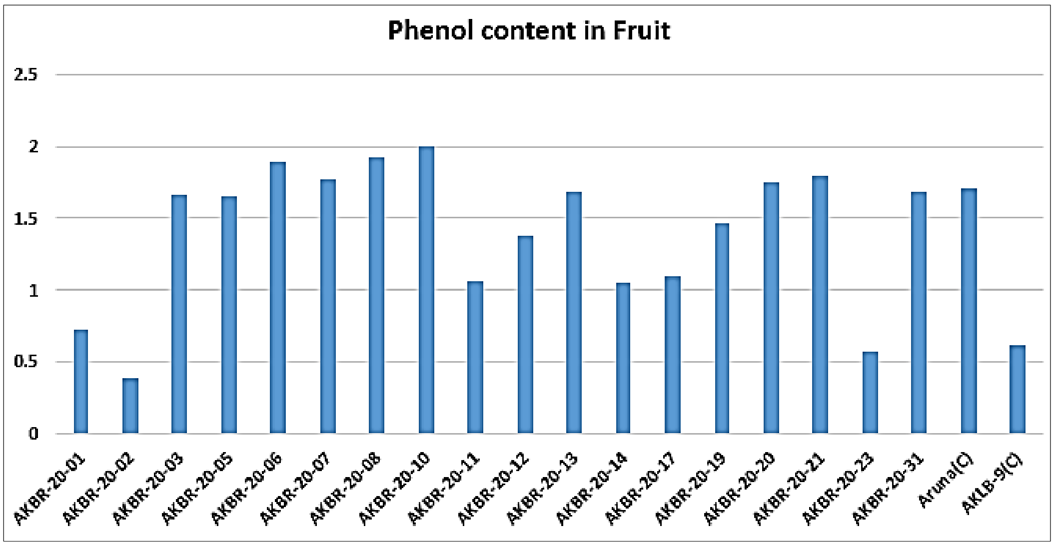

Fig 3: Biochemical parameter (Phenol content in fruit) of different genotypes of brinjal

Total sugars

A 100 mg sample of shoot or fruit were taken and hydrolyzed in a boiling water bath for 3 hours using 5 ml of 2.5 N hydrochloric acid (HCl), then allowed to cool to room temperature. The hydrolysate was neutralized with solid sodium carbonate until the effervescence stopped. The final volume was made up to 100 ml with distilled water and then centrifuged at 5,000 rpm for 20 minutes. The resulting supernatant was collected, and 1 ml aliquots were taken for further analysis. For preparing the standards, 0, 0.2, 0.4, 0.8, and 1.0 ml of working standard solutions were used, where 0 ml served as the blank. The volume in all tubes, including the sample tube, was adjusted to 1 ml using distilled water. To each tube, 4 ml of anthrone reagent was added, and the tubes were heated in a boiling water bath for 8 minutes. After heating, the tubes were rapidly cooled, and the developed green to dark green color was measured using a spectrophotometer at 630 nm. A standard graph was plotted with the concentration of standard sugar solutions on the X-axis and absorbance on the Y-axis (Figure 4). Using this graph, the total sugar content in the sample was calculated and expressed accordingly.

$$\text{Total sugars (mg/g)} = \frac{\text{Sugar value from graph } (\mu g) \times \text{Total volume of extract (ml)} \times 100}{\text{Aliquot used (ml)} \times \text{Weight of sample (mg)}}$$

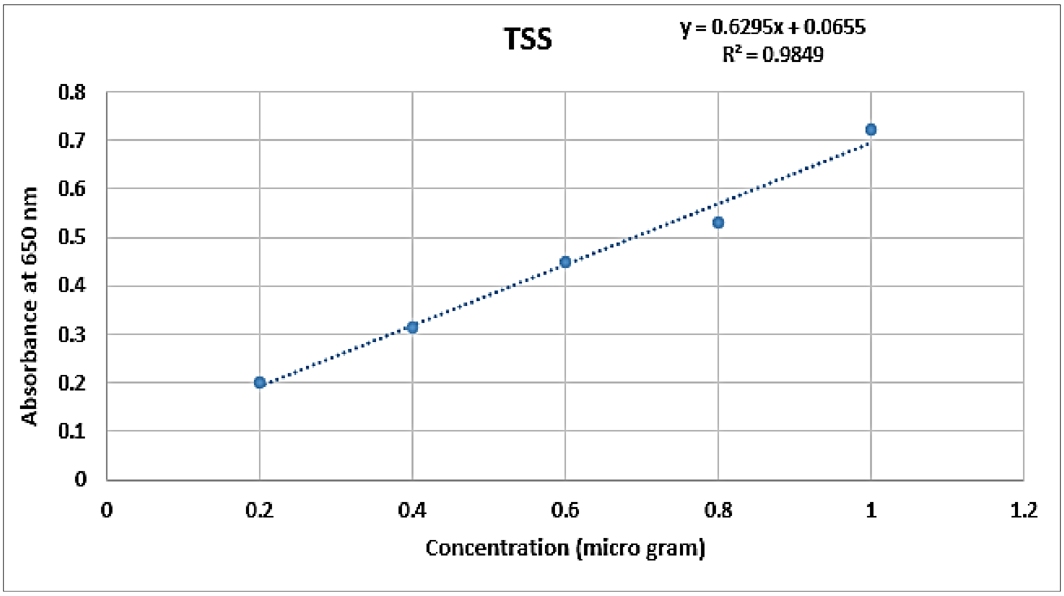

Fig 4: Standard curve for sugar estimation in various brinjal genotypes during 2024: A standard curve (optical density vs. concentration) was constructed for the estimation of sugars.

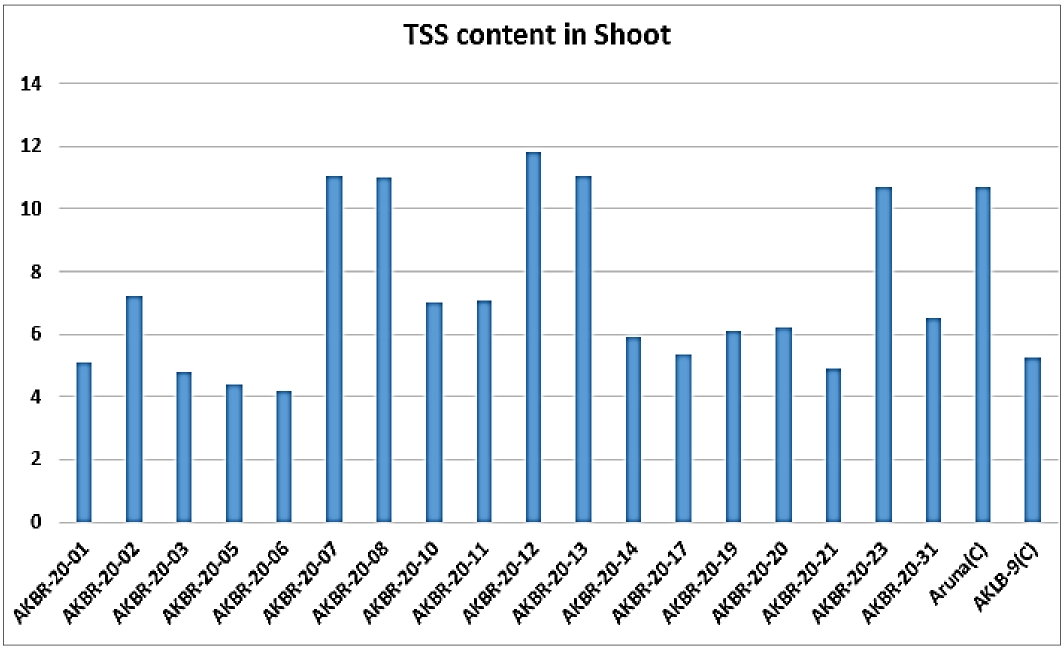

Fig 5: Biochemical parameter (TSS content in shoots) of different genotypes of brinjal

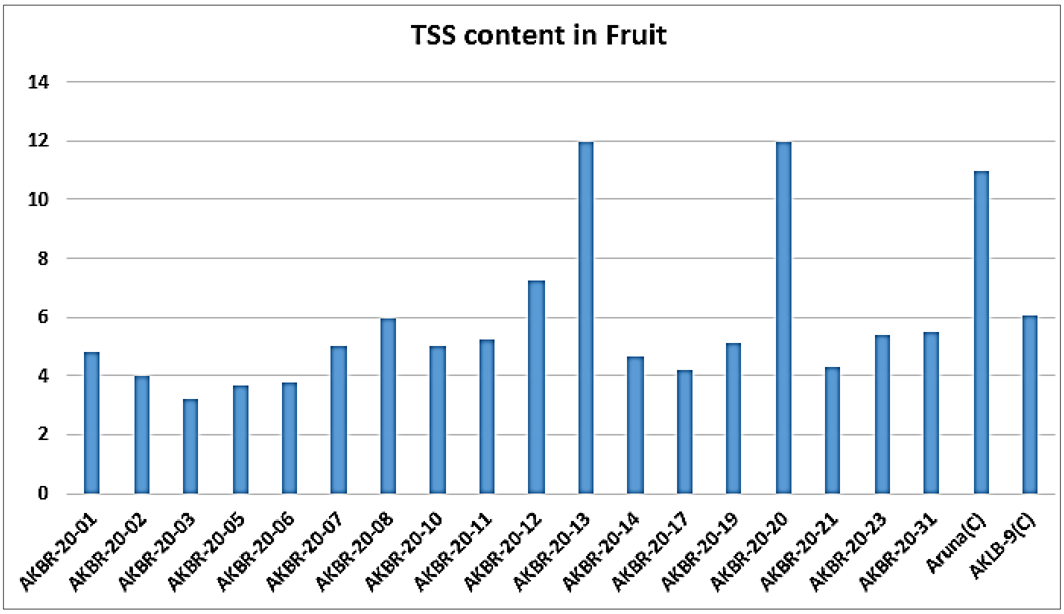

Fig 6: Biochemical parameter (TSS content in fruit) of different genotypes of brinjal

Results and Discussion

Numerous biochemical factors are known to play a key role in insect resistance, with biochemical traits generally considered more influential than morphological or physiological characteristics in determining resistance mechanisms such as non-preference and antibiosis. Some biochemical compounds act as feeding stimulants for insects; therefore, a reduction in their levels or their complete absence may enhance the plant's resistance (Singh, 1983) [27]. The biochemical composition of host plants plays a crucial role in resistance to various insect pests (Panda and Khush, 1995) [23]. Relatively resistant genotypes tend to have inherently higher phenol content (Dhaliwal and Dilawari, 1993) [6], as phenols are associated with feeding deterrence, growth inhibition, and, at high concentrations, can act as direct toxins to pests (Mohan *et al.*, 1987) [19]. Praneetha (2002) [26] emphasized that while selecting brinjal genotypes for resistance to shoot and fruit borer, the biochemical composition—alongside yield performance should be considered. Overall, various plant biochemical constituents contribute significantly to insect resistance (Dar, 2015) [3]. In brinjal, low sugar content combined with high phenolic content has been shown to provide considerable resistance to biotic stresses (Kumari *et al.*, 2014; Prasad *et al.*, 2014) [15, 25]. In the present investigation, among the genotypes screened, AKBR-20-21, AKBR-20-05, AKBR-20-03, and AKBR-20-06 (resistant types) recorded the lowest fruit infestation levels of 5.99%, 7.30%, 7.83%, and 7.86%, respectively. The lowest shoot infestation was observed in AKBR-20-03, AKBR-20-05, and AKBR-20-06, with infestation rates of 1.33%, 1.33%, and 1.41%, respectively. These low infestation rates correspond to high levels of total phenols in these genotypes. The total phenol content, measured on a dry weight basis, ranged from 0.41 to 2.07 mg/g in shoots and from 0.38 to 2.00 mg/g in fruits**.** The highest phenol content in shoots (2.07 mg/g) was recorded in AKBR-20-03, followed by AKBR-20-05 (1.72 mg/g) and AKBR-20-21 (1.60 mg/g). Other genotypes showed intermediate levels of phenol content. The lowest phenol content in shoots was observed in the genotype Aruna (0.41 mg/g). In fruits, the highest phenol content was found in AKBR-20-10 (2.00 mg/g), followed by AKBR-20-08 (1.93 mg/g) and AKBR-20-06 (1.89 mg/g), while the minimum was recorded in AKBR-20-02 (0.38 mg/g).

The data in Table 1 showed that higher the total phenols in the genotypes, the lesser the fruit borer attack. This might be due to the fact that the phenols act as antifeedant to insect herbivores. The present results are in good agreement with the earlier reports of Jat and Parrek (2003) [11] and Elanchezhyan *et al.*, (2009) [10] who reported that higher phenol contents increased resistance to fruit borer infestation.

Phenols are among the most abundant allelochemicals found in plants and are known to deter insect pests when present in relatively high concentrations due to their direct toxic effects (Mohan *et al.*, 1987) [19]. Similar findings have been reported by Prasad *et al.* (2014) [25], Docimo *et al.* (2016) [8], Prabhu *et al.* (2007) [24], and Khorsheduzzaman *et al.* (2010) [13], who noted that genotypes with elevated levels of total phenols exhibit enhanced resistance to shoot and fruit borer infestation. Supporting this, Kumari *et al.* (2014) [15] stated that higher phenolic content in brinjal significantly contributes to resistance against various biotic stresses. Likewise, Praneetha (2002) [26] emphasized that in selecting brinjal genotypes for resistance to shoot and fruit borer, it is important to consider not only yield performance but also the levels of key biochemical constituents.

In general, it was observed that resistance genotypes recorded lesser amount of total sugar as compared to susceptible genotypes. The reason might be due to the fact that high total sugar content act as phago deterrent to insect pests. The effect of total sugar content of brinjal fruits on borer infestation was studied by several researchers. Regarding the range of total soluble sugar, same trends were reported by Kumari *et al.* (2014) [15] who estimated total sugar content of fruits of tested genotype ranged from 0.71 to 20.36 per cent and Kandolia *et al.* (2015) observed the range between 3.02 to 3.64 mg g-1 on a fresh weight basis in tested brinjal varieties. Present findings are in conformity with the results of Nirmala and Vethamoni (2016) [20] who reported that highest total sugars (18.3 g/g FW) were observed in highly susceptible brinjal genotype IC 354721, while lowest sugars (6.5 g/g FW) were recorded in resistant genotype ABSR-2. Kandoliya *et al.* (2015) [12] who found that less susceptible brinjal variety, GJB-3 recorded the lowest sugar content of 3.03 mg/100 g and more susceptible brinjal variety GBL-1 recorded the highest sugar content of 3.64 g/100g.

Table 1: Total phenol content in the shoots and fruits of various brinjal genotypes evaluated for resistance against shoot and fruit borer (*Leucinodes orbonalis guenée).*

Genotype	Phenol in Shoot (mg/g)	TSS in Shoot (%)	Phenol in Fruit (mg/g)	TSS in Fruit (%)	C.M. of Damage (%) (√Transformed)
AKBR-20-01	1.55	5.10	0.72	4.80	11.58 (1.60)
AKBR-20-02	1.33	7.20	0.38	4.00	19.80 (2.10)
AKBR-20-03	2.07	4.80	1.66	3.20	5.05 (1.06)
AKBR-20-05	1.72	4.40	1.65	3.68	5.06 (1.06)
AKBR-20-06	1.44	4.20	1.89	3.77	4.78 (1.03)
AKBR-20-07	1.31	11.07	1.77	5.00	19.51 (2.08)
AKBR-20-08	0.82	11.00	1.93	5.95	19.14 (2.06)
AKBR-20-10	0.80	7.00	2.00	5.00	10.51 (1.53)
AKBR-20-11	0.61	7.05	1.06	5.25	11.45 (1.60)
AKBR-20-12	0.82	11.80	1.38	7.26	12.03 (1.64)
AKBR-20-13	0.55	11.03	1.69	11.94	18.31 (2.02)
AKBR-20-14	0.60	5.90	1.05	4.66	11.27 (1.58)
AKBR-20-17	0.69	5.36	1.09	4.20	12.96 (1.70)
AKBR-20-19	0.67	6.10	1.47	5.15	13.83 (1.75)
AKBR-20-20	0.52	6.22	1.75	11.94	18.35 (2.02)
AKBR-20-21	1.60	4.90	1.80	4.30	4.24 (0.97)
AKBR-20-23	0.71	10.68	0.57	5.40	20.84 (2.15)
AKBR-20-31	0.53	6.52	1.68	5.50	18.85 (2.05)
Aruna©	0.41	10.68	1.71	11.00	19.18 (2.06)
AKLB-9©	0.43	5.23	0.61	6.05	14.25 (1.78)
SEm	0.02	0.61	0.01	0.24	0.004
CD (5%)	0.05	1.80	0.03	0.72	0.0118
C.V. (%)	2.67	11.78	1.18	5.86	0.221

Table 2: Correlation between various biochemical traits of different brinjal genotypes and their susceptibility to shoot and fruit borer (*Leucinodes orbonalis guenée*).

Traits	C.M. of Damage (%)	Phenol in Shoot	TSS in Shoot	Phenol in Fruit	TSS in Fruit
C.M. of Damage (%)	1				
Phenol in Shoot	-0.619**	1			
TSS in Shoot	0.678**	-0.398**	1		
Phenol in Fruit	-0.232**	0.108**	0.092**	1	
TSS in Fruit	0.522**	-0.594**	0.505**	0.223**	1

r = 0.443 at 5%, r = 0.561 at 1%, ** = level of significance

From the Table 2 it was observed that phenol content in shoots (r = -0.619) showed the negative significant correlation with shoot and fruit borer infestation. Whereas phenol content in fruits (r = -0.232) showed the negative non-significant correlation with fruit borer. However TSS in shoots (r=0.678) and TSS in fruits (r=0.522) showed positive significant correlation with shoot and fruit borer infestation.

Conclusion and recommendations

These findings underscore the importance of phenolic compounds as defensive metabolites associated with reduced infestation, while higher sugar content appears to enhance pest attractiveness or development. Therefore, total phenol and sugar concentrations can be considered reliable biochemical indicators for screening brinjal genotypes for resistance or susceptibility to *L. orbonalis*

Acknowledgement

The authors express their sincere gratitude to the Biochemistry Laboratory, AICRP on PHET, Dr. PDKV, Akola, for providing the essential facilities and support required to carry out this research. Special thanks are extended to Dr. Vandana D. Mohod and Dr. Indira B. Soneji for their valuable assistance in the biochemical analysis of the brinjal samples.

References

1. Ali M, Muhammad A, Naureen R, Muhammad SH, Muhammad A, Muhammad A. The susceptibility study of some aubergine (*S. melongena* L.) cultivars against jassid (*Amrasca biguttula biguttula* (Ishida). Pak J Agri Sci. 2014;51(3):679-683.
2. Bray HG, Thorpe WV. Estimation of total phenol from plant tissues. Meth Biochem Anal. 1954;1:27-52.
3. Dar SA, Padder SA, Wani AR, Mir SH, Sofi MA. Evaluation of combined options for the management of the brinjal shoot and fruit borer, L. *orbonalis* Guenee in Kashmir. J Exp Zool India. 2015;18(1):359-365.
4. Dar SA, Wani AR, Mir SH, Nehru RK, Jeelani MI. Relationship between morphological characters of different brinjal genotypes and extent of the infestation by L. *orbonalis*, Guenee. Green Farming. 2014;5(6):1096-1100.
5. Dar SA, Wani AR, Nehru RK, Mir SH, Jeelani MI. Physio-chemical characteristics of the brinjal genotypes imparting the tolerance to the brinjal shoot and fruit borer (L. *orbonalis*) under field conditions of Kashmir, India. Ecology. 2014.
6. Dhaliwal GS, Dilawari VK. Advances in host resistance to insects. India: Kalyani Publishers; 1993. p.443.
7. Dar SA. Biochemicals mode of defense against insect pests. In: INSECT. Delhi: International Research

Publication House; 2017. p. 397-409. Chapter 28.
8. Docimo T, Francese G, Ruggiero A, Batelli G, Palma MD, Bassolino L, *et al.* Phenylpropanoids accumulation in eggplant fruit: characterization of biosynthetic genes and regulation by a MYB transcription factor. Front Plant Sci. 2015;6:1233. doi:10.3389/fpls.2015.01233.
9. Dubois M, Gilles EK, Hamilton JK, Rebers PAJ. Calorimetric Dubois method for determination of sugar and related substances. Anal Chem. 2002. doi:10.1021/ac60111a017.
10. Elanchezhyan K, Murali Baskaran RK, Rajavel DS. Biochemical basis of resistance in brinjal genotypes to shoot and fruit borer, *Leucinodes orbonalis* Gen. J Entomol Res. 2009;33:101-104.
11. Jat KL, Pareek BL. Biophysical and biochemical characters in brinjal against *Leucinodes orbonalis* Guen. Indian J Entomol. 2003;65(2):252-258.
12. Kandoliya UK, Bajaniya VK, Bhadja NK, Bodar NP, Golakiya BA. Antioxidant and nutritional components of eggplant (*Solanum melongena* L.) fruit grown in Saurastra region. Int J Curr Microbiol Appl Sci. 2015;4(2):806-813.
13. Khorsheduzzaman AKM, Alam MZ, Mian IH. Biochemical basis of resistance in eggplant (*Solanum melongena* L) to *Leucinodes orbonalis* Guen. and their correlation with shoot and fruit infestation. Bangladesh J Agric Res. 2010;35(1):149-155.
14. Krishnaiah K. Assessment of crop losses due to pests and diseases. In: Govindu HC, editor. UAS Tech Ser. 1980;33:259-267.
15. Kumari A, Neena C, Dhankar AS. Comparison of eggplant genotypes for phenolic compounds and other biochemical parameters. Int J Adv Res. 2014;2(9):615-622.
16. Mainali RP. Biology and management of eggplant fruit and shoot borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae): a review. Int J Appl Sci Biotechnol. 2014;2(1):18-28. doi:10.3126/ijasbt.v2i1.10001.
17. Matsubara K, Kaneyuki T, Miyake T, Mori M. Response of aubergine cultivars to *Leucinodes orbonalis*. J Agric Chem. 2005;53:6272-6275.
18. Mishra K, Keshav S, Tripathi CPM. Management of infestation of pod borer (*Leucinodes orbonalis* Guenee) and productivity enhancement of brinjal through vermiwash with biopesticide. Int J Adv Res. 2014;2(1):780-789.
19. Mohan S, Jayaraj S, Purusothaman D, Rangarajan AV. Can use of Azospirillum biofertilizers control sorghum shootfly. Curr Sci. 1987;56(20):723-725.
20. Nirmala N, Vethamoni PI. Biophysical and biochemical characteristics of green fruited brinjal genotypes for resistance to shoot and fruit borer. Electron J Plant Breed. 2016;7(2):325-331.
21. Nonnecke IL. Solanaceous crops: Potato, Tomato, Pepper, Eggplant. In: Vegetable Production. New York: Van Nostrand Reinhold; 1989. p. 240-250.
22. Onekutu A, Omoloye AA, Odebiyi JA. Integrated pest control of the egg fruit and shoot borer L. *orbonalis* Guenee on the garden egg *Solanum* aethiopicum L in Southwest Nigeria. Int J Sci Res Publ. 2014;4(7). ISSN: 2250-3153.
23. Panda N, Khush GS. Host plant resistance to insects. IRRI-CABI; 1995. p.431.
24. Prabhu M, Natarajan S, Pugalendhi L. Biochemical basis of shoot and fruit borer resistance in brinjal. In: Keshavachandran R, *et al.*, editors. Recent Trends in Horticultural Biotechnology. New Delhi: New India Publishing Agency; 2007. p. 829-837.
25. Prasad TV, Rakesh BKK, Gangopadhyay M, Arivalagan MK, Bag BL, Meena L, *et al.* Biophysical and biochemical basis of resistance to fruit and shoot borer in eggplant. Indian J Hort. 2014;71(1):67-71.
26. Preneetha S. Breeding for shoot and fruit borer resistance in brinjal. [PhD thesis]. Coimbatore: Tamil Nadu Agricultural University; 2002.
27. Singh BD. Breeding for resistance to biotic stresses II. In: Plant Breeding Principles and Methods. Ludhiana: Kalyani Publishers; 1983. p. 494.
28. Subramanyam TR, Butani DK. Brinjal and its insect pests. In: Pests of Vegetables in India (Part I). New Delhi: Indian Council of Agricultural Research; 1981. p. 49-92.
29. Thompson CH, Kelly CW. Vegetable crops. New York: McGraw Hill; 1957. p. 501.
30. Tindall D. Commercial vegetables growing. London: ELBS & Oxford University Press; 1978. p. 711.