International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 1, 2025
https://theaspd.com/index.php

A Study On Biochemical Basis Of Resistance Against Brinjal L. Orbonalis

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Abstract
The biochemical basis of resistance is a key part of host plant resistance. Some biological elements may serve as feeding stimulants for insects. In this study the researcher investigate the Biochemical basis of resistance against Brinjal L. Orbonalis. The presence of such biochemicals at lower concentrations or their complete absence results in non-preference, which is a type of insect resistance. A substantial positive association was found between climatic parameters and the mean % infestation of L. orbonalis during Kharif, including maximum and lowest temperatures and sunlight levels. Thus, according to the findings of this study, brinjal shoot and fruit borer L. orbonalis liked accession IC 546016 and IC Banthar less. These accessions also demonstrated stronger antixenosis and antibiotic activity against L. orbonalis.
Keywords: *Biochemical analysis, Brinjal L. Orbonals, Ash, Wax, Moisture and Cholrolofyll contents etc.*

INTRODUCTION

The most effective way to address the pest problem is to implement Integrated Pest Management strategies. Host Plant Resistance (HPR) is an environmentally beneficial alternative strategy for insect pest management (Sharau Patil and Uttam Hole 2020). The use of resistant varieties is a significant element in biointensive pest management systems that is also environmentally friendly. They are regarded as a cost-effective pest management strategy. Farmers can employ resistant genotypes to manage the pest at no cost (Sharma et al., 2017).

The shoot and fruit borer (Leucinodes orbonalis G.) destroys brinjal quickly after transplantation. Pests attack at all stages and parts of the plant. The life cycle of this pest lasts 19-28 days. The eggs are placed separately on the ventral side of the leaves, flowering buds, and, occasionally, early fruits. In immature plants, the caterpillars drill into petioles, leaf midribs, early shoots, and foliage. As a result, the impacted leaves dry & drop off. In some circumstances, developing point is reached, & the plant no longer continues to grow & develop.

During reproductive stage, small larvae bore into flower buds & fruits, and dug holes are filled with excreta. The entire opening is filled with excreta, and feeding is entirely internal (Bhutani and Jotwani, 1983). Larval activity impairs nutrition transfer in shoots, resulting in withering and drooping (Alam and Sana, 1962). Petioles, midribs, and young shoots become infested with immature larvae, causing shoot tips to droop. Flower buds and fruits are gradually attacked, reducing their market value. A single larva can assault as many as 4-6 fruits (Atwal and Verma, 2007).

Despite importance of brinjal & the severity of the brinjal shoot & fruit borerproblem, management approaches for combating the pest remain restricted to regular application of chemicalpesticides. Due to a lack of information, Asian farmers do not use the proper pesticide application methods. Theindiscriminate use ofpesticides pollutesenvironment & leaves residues in food, posing health risks. In addition, the Leucinodes orbonalis population was shown to be resistant to a widerange of conventional insecticides. As a result, it emphasizes the critical necessity for safe management approaches in brinjal pest control.

Resistant and tolerant types constitute the foundation of IntegratedPest Management(IPM), upon which additional components will be synergistic. Host plantresistance strategy is an excellentcomponent when combined withother components since ithas various advantagesover other management techniques (Javed et al., 2011).

Most crops, including rice, wheat, potato, and tomato, now have resistant variants to help manage important pests. Despite numerous attempts to investigate the source of resistance to brinjal shoot and fruit borer, no commercial variety against this pest has been developed with a significant level of resistance. It is important to note that using a resistant variety in any crop can reduce the major pest problem by at least 50%. As a result, incorporating resistant varieties into IPM programs is critical. The resistance characteristic of the variety is mostly biophysical and biochemical in nature.

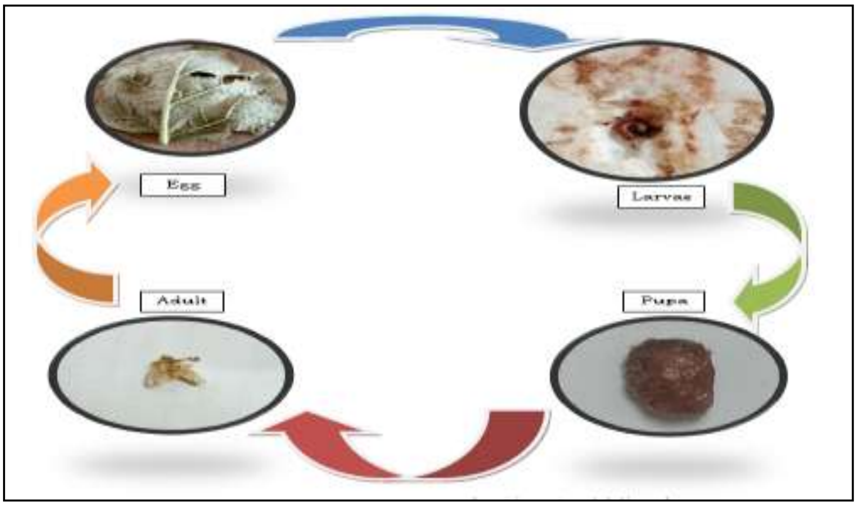

FIG. 1: LIFE STAGES OF *L. ORBONALIS*

The biochemical basis of resistance is a key part of host plant resistance. Some biological elements may serve as feeding stimulants for insects. Previous study found that biochemical factors including total sugars and free amino acid content were favourably linked with fruit infestation, but polyphenol oxidase and glycoalkaloids had a negative connection with fruit borer assault. The presence of such biochemicals at lower concentrations or their complete absence results in non-preference, which is a type of insect resistance (Showket and Khan 2015). Resistance properties (biochemical) are controlled genetically. The wild forms of crops are resistant to insect pests because they contain resistance genes. As a result, the present method to dealing with polyphagous insects is to identify resistant genes, isolate them, and integrate them into the genetic background of a regionally chosen cultivable variety with insect susceptibility.

REVIEW OF RELATED LITERATURE

According to Mohammed's report from BAU in 2005, the larval weight was lowest (0.017 g) in the resistant line ISD 006, and the lowest (0.086 g) in the susceptible check. The author stated that due to the presence of strong glycoalkaloid and phenolic chemicals, larval growth was minimal in the resistant check, and hence weight was likewise minimal in the particular genotype.

Naqvi et al. (2009) conducted a field trial at Tamil Nadu Agricultural University in Coimbatore and found that long-fruited genotypes with more seeds in the mesocarp were resistant. As a result, the length of the fruit and the seediness of the mesocarp correlated negatively with the fruit infection %. According to Prabhu et al. (2009), there is a clear association between the quantities of biochemical elements in better genotypes and fruit and shoot borer resistance.

Prabhu et al. (2009a) from the Horticultural College & Research Institute, TNAU,Coimbatore reported that among 100 genotypes tested, genotypes with a highor moderate degree of PPO activity contributed to improve resistance to BSFB. The resistant genotype, S-14, showed the greatest value of PPO activity, 0.377 and 0.365 OD/min/g of shoot & fruit samples, respectively, while susceptible counter partsrecorded 0.320 & 0.302 OD/min/g of shoot & fruit samples, respectively. As a result, PPO activity is one of most important biochemical factorsinfluencing BSFB resistance.

Sandoval et al. (2010) investigated the ovipositional behaviour of brinjal shoot and fruit borer, L. orbonalisto, in various brinjal types. Based on the amount of eggs laid, L. orbonalis preferred eggplant varieties in this order: Bilog - San Roque >Mara > DLP > Balbalusa -Bilog - Pangasinan > Mistisa CasinoKirit Concepcion. They determined that allelochemicals or secondary plant compounds were responsible for the adult's ovipositional preferences.

Dhruve and colleagues reported in 2014 that out of 21 brinjal germplasm accessions tested, germplasm resistant to BSFB showed higher solasodine concentration than susceptible germplasm. Out of all the genotypes studied, the resistant check Pant Samrat contained 3.86 mg/100g fresh weight of solasodine, whereas the susceptible variety OB-1-1 contained 0.22 mg/100g fresh weight. As a result, glycoalkaloid (Solasodine) played an important function as a biochemical agent in lowering the BSFB infestation rate by imparting a bitter flavour to the fruit.

Nirmal and Vethamoni (2016) of TNAU, Coimbatore examined 30 genotypes to determine the relevance of biochemical factors in providing resistance to BSFB. The most susceptible cultivar had the lowest phenol level (1.32mg/g), while resistant genotype BR-108 had a high phenol concentration (1.59mg/g).

The genotypes with high phenol content had a low proportion of infection, indicating their significance in imparting resistance against this pest attack.

Lu et al. (2017) conducted a biochemical examination of eight C. suppressalis populations and discovered a strong association between esterase (EST) activity and chlorantraniliprole resistance. The activity of EST varied from 24.5 ± 2.6 to 57.7 ± 2.8 nmol min-1 mg-1 protein in different populations. However, nosignificant link was found b/w chlorantraniliprole resistance development and the activity of cytochrome P450 or glutathione S-transferases (GSTs).

Muhammad Abdullah et al. (2020) divided seven eggplant varieties into four categories: immune (0), resistant (Eggplant F1 Black Boy-706), tolerant (Eggplant BlackLong US 3715 and EggplantRosa Bianica Organic), and highly susceptible (Eggplant F1 BSS914, Eggplant F1Chutu 705, Eggplant LongPurple Sky 384, and Eggplant F1Chaya 704).

Salve et al. (2020) found that the Utkal Keshri variety produced the highest mean yield of brinjal fruits (658 q/ha), followed by BH-2 (598 q/ha). JBH-3 (412 q/ha) produced the lowest mean fruit production, followed by Utkal Jyoti (452 q/ha), Pusa Upkar (458 q/ha), and JB-262 (490 q/ha).

Gokulapriya et al. (2021) discovered that susceptible checks (IC112991 (84 mg/g), IC08988 (75 mg/g), IC 446654 (67 mg/g), and IC 393239 (56 mg/g) contained more soluble protein than tolerant and moderately resistant types.The total soluble protein level had a substantial positive connection with shoot and fruit borer incidence (r = 0.88).

According to Sharayu Patil and Uttam Hole (2021), the biochemical parameters polyphenol concentration and ash content were adversely connected with brinjal shoot and fruit borer infection; nevertheless, the presence of high sugar, proteins, and fats encouraged L. orbonalis infestations.

Neeraja Puthiamadom and Jiji Joseph did a study on solanum species diversity and morphological characterisation in 2022. S. melongena exhibits wide variety in fruit characteristics that bear huge fruit and are free of prickles.

Elias Oliveira Padovez et al. (2022) found substantial changes in biological features between S. frugiperda strains susceptible (SS) and resistant (RR) to chlorantraniliprole. The SS strain had a greater survival rate in the egg stage, with 90% survival compared to 80% in the RR strain. Furthermore, the SS strain had a higher reproductive capacity, generating 1635 eggs per female, whereas the RR strain only produced 520 eggs per female. However, the RR strain had a faster larval development time (14.6 days) than the SS strain (15.3 days), but the overall mean length of generation was greater in the RR strain (37.1 days) than in the SS strain (32.9 days). These data demonstrate the adaptive responses of S. frugiperda to pesticide resistance.

RESEARCH METHODOLOGY

This study, "Investigated the biochemical basis of resistance against brinjal shoot and fruit borer, L. orbonalis." was conducted from 2021 to 2024 at Maharishi University's Department of Science (Maharishi School of Science and Humanities). The experimental material consisted of seventy brinjal accessions were collected from NBPGR, SVPUAT, and Maharishi University, of which 37 of them cultures were obtained from ICAR- National Bureau of PlantGenetic Recourses, Pusa Campus, NewDelhi, two accessions of state released brinjal variety from SVPUAT Meerut, and thirty-one local accessions were collected. The field evaluations were conducted at a farmer's field in Lucknow district, UP, India,during Kharif 2022 (season I) and Rabi 2023 (season II), while the laboratory trials were carried out at Maharishi University's Department of Science, Maharishi School of Science and Humanities.

BIOCHEMICAL BASES OF RESISTANCE

The composition of several biochemical components in selected brinjal accessions was investigated. The lowest percentage of crude protein was identified in IC 546016 (4.07%), followed by Banthar (4.68%), and the highest crude fat content was reported in Indiranagar Local (4.21%) and IC 136177 (2.15%). While the total phenol content of brinjal fruit, the maximum amount of phenol was identified in the accession IC 546016 (2.83%), and the lowest amount of phenol was detected in the susceptible check Indiranagar Local (1.06%). In terms of enzyme activity of selected brinjal accessions, IC 546016 (3.74 units/min/g) and Banthar (3.38 units/min/g) had greater levels of peroxidase (PO). The polyphenol oxidase (PPO) concentration was lowest in susceptible check Indiranagr Local (3.86 units/min/g) and highest in IC 546016 (8.83 units/min/g) (Table 1).

TABLE 1: BIOCHEMICAL PROPERTIES OF FRUITS OF SELECTED BRINJAL ACCESSIONS AGAINST *L. ORBONALIS.*

SN	ACCESSIONS	CRUDE PROTEIN CONTENT (%)*	CRUDE FAT CONTENT (%)*	TOTAL PHENOL CONTENT (%)*	ENZYME ACTIVITY (UNITS/min/g)**	
					PEROXIDASE (PO)	POLYPHENOLOXYDASE (PPO)
1	IC 546016	4.07 (11.58)	1.84 (7.74)	2.83 (9.62)	3.74 (1.93)	8.83 (2.95)
2	Banthar	4.68 (12.38)	1.87 (7.85)	2.74 (9.43)	3.38 (1.83)	8.38 (2.85)
3	IC 136297	5.38 (13.45)	1.93 (7.88)	2.71 (9.47)	3.03 (1.73)	8.02 (2.84)
4	IC 154571	7.03 (15.26)	1.95 (8.01)	2.64 (9.25)	2.82 (1.66)	7.64 (2.74)
5	IC 136302	7.15 (15.44)	2.06 (8.16)	2.57 (9.21)	2.53 (1.58)	7.48 (2.67)
6	IC 136177	7.21 (15.54)	2.15 (8.46)	2.21 (8.47)	2.41 (1.54)	7.32 (2.68)
7	Indiranagar Local	12.06 (20.18)	4.21 (11.74)	1.06 (5.76)	0.94 (0.96)	3.86 (1.95)
	SEd	0.26	0.16	0.16	0.04	0.05
	CD	0.54	0.32	0.36	0.06	0.11

To detect bioactive chemicals, GCMS analysis was performed on fruits from resistant and susceptible accessions. (Tables 2 and 3.) The Table 1 and 2 displayed the compound with the highest peak area per cent. eleven compounds were discovered in IC 546016. (1) Propanamide, 2-hydroxy; (2) 1,3-propanediamine, N'-bis (3-aminopropyl); and (3) 5-Butyl-2-methyl.delta.1-pyrroline, (4) 3-buten-2-one, 4,4-bis (dimethylamino), (5) Tris (Aziridinomethyl) hydrazine, (6) Mannosamine, (7) 4-Chlorolysine, (8) DL-alanyl-DL-ethionine, (9) Diethyl 3,3'-Methylimino) dipropionate, (10)L-Alanine, N-isobutoxycarbonyl-,hexyl ester, and (11) N(3-(N-Azyridyl) propyliddene) hexylamine. Among the eleven compounds, the maximum peak area was seen in 3 - buten-2-one,4,4-bis (Dimethylamino) (20.60 RT), while the lowest peak was reported in Propanamide, 2-hydroxyl (3.06 RT).

TABLE 2: BIOCHEMICAL COMPOUNDS IMPARTING RESISTANCE TO *L. ORBONALIS*IN IC 136546 (GC-MS ANALYSIS)

SN	RT*	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PEAK AREA(%)
1.	3.05	Propanamide,2- hydroxy	$C_3H_7O_2N$	88	2.08
2.	18.82	1,3-propanediamine,N'-Bis (3-aminopropyl)	$C_9H_{24}N_4$	187	7.28
3.	20.53	5-Butyl-2-methyl.delta.1-pyrroline	$C_9H_{17}N$	138	14.93
4.	20.61	3–buten-2-one,4,4-bis (Dimethylamino)	$C_8H_{16}ON_2$	155	46.68
5.	20.75	Tris(Aziridinomethyl) hydrazine	$C_9H_{19}N_5$	196	12.68
6.	23.23	Mannosamine	$C_6H_{13}O_5N$	178	1.77
7.	25.17	4-Chlorolysine	$C_6H_{14}N_2$	181	2.16
8.	25.34	DL-alanyl-DL-ethionine	$C_8H_{16}O_3N_2S$	221	3.34
9.	29.08	Diethyl3,3'-Methylimino) dipropionate	$C_{11}H_{21}O_4N$	232	4.53
10.	29.96	L- Alanine, N- is obut oxy car bony l-,hexy lester	$C_{14}H_{27}O_4N$	274	1.96
11.	30.07	N(3-(N-Azyridyl) propyliddene) hexy lamine	$C_{11}H_{22}N_2$	183	2.55

TABLE 3: BIOCHEMICAL COMPOUNDS IMPARTING RESISTANCE TO *L. ORBONALIS*IN MANAPAARAI LOCAL (GC-MS ANALYSIS)

SN	RT*	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PEAK AREA(%)
1.	18.84	N-ethyltrimethylenedamine	$C_5H_{14}N_2$	103	9.08
2.	20.55	5-butyl-2-methyl-.delta.1pyroline	$C_9H_{17}N$	138	42.26
3.	20.63	N-(5-azidopentyl)-4- vinylazetidin-2-2one	$C_{11}H_{18}ON_4$	223	34.65
4.	20.77	L-4-hydroxylysine	$C_6H_{14}O_3N2$	163	7.34
5.	25.16	Decanal	$C_{10}H_{20}O$	155	2.46
6.	26.02	3,7-dimethyl-1,7 -octadien-3- amine	$C_{10}H_{19}N$	154	4.16

While the susceptible check contained six compounds: (1) N-ethyltrimethylenedamine, (2) 5-butyl-2-methyl-.delta.1pyroline, (3) N-(5-azidopentyl)-4-vinylazetidin-2-one, (4) L-4-hydroxylysine, (5) decanal, and (6) 3, 7-dimethyl-1,7-octadien-3-amine. The largest peak among the six compounds was recorded in 5-butyl-2-methyl-delta.1pyroline, the lowest peak was found Decanal (25.17 RT).

Among the numerous economic characteristics of the brinjal accessions, IC 546016 (64) produced the most fruits per plant, followed by Banthar (60). The fruit weight (single) was highest in IC 136297 (66.62 g). However, the lowest fruit weight (single) was found in IC 136177 (63.04 gm). In terms of overall yield per plant, IC 546016 had a greater yield (4.16 kg/plant) than Banthar (3.96 kg/plant). The susceptible check Indiranagar Local produced the lowest yield (1.22 kg/plant) (see Table 4).

TABLE 4: YIELD CHARACTERS OF BRINJAL ACCESSIONS

SN	ACCESSIONS	NO. OF FRUITS PER PLANT	SINGLEFRUIT WEIGHT (g)	TOTALYIELDPER PLANT (kg)
1	IC 546016	62 (7.75)	68.53 (8.24)	4.16 (2.03)
2	Banthar	61 (7.73)	66.25 (8.05)	3.96 (1.96)
3	IC 136297	56 (7.48)	66.62 (8.17)	3.78 (1.95)
4	IC 154571	55 (7.31)	63.22 (7.88)	3.58 (1.86)
5	IC 136302	56 (7.35)	63.11 (7.92)	3.46 (1.86)
6	IC 136177	52 (7.15)	63.04 (7.88)	3.22 (1.76)
7	Indiranagar Local	17 (4.27)	67.26 (8.05)	1.22 (1.06)
	SEd	0.15	0.16	0.04
	CD	0.31	0.34	0.06

CORRELATION ANALYSIS OF BIOPHYSICAL AND BIOCHEMICAL FACTORS WITH PERCENT SHOOT INFESTATION OF *L. ORBONALIS*

Tables 5, 6, and 7 show the results of a simple correlation analysis that associated biophysical and biochemical parameters with percent shoot infestation of L. orbonalis. The results showed a substantial positive connection between biophysical characteristics and % shoot infection of L. orbonalis. Plantheight (r = 0.98), number of major branches (r = 0.883), number of leaves per plant (r = 0.952), leaf area (r = 0.918), and pedicel length (r = 0.978) were measured.

In terms of biochemical factors, crude protein (r = 0.942), crude fat (r = 0.975), & total soluble sugar (r = 0.934) had a significantpositive correlation, whereas total phenol (r = -0.934), peroxidase (PO) (r = -0.925), and polyphenol oxidase (PPO) (r = -0.871) had asignificant negative correlation with percent shootinfestation. Other plant constituents, such as total chlorophyll (r = 0.976), moisture (r = 0.851), nitrogen (r = 0.978), & phosphorous (r = 0.954), showed significantpositive correlation, whereas remaining constituents, ash (r = -0.895), wax (r = -0.922), and potassium, showed significantnegativecorrelation with percent shoot infestation of L. orbonalis.

TABLE 5: CORRELATION ANALYSIS OF BIOPHYSICAL FACTORS OF BRINJAL ACCESSIONS AND PERCENT SHOOT INFESTATION OF *L. ORBONALIS*.

BIOPHYSICAL CHARACTERS	CORRELATION (R)
Plant Height	0.972**
Number of primarybranches per plant	0.883**
Number of leaves per plant	0.952**
Leaf area	0.918**
Length of pedicel	0.978**

TABLE 6: CORRELATION ANALYSIS OF BIOCHEMICAL FACTORS OF BRINJAL ACCESSIONS AND PERCENT SHOOT INFESTATION OF *L. ORBONALIS*

BIOCHEMICAL CHARACTERS	CORRELATION (R)
Crude protein	0.942**
Crude fat	0.975**
Total soluble sugar	0.931**
Total phenol	- 0.934**
Peroxidase(PO)	- 0. 925**
Polyphenoloxydase (PPO)	- 0. 871**

TABLE 7: CORRELATION ANALYSIS OF PLANT CONSTITUENTS OF BRINJAL ACCESSIONS AND PERCENT SHOOT INFESTATION OF *L. ORBONALIS*

PLANT CONSTITUENTS	CORRELATION (R)
Total chlorophyll	0.976**
Ash	- 0.895**
Moisture	0.851**
Wax	- 0.922**
Nitrogen	0.978**
Phosphorus	0.954**
Potassium	- 0.885**

CORRELATION ANALYSIS OF BIOPHYSICAL AND BIOCHEMICAL FACTORS WITH PERCENT FRUIT INFESTATION OF *L. ORBONALIS*

Tables 8, 9, and 10 show how biophysical and biochemical parameters correspond with percentage fruit infestation. Using simple correlation analysis, the following biophysical fruit characters of selected brinjal accessions had a significant positive correlation with percent fruit infestation of L. orbonalis: fruit diameter (r = 0.858), fruit length (r = 0.848), calyx length (r = 0.867), and exit holes (r = 0.906). Biochemical variables such as total phenol (r = -0.794), peroxidase (PO) (r = -0.821), and polyphenol oxidase (PPO) (r = -0.766) had a strong negative connection with percent fruit infestation of L. orbonalis. In addition to the other plant constituents, total chlorophyll (r = 0.877), nitrogen (r = 0.835), phosphorous (r = 0.892), and moisture content (r = 0.916) had significantpositive correlations, while ash (r = -0.771), wax (r = -0.843), and potassium (r = -0.777) had significant negativecorrelations.

TABLE 8: CORRELATION ANALYSIS OF FRUIT CHARACTERS OF BRINJAL ACCESSIONS AND PERCENT FRUITINFESTATION OF *L. ORBONALIS*

BIOPHYSICAL CHARACTERS	CORRELATION (R)
Length of the fruit	0.848**
Diameter of the fruit	0.858**
Calyx length	0.867**
Number of exit holes	0.906**

TABLE 9: CORRELATION ANALYSIS OF BIOCHEMICAL FACTORS OF BRINJAL ACCESSIONS AND PERCENTFRUIT INFESTATIONOF *L. ORBONALIS*

BIOCHEMICAL CHARACTERS	CORRELATION (R)
Crude protein	0.864**
Crude fat	0.873**
Total phenol	- 0.794**
Total soluble sugar	0.878**
Peroxi dase(PO)	- 0.821**
Polyphenoloxydase (PPO)	- 0.766**

TABLE 10: CORRELATION ANALYSIS OF PLANT CONSTITUENTS OF BRINJAL ACCESSIONS AND PERCENT FRUIT INFESTATION OF *L. ORBONALIS*

PLANT CONSTITUENTS	CORRELATION (R)
Total chlorophyll	0.877**
Ash	- 0.771**
Moisture	0.916**
Wax	- 0.843**
Nitrogen	0.835**
Phosphorus	0.892**
Potassium	- 0.777**

DISCUSSION

Using simple correlation analysis, the following biophysical fruit characteristics of selected brinjal accessions were found to have a significant positive correlation with percentfruit infestation of L.orbonalis: fruit diameter (r = 0.858), fruit length (r = 0.848), calyxlength (r = 0.867), and exit holes (r = 0.906). In current study, similar to findings of Shaik Javed (2017), the minimum fruit length and diameter were recorded in the resistant brinjal genotype IC 136299, while the highest fruit length and dimension were found in the susceptible genotype IC 89950. For correlation analysis, the length and diameter of the fruit showed a positive non-significant connection (r = 0.44) with the percent infestation of L. orbonalis. According to Muhammad Abdullah et al. (2020), there is a positive link between fruit length (r = 0.205), fruit diameter (r = 0.159), and L. orbonalis infestation rate. Swarnamai is the susceptible check with the most exit holes, whereas 2010/BRL VAR-1 has the fewest.

Calyx is the most essential morphological component and is strongly associated with Leucinodes infection. The present study found that the long and large calyx exhibited in susceptible genotypes may enable neonates hide and readily penetrate fruit via the soft tissue beneath calyx, whereas the short and small calyx was detected in resistant genotypes. Niranjana et al. (2015) discovered that susceptible germplasm SM 166 had the longest calyx, whereas resistant brinjal germplasm SM 16 had the shortest. Wagh et al. (2012) reported a highly substantial & positive connection between calyx length and L. orbonalis infection (r = 0.77). Sharayu Patil and Uttam Hole (2020) reported a similar outcome.

Here, we substantiate our findings. Effects of brinjal fruit shape & colour, minimum fruitinfestation of L. orbonalis wasobserved on F1 blackboy 706 with round and purple fruit, & maximum infestation wasrecorded in Egg-plant F1 Chaya 704 with round and dark purple fruit (Muhammad Abdullah et al., 2020). Naqvi et al. (2009)found no significant effects of brinjalfruit colour on fruit infestation by L.orbonalis. When the biochemical variables of resistance wereestimated in selected brinjal accessions, susceptible check Manapaarai Local had the highest levels of chlorophyll, moisture content, total soluble sugar content, nitrogen, and phosphorus contents. The accession IC 136546 has the highest levels of ash, wax, and potassium content. (Fig. 2, 3 & 4)

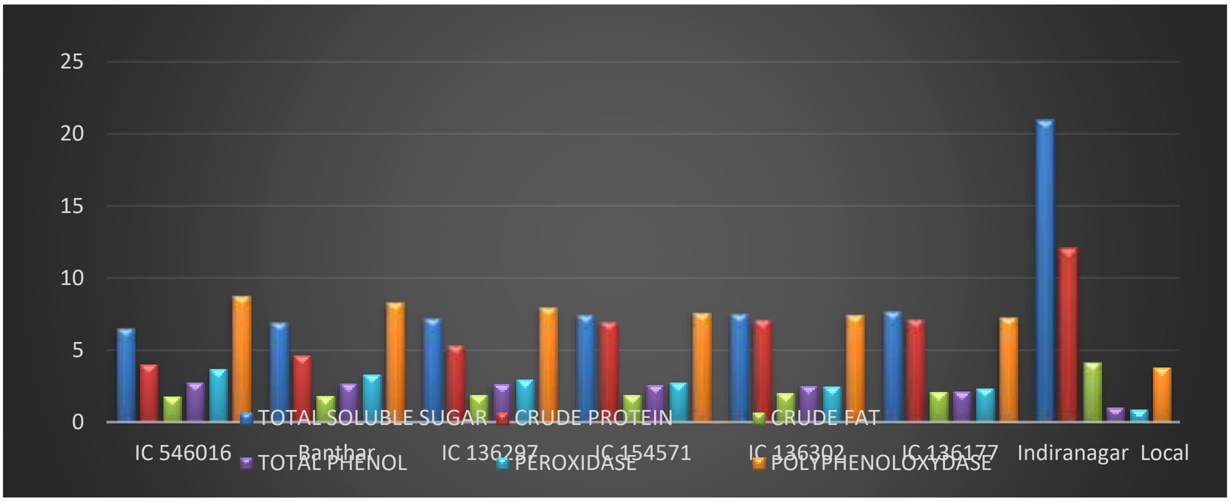

FIG. 2: BIOCHEMICAL PARAMETERS OF SELECTED BRINJAL ACCESSIONS

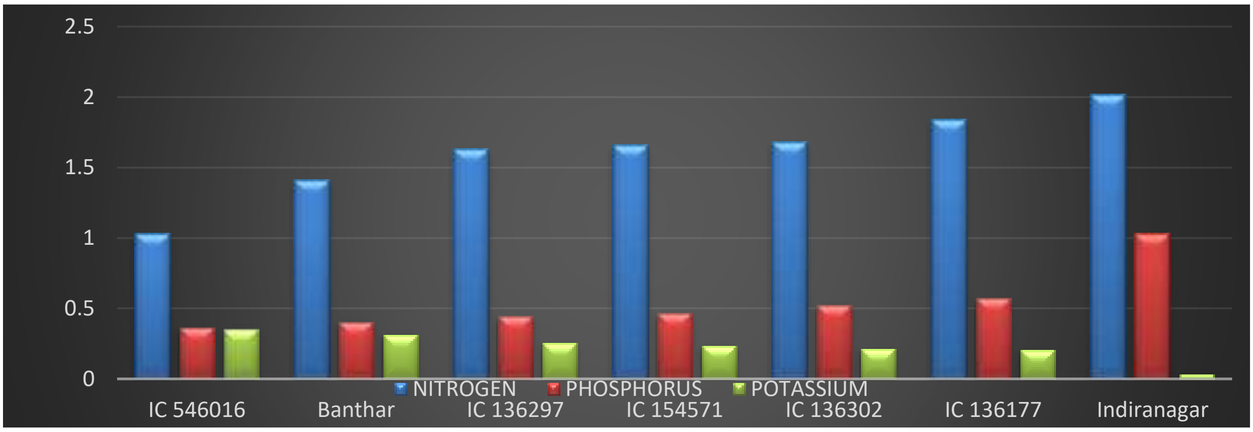

FIG. 3: NITROGEN, PHOSPHORUS AND POTASSIUM CONTENTS OF SELECTED BRINJAL ACCESSIONS

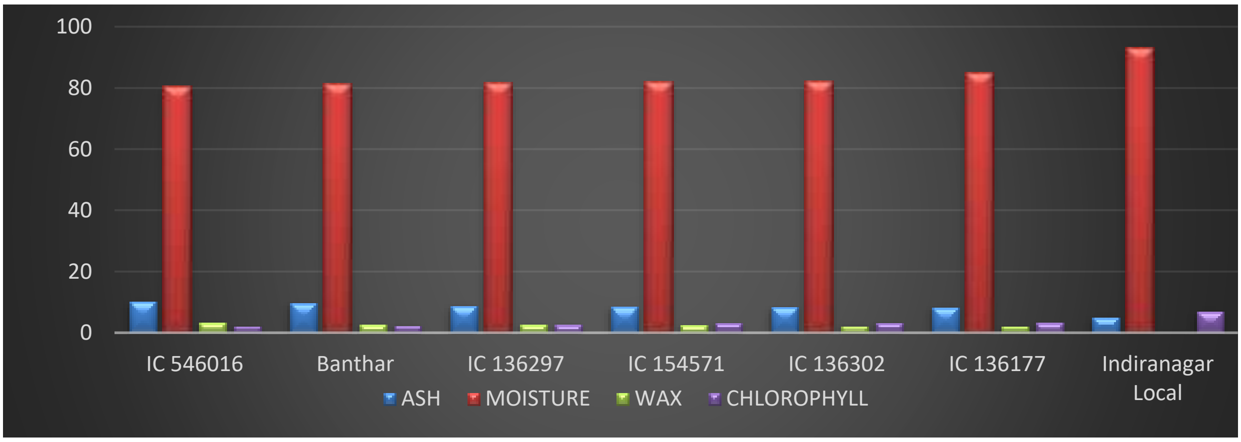

FIG. 4: ASH, WAX, MOISTURE AND CHLOROPHYLL CONTENTS OF SELECTED BRINJAL ACCESSIONS

Sugar plays an important role in plants; difference in proportional amount of sugars b/w genotypes with varied susceptibilities tofruit borer suggested that these substances could operate as phagostimulants for L. orbonalis. The current study's findings areconsistent withprevious reports by Umesh et al. (2015), who observed the maximum amount of sugar and chlorophyll contents in highly vulnerable variety GBL-1 and the lowest amount in resistant variety GJB-3.Similar results wereobtained by Nirmala Nagappan (2017), who reported that the lowest sugar content was recorded in highly resistantgenotype ABSR-2, while the highest sugar was recorded in susceptible genotype IC 354721, and phenols showed a significant negativecorrelation with shoot & fruit borer infestations.

Prabakaran et al. (2015) found that susceptible genotype EP-28 had the least amount of phenol and the highest sugar content, whereas the resistant genotype Nilakottai Local had a lower preference for L. orbonalis due to the presence of more phenol. Similar observations were found by Shinde (2006) and Nirmala et al. (2017). According to Sharayu Patil and Utam Hole (2021), resistant genotypes Ol green had lower moisture content and higher ash content than susceptible genotype PBSR-52, as well as a strong positive correlation (r = 0.831) of moisture content (%) and a strong negative correlation with ash content (%) with percentage infestation of L. orbonalis. Previous researchers Dadmal et al. (2003) found a similar association.

Elanchezhyanet al. (2008, as well as Shaik Javed's (2017) findings, found that the highly resistant genotype IC 136299 had the lowest nitrogen and phosphorus content, while the susceptible genotype IC 345271 had the highest. In addition, Tripati et al. (2013) discovered that the brinjal variety Pusa Purple Long had the greatest phosphorus level, whereas variety NDBH-1 had the lowest. Awasthi et al. (1987) reported a similar finding. The maximum potassium concentration wasrecorded in the highly resistant genotype IC 136299, while the lowest potassium content was detected in the very vulnerable genotype IC 345271 (Shaik Javed, 2017). Thesefindings are consistent with observations obtained by (Tripati et al. 2013).

The biochemical factors, such ascrude protein and crudefat content of fruit, were highest in the susceptible check Indiranagar Local, followed by IC 136177, and lowest in the accession IC 546016, and the enzymes peroxidase (PO) and polyphenol oxydase (PPO) content were high in IC 546016 and very low in the susceptible check Indiranagar. These findings are consistent with those of Sharayu Patil and Uttam Hole (2021), who found that the susceptible genotype DBSR-95 had the highest amount of crude protein and crude fat content, while the resistant genotypes Krishna Kathi-1 and Arka keshav had the lowest amount. There was a substantial positive association between crude fat (r = 0.65) and crude protein (r = 0.802) content and L. orbonalis infestation percentage. Previous researchers have documented a similar pattern, including Panda and Das (1975), Kale et al. (1986), Hazra et al. (2004), Chandrashekhar et al. (2009), and Prasad et al. (2014).

During Kharif 2020, the mean % shoot infestationhad a significant positive connection withmaximum and minimum temperatures (r = 0.376 and r= 0.095, respectively) & sunshine (r = 0.041). However, rainfall (r = -0.041) & relativehumidity (r = -0.504) have a substantial negative association. A contrast was detected between the mean % fruit infestation and the climatic conditions. Rain fall (r = 0.592) and relative humidity (r = 0.681) had a substantial positive connection with the mean percent fruit infection of L. orbonalis. During Rabi 2021, the mean percent shoot infestation was significantly positivecorrelation with sunshine (r = 0.076) and relativehumidity (r = 0.231) & negatively correlatedwith maximumtemperature (r = -0.161), minimum temperature (r = -0.660), and rain fall (r = -0.402), whereas the mean percent fruit infestation was disparity of correlation with meteorological parameters, because it showed the significantpositive correlation with maximum temperature(r = 0.517).

The current observations are consistent with the findings of Anju Shukla and Khatri (2010), who found that the maximumtemperature (r = 0.319) & minimum temperature (r = 0.389) were favourably connected with the percentage infestation of L. orbonalis. A significant negative association was found b/w relative humidity & rainfall. Similarly, Shukla (1987) found that the population of L. orbonalis waspositively linked withtemperature, relative humidity, & total rainfall. Also, Showket Ahmed & Sajad Hussain (2016) found a negative association between rain fall and relative humidity and the population of L. orbonalis. According to Atwal and Verma (1972), the abundance of L. orbonalis was highest during monsoon season (khairi). The highest infestation occurred between 23oC and 35oC. The peakpopulation of L. orbonalis was detected during the first week of July & the third week of August. Similarly, Dhamedhere et al. (1995) discovered that moderate temperatures & high humidity promote population growth of L. orbonalis during the (Rabi season) summer.

Gupta and Kauntey (2008) also discovered that abiotic variables were responsible for population growth. Prasad & Logiswaran(1997) found a substantial positive link withmaximum temperature & relative humidity, but a negativecorrelation with minimumtemperature. Amit Kumat et al. (2022) studied the seasonal occurrence of L. orbonalis in brinjal in 2014 and 2015. The peak larval population was recorded between the 24th and 30th standard weeks, and maximum and minimum temperatures, as well as relative humidity, were positively connected with L. orbonalis.

CONCLUSION

This paper is to invesyigate the biochemical basis of resistance against brinjal shoot and fruit borer, L. orbonalis." Indiranagar Local had high crude protein and fat content, whereas IC 546016 had the lowest, followed by Banthar. IC 546016 also had the highest total phenol level. IC 546016 had the highest levels of peroxidase (PO) and polyphenol oxidase (PPO) enzyme activity, followed by Banthar. A substantial negative connection was found between total phenol, peroxidase (PO), and polyphenol oxidase (PPO) levels and larvae mortality. Significant positive association found between total soluble sugar, crude fat, and crude protein levels and larval mortality. Pupal weight was inversely connected with total phenol, Peroxidase (PO), and Polyphenol oxidase (PPO), while sugar, crude protein, and fat content were positively correlated. GCMS was used to identify insecticidal compounds against L. orbonalis (accession IC 546016). (1) Propanamide, 2-hydroxy; (2) 1,3-propanediamine, N'-bis (3-aminopropyl); and (3) 5-Butyl-2-methyl.delta.1-pyrroline, (4) 3-buten-2-one,4,4-bis (Dimethylamino), (5) Tris (Aziridinomethyl) hydrazine, (6) Mannosamine, (7) 4-Chlorolysine, (8) DL-alanyl-DL-ethionine, (9) Diethyl 3,3'-Methylimino) dipropionate, (10) L-Alanine, N-isobutoxycarbonyl,hexyl ester, and (11) N(3-(N-Azyridyl) propyliddene) hexylamine. Among the eleven compounds, 3 - buten-2-one,4,4-bis (Dimethylamino) had the biggest peak area (20.60 RT) and Propanamide, 2-hydroxyl had the lowest peak (3.06 RT). The susceptible check Manapaarai Local contains six compounds: (1) N-ethyltrimethylenedamine, (2) 5-butyl-2-methyl-delta.1pyroline, (3) N-(5-azidopentyl)-4-vinylazetidin-2-one, (4) L-4-hydroxylysine, (5) Decanal, and (6) 3,7-dimethyl-1,7-octadien-3-amine. The largest peak among the six compounds was recorded in 5-butyl-2-methyl-delta.1pyroline, and the lowest peak was reported in Decanal (25.17 RT). A substantial positive association was found between climatic parameters and the mean % infestation of L. orbonalis during Kharif, including maximum and lowest temperatures and sunlight levels. However, rainfall and relative humidity had a substantial negative association. In Rabi, there was a substantial positive association between solar brightness and relative humidity, but a significant negative correlation between maximum and minimum temperatures and rainfall.

Thus, according to the findings of this study, brinjal shoot and fruit borer L. orbonalis liked accession IC 546016 and IC Banthar less. These accessions also demonstrated stronger antixenosis and antibiotic activity against L. orbonalis. However, in-depth and repeated field and glasshouse evaluations of chosen brinjal against L. orbonalis without compromising yield traits are possible. The biochemical contents of the trichome can be examined to better understand the causes of resistance. The aforementioned future research will aim to get a better knowledge of the manifestation of resistance in brinjal accessions to L. orbonalis, as well as its practical use.

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