The Pharma Innovation Journal 2021; 10(12): 1862-1866

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 1862-1866

www.thepharmajournal.com
Received: 13-10-2021
Accepted: 15-11-2021

G Gokulapriya
Research Scholar, Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu, India

M Chandrasekaran
Associate Professor, Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu, India

A Nithya Devi
Assistant Professor(s), Horticultural College and Research Institute for Women Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu, India

K Indhumathi
Assistant Professor(s), Horticultural College and Research Institute for Women Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu, India

Corresponding Author:
G Gokulapriya
Research Scholar, Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu, India

Study on biochemical basis of resistance in brinjal accessions against shoot and fruit borer, *Leucinodes orbonalis* Guenee

G Gokulapriya, M Chandrasekaran, A Nithya Devi and K Indhumathi

Abstract
The study was conducted to identify the biochemical basis of resistance in the brinjal accessions against shoot and fruit borer, *Leucinodes orbonalis* (Guenee). The experiment was laid out at Horticultural College and Research Institute (Women), Tamil Nadu Agricultural University, Trichy, Tamil Nadu, with thirty nine accessions and three varieties. The results of the screening revealed that, out of thirty nine entries only six brinjal accessions *viz*., IC 136451, IC 136231, IC 136061, IC 136296, IC 546016, IC 089964 were identified under moderately resistant category with 11- 20% mean fruit damage. Another twelve accessions namely IC 136249, IC 136309, IC 383099, IC 136250, IC 112341, IC 215021, IC 136302, IC 136546, IC 127023, IC 90982, IC 136299, IC 90925 were found to be tolerant with 21 - 30% damage intensity and remaining 12 accessions were identified in susceptible category with 31 - 40% fruit damage. Nine brinjal accessions with mean per cent damage intensity greater than 41 were graded as highly susceptible category. The biochemical analysis performed for each category indicated that the protein content ranged between 26 mg/g to 84 mg/g, total sugars varied from 5.58 mg/g to 18.25 mg/g and the phenol content found between 1.26 to 5.79 mg/g. It is obvious from the correlation studies which revealed that the total sugar (r = 0.76), and soluble protein (r = 0.48) were positively correlated whereas total phenol (r = - 0.96) was negatively correlated with the infestation of shoot and fruit borer.

Keywords: brinjal, biochemical compounds, host plant resistance, shoot and fruit borer

Introduction
Eggplant (*Solanum melongena* L.) belonging to Solanaceae is one among the top ten vegetables produced in the world. Asia shares 93.2% in global brinjal production. India is the second leading brinjal producer with 1.268 million tonnes of production under harvested area of 0.072 mha (INDIASTAT, 2018) [10]. The shoot and fruit borer, *Leucinodes orbonalis* is considered as the most challenging pest among brinjal growing farmers. It is well adapted to hot and humid climate. During the rainy and summer seasons, the pest is very prolific, inflicting 90 - 95 per cent damage across the Southeast Asia (Anwar *et al*., 2017) [1]. Many farmers are reluctant to cultivate eggplant as a consequence of serious menace of many harmful arthropod diversities. Yield loss brought by shoot and fruit borer has been estimated and it is ranging from 16 - 92 per cent (Rosaiah, 2001; Chakraborti and Sarkar, 2011) [20, 2]. Rahman, 2009 [19] has reported that the yield loss may reach 100 per cent if farmers are failing to take necessary control measures. Utilisation of synthetic pesticides has resulted in resistance development against insecticides among insects, contamination of environment, induce the emergence of secondary pests, decline in natural enemies fauna and numerous human hazards. In general, the amounts of phenolic flavonoid phytochemical called anthocyanin might vary among the brinjal varieties but the appreciable amount of anthocyanin is found in deep blue/purple pulp or skin/peel of brinjal which could serves as an antioxidant and provides potential health benefits against cancer, aging and other neurological disorders. Use of resistant varieties is recognized as an important tool in bio-intensive pest management system. The morphological and physiological characteristics of plants and fruits are associated with attraction, feeding and oviposition of the insects. The identification of biophysical and biochemical characteristics from insect resistant varieties is of most practical significance. Selecting genotypes with higher glycoalkaloid (solasodine) content, total phenols, and polyphenol oxidase activity has been suggested as a way to boost resistance to BSFB infestation without compromising yield potential (Doshi *et al*., 1998; Dar *et al*., 2014b) [7, 6]. The present study dealt with the biochemical constituents which are responsible for resistance/susceptible response of host plants against shoot and fruit borer, *Leucinodes orbonalis.*

Materials and Methods

Screening studies on brinjal accessions against shoot and fruit borer was carried out at experimental farm of Horticultural College and Research Institute (W), Trichy. The seedlings of 39 accessions and 3 varieties were raised on protrays and transplanted 45 DAS at 60 x 60 cm spacing. The experiment was laid out in Randomised Block Design with three replications. About ten plants per entry per replication was maintained and 30 plants per entry was planted. All the packages of Tamil Nadu Agricultural University for raising brinjal was practiced except plant protection measures. Five plants were randomly selected in each cultivar per replication and the plants were tagged for taking observations at fortnight interval commenced from 7 DAT to till the crop harvest (150 days). Shoot damage was calculated based on the number of shoots dried in a selected cultivar and it was expressed in percent shoot damage. After each observation infested shoots were removed. On number basis, fruit damage was assessed by counting number of infested and un-infested fruits taken from five randomly chosen plants in each cultivars and was expressed in per cent fruit damage. Genotypes were screened and assessed based on the percent fruit infestation range provided by Mishra *et al*. 1988 [16]. Out of 39 entries screened, two entries were selected from each category *viz*., moderately resistant, tolerant, susceptible, highly susceptible for biochemical evaluation. The protein content, total phenols, total sugars were determined by following standard procedure of Lowry *et al.*, (1951) [14], Malik and Singh, (1980) [15] and Hedge and Hofreiter's (1962) [9] respectively.

Results and Discussion

The biochemical components found in host plants plays a significant role in conferring resistance by antibiosis. The presence of such biochemical constituents in remarkable quantity will make the pest to provoke / avoid feeding and boost / break the biological cycle of the pest. Of the biochemical traits studied, the total soluble protein of brinjal accessions ranged from 26 mg/g to 84 mg/g (Table 1 and 3). The higher amount of soluble protein was recorded in the susceptible entries *viz*., IC 112991 (84 mg/g), IC 08988 (75 mg/g), IC 446654 (67 mg/g) and IC 393239 (56 mg/g) (Figure 1). The tolerant and moderately resistant entries had shown lower amount of protein. The total soluble protein showed a significant and positive correlation with shoot and fruit borer incidence (r = 0.88) as reported by the findings of Jat and Pareek, 2003 [11]; Chandrashekar *et al*., 2009 [3]. The results were in consistent with Prasad *et al*., 2014 [18] who registered that the protein content was correlated positively (r = 0.48) with the fruit infestation of shoot and fruit borer. In the present investigation the total sugar content found in the brinjal accessions ranged from 5.58 mg/g to 18.25 mg/g (Table 3). The higher amount of total sugar was recorded in the susceptible accession such as IC 112991(18.25 mg/g), IC 446654 (10.80 mg/g), IC 08988 (15.60 mg/g) and IC 393239 (9.56 mg/g). The resistant and tolerant entries recorded the minimum level of total sugars. The results are in agreement with the report of Dar *et al.*, 2017 [5] recorded the lowest level of total sugars in the genotypes showed resistance and fairly resistance. Similarly, Prasad *et al*., 2014 [18] also reported that the susceptible accession recorded the highest sugar content of 1.76g/100g of fruit sample. From the correlation study, it is revealed that the fruit infestation was significantly and positively correlated with total sugars (r = 0.76). The results obtained in present findings are supported by Elanchezhyan *et al*., 2008 [8]; Chandrashekhar *et al.*, 2009 [3] and Prasad *et al*., 2014 [18] suggested that the total sugars showed positive association with the infestation of shoot and fruit borer. They added that the sugar content was vital component in plants and this content provokes the feeding behaviour of shoot and fruit borer which resulted in susceptibility of brinjal accessions containing maximum level of total sugars comparatively with other genotypes.

Phenol content is considered as one of the most crucial biochemical component influences the feeding nature of brinjal pest (Kaur *et al*., 1985) [12]. Doshi *et al*., 1988[7] stated that the phenol content in plant increases with increase in age of the crop and the plants having higher content will resist the pest from feeding. The range of total phenol content in the brinjal accessions estimated in the present study was from 1.26 to 5.79 mg/g (Table 3 and Figure 1). The moderately resistant and tolerant brinjal accessions such as IC136451, IC 136061, IC 136250, IC 383099 registered 5.79, 4.49, 3.17, 3.06 mg/g of total phenol and the susceptible entries such as IC 446654, IC 112991, IC 393239, IC 08988 recorded lower phenol amount of 2.49, 1.26, 2.05, 1.94 mg/g of leaf sample respectively (Table 2 and 3). It is obvious from the correlation study, that the fruit infestation was significant and negatively associated (r = -0.92) and depicted that the increased phenolic content resists the plants from shoot and fruit damage. It is evident from the reports of earlier findings of authors such as Dadmal *et al*., 2004 [4]; Shinde 2007 [21]; Elanchezhyan *et al*., 2008 [8]; Khorsheduzzaman *et al*., 2010 [13]; Prasad *et al*., 2014 [18]; Dar *et al.*, 2017 [5] obtained the similar negative correlation of total phenols with the incidence of shoot and fruit borer. When phenols become oxidised in the midgut of insects, reactive oxygen species (ROS) such as semiquinone radicals is produced which is responsible for inducing oxidative stress in the digestive system, thereby weakens the functions of digestive system and the growth rate of leaf-feeding insect got reduced (Pecci, 2000 and Dar *et al*., 2017) [17, 5]. Phenolic substances work by generating reactive oxygen species, notably tannins, which are oxidised in the digestive tract of insects and have the ability to destroy critical nutrients, resulting in insect deterrence or antibiosis (Summers and Felton, 1994) [22].

Table 1: Mean per cent shoot and fruit infestation of shoot and fruit borer in different brinjal accessions

S. No	Accession name	Per cent infestation		Grade
		Shoot damage	Fruit damage	
1	IC 0899059	9.67 (33.01)	36.31 (28.64)	S
2	IC 136450	29.03 (32.60)	36.01 (37.06)	S
3	IC 383099	15.35 (23.07)	23.47 (36.88)	T
4	IC 546016	12.10 (20.36)	19.14 (28.98)	MR
5	IC 136451	11.49 (19.81)	19.78 (25.95)	MR
6	IC 112341	16.79 (24.19)	25.79 (26.41)	T
7	IC 136309	14.57 (22.44)	22.61 (30.52)	T
8	IC 136188	17.50 (24.73)	42.34 (28.39)	HS
9	IC136250	18.32 (25.34)	26.72 (40.59)	T
10	IC 90925	19.40 (26.13)	27.85 (31.12)	T
11	IC 136231	8.55 (17.00)	15.67 (31.85)	MR
12	IC203589	19.46 (26.18)	42.64 (23.32)	HS
13	IC 215021	16.57 (24.02)	25.94 (39.61)	T
14	IC 089964	7.79 (16.21)	15.10 (30.62)	MR
15	IC 136017	29.92 (33.16)	38.12 (22.87)	S
16	IC 136176	21.19 (27.41)	41.30 (38.13)	HS
17	IC 136302	20.64 (27.02)	28.99 (39.99)	T
18	IC 112991	24.76 (29.84)	43.81 (32.58)	HS
19	IC 112851	18.27 (25.31)	31.34 (39.71)	S
20	IC 136546	22.36 (28.22)	29.73 (34.05)	T
21	IC 136297	26.16 (30.76)	41.47 (33.05)	HS
22	IC 089888	25.60 (30.40)	41.65 (39.51)	HS
23	IC 112315	23.78 (29.19)	42.11 (40.20)	HS
24	IC 393239	24.67 (29.78)	35.74 (40.46)	S
25	IC 136249	19.08 (25.90)	28.48 (36.72)	T
26	IC 446654	26.63 (31.07)	36.15 (32.26)	S
27	IC 136260	20.97 (27.25)	44.22 (36.96)	HS
28	IC 136177	24.36 (29.57)	32.96 (39.36)	S
29	IC 127023	17.43 (24.68)	26.28 (35.04)	T
30	IC 136061	5.10 (13.06)	11.24 (30.84)	MR
31	IC 89910	22.98 (28.65)	35.05 (19.59)	S
32	IC 90982	19.82 (26.44)	27.95 (36.31)	T
33	IC 136299	17.81 (24.96)	27.11 (31.92)	T
34	IC 144518	12.50 (20.71)	43.05 (24.07)	HS
35	IC 136189	20.00 (26.57)	36.22 (41.01)	S
36	IC 136296	9.24 (17.69)	16.63 (37.00)	MR
37	IC 136290	22.44 (28.28)	33.55 (24.07)	S
38	IC 136300	28.41 (32.21)	31.18 (35.39)	S
39	IC 136182	30.60 (33.58)	37.30 (33.94)	S
40	Pusa purple round# (SNC)	6.11 (14.31)	12.50 (37.64)	MR
41	Pusa Oishiki# (SNC)NC	9.91 (18.35)	17.74 (20.70)	MR
42	Manapparai local (SLC)	14.31 (22.23)	22.97 (24.91)	T

* Mean of 5 plants/replication/entry; Figures in the parentheses are arc sin transformed values.
# Standard National Check (SNC); Standard Local Check (SLC)

Table 2: Categorisation of brinjal accessions based on the mean per cent fruit damage

Fruit damage (%)	Accessions	Grade
0	Nil	Immune
1-10	Nil	Resistant
11-20	IC 136451, IC 136231, IC 136061, IC 136296, IC 546016, Pusa oishiki, Pusa purple round, IC 089964	Moderately resistant
21-30	IC 136249, IC 136309, Manapparai local, IC 383099, IC 136250, IC 112341, IC 215021, IC 136302, IC 136546, IC 127023, IC 90982, IC 136299, IC 90925	Tolerant
31-40	IC 446654, IC 393239, IC 089905, IC 136450, IC 136182, IC 136017, IC112851, IC 136177, IC 89910, IC 136189, IC 136290, IC 136300	Susceptible
>41	IC 112991, IC 089888, IC136188, IC 203589, IC 136176, IC 136297, IC 112315, IC 136260, IC 144518	Highly susceptible

Table 3: Biochemical composition in the leaves of identified brinjal accessions

Accession no.	Shoot damage (%)	Soluble protein (mg/g)	Total sugars (mg/g)	Total phenol (mg/g)
IC 136451	11.49	29.00	9.17	5.79
IC 446654	26.63	67.00	10.80	2.49
IC 136250	18.32	42.00	8.49	3.17
IC 112991	24.76	84.00	18.25	1.26
IC 393239	24.67	56.00	9.56	2.05
IC 136061	9.14	26.00	6.43	4.49
IC 383099	15.35	48.00	7.50	3.06
IC 089888	25.60	75.00	15.60	1.94
Pusa purple round	6.11	370.00	5.58	5.63
Pusa oishiki	9.91	320.00	6.92	5.14
Manapparai local	14.31	410.00	10.13	3.47
Correlation coefficient (r)**		0.88	0.76	-0.92

** Significant at 1% level.

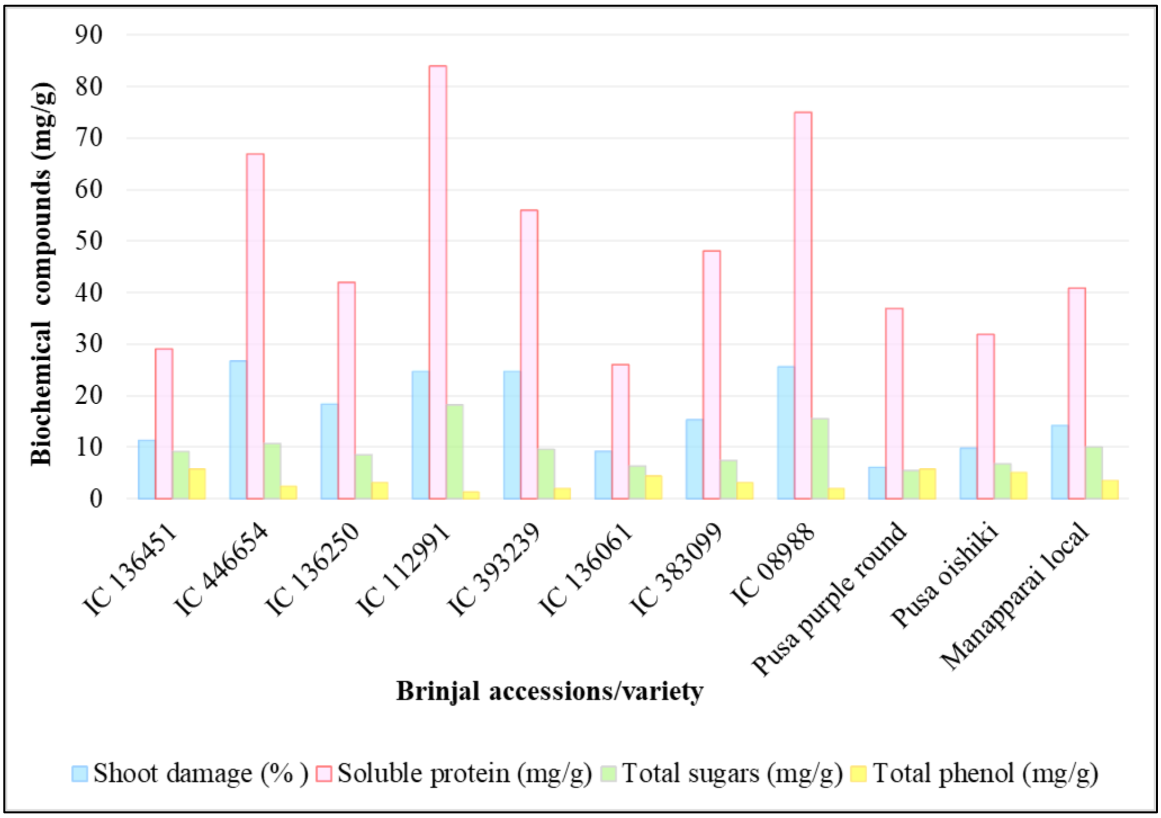

Fig 1: Biochemical profile of different entries offering resistance to shoot and fruit borer

Conclusion

The secondary metabolites synthesised in plants perform a greater role by causing malign to the pest infesting it and thereby sustain at certain level in an ecosystem. The biochemical compounds present in genotypes should also be considered besides concentrating in yield and other attributes while involve in breeding programmes. The genotypes possessing low sugar content, protein content, ash content, moisture content and high amount of phenols could be selected and utilised as the source for breeding to evolve new varieties with the resistance of brinjal shoot and fruit borer.

Acknowledgement

The corresponding author is greatly thankful the Dean, Horticultural College and Research Institute for Women, Trichy for granting permission to take-up the field trial in the HCRIW campus. The support rendered by the Professor and Head, Department of Plant Protection and the Dean, Anbil Dharmalingam Agricultural College and Research Institute, TNAU, Trichy by providing laboratory and other facilities for the conduct of study is duly acknowledged.

References

1. Anwar SJ, Mari M, Ullah F, Khanzada MA, Badshah H, Zada H, *et al*. Population dynamics of brinjal shoot and fruit borer *Leucinodes orbonalis* Guen (Pyralidae: Lepidoptera) in central districts of Khyber Pakhtunkhwa, Pakistan. Pure and Applied Biology (PAB) 2017;6(4):1464-1476.
2. Chakraborti S, Sarkar P. Management of *Leucinodes orbonalis* Guenee on eggplants during the rainy season in India. Journal of Plant Protection Research 2011;51(4).
3. Chandrashekhar CH, Malik VS, Singh R. Morphological and biochemical factors of resistance in eggplant against *Leucinodes orbonalis* (Lepidoptera: Pyralididae). Entomologia Generalis 2009;31:337-45.
4. Dadmal SM, Nemade SB, Akhare MD. Field screening of brinjal cultivars for resistance to *Leucinodes orbonalis* Guen. Pest Management in Horticultural Ecosystem 2004;10(2):145-150.

5. Dar SA, Wani AR, Rathur A, Kandoo AA. Biochemical basis of resistance in brinjal genotypes against shoot and fruit borer (*Leucinodes orbonalis*, Guenee). Chemical Science Review and Letters 2017;6(23):1931-1940.
6. 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 the Kashmir, India. Ecology, Environment and Conservation 2014b;20(4):1605-1611.
7. Doshi KM, Bhalala MK, Kathiria KB. Correlation and path analysis for yield, fruit borer infestation, little leaf incidence and quality traits in brinjal (*Solanum melongena*. L). Capsicum and Eggplant Newsletter 1998;17:84-87.
8. Elanchezhyan K, Baskaran RK, Rajavel DS. Field screening of brinjal varieties on major pests and their natural enemies. Journal of Biopesticides 2008;1(2):113-120.
9. Hedge JE, Hofreiter BT. Estimation of carbohydrate. Methods in carbohydrate chemistry. Academic Press, New York 1962, 17-22.
10. Indiastat 2018. http://www.indiastatagri.com/data/agriculture/agricultural-production.
11. Jat KL, Pareek BL. Biophysical and biochemical characters in brinjal against *Leucinodes orbonalis* Guen. Indian Journal of Entomology 2003;65(2):252-258.
12. Kaur G, Bajaj, KL, Chadha ML. Quality characters in fruits of eggplant (*Solanum melongena* L.) as affected by maturity. Vegetable Sciences 1985;12(2):68-72.
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 Journal of Agricultural Research 2010;35(1):149-155.
14. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin phenol reagent. Journal of biological Chemistry 1951;193(1):265-275.
15. Malik CP, Singh MB. Extraction and estimation of total phenols. Plant enzymology and histoenzymology. Kalyani Publishers, New Delhi, India 1980, 286.
16. Mishra PN, Singh YV, Nautiyal MC. Screening of brinjal varieties for resistance to shoot and fruit borer (*Leucinodes orbonalis* Guen.) (Pyralidae:Lepidoptera). South Indian Horticulture 1988;36(4):188-192.
17. Pecci CD. Oxidation of ingested phenolic compounds creates oxidative stress in the midgut tissues of *Lymantria dispar* caterpillars. Department of Molecular, Cellular, and Developmental Biology, Raymond V. Barbehenn, Faculty Sponsor, 2000, 8-10.
18. Prasad TV, Bhardwaj R, Gangopadhyay KK, Arivalagan M, Bag MK, Meena BL *et al*. Biophysical and biochemical basis of resistance to fruit and shoot borer (*Leucinodes orbonalis* Guennee) in eggplant. Indian Journal of Horticulture 2014;71(1):67-71.
19. Rahman MM, Islam KS, Jahan M, Uddin MA. Efficacy of some botanicals in controlling brinjal shoot and fruit borer, *Leucinodes orbonalis*. Progressive Agriculture 2009;20(1):35-42.
20. Rosaiah B. Evaluation of different botanicals against the pest complex of brinjal. Pestology 2001;25(4):14-16.
21. Shinde KG. Correlation of physical and chemical characters in brinjal in relation to shoot and fruit borer infestation. Advances in Plant Sciences 2007;20(2):613-615.
22. Summers CB, Felton GW. Prooxidant effects of phenolic acids on the generalist herbivore *Helicoverpa zea* (Lepidoptera: Noctuidae): Potential mode of action for phenolic compounds in plant anti herbivore chemistry. Insect Biochemistry and Molecular Biotechnology 1994;24:943-953.