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Evaluation Of The Biophysical Basis Of Resistance Against Brinjal Shoot And Fruit Borer, L. Orbonalis

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Abstract
There is an increasing demand for development of a newchemical class of insecticides for management of emerging agricultural pests, with a novel mechanism of action and enhanced toxicity and environmental profile. However, development of pesticideresistance in pests necessitates discontinuation of currently effective insecticides and the search for alternative compounds. This study is titled "Evaluation of the biophysical basis of resistance against brinjal shoot and fruit borer, L. orbonalis." The results of the study concluded that the L. orbonalis feeding and ovipositional preferences show a significant negative connection with trichome density. A significant negative association was found between trichome density, impedance, and entrapment of L. orbonalis larvae. Indiranagar Local and IC 136177 plants had the highest plant height, primary branch count, and calyx length. IC 136177 had the longest fruit length, followed by Indiranagar Local, which also had the largest fruit diameter.
Keywords: *Biophysical basis of resistance, Brinjal Shoot and Fruit, Tricome density, Impedence, & Entrapment, etc.*

INTRODUCTION

Development of pesticideresistance in pests necessitates discontinuation of currently effective insecticides and the search for alternative compounds. Given the difficulty, time, and cost involved in developing a new insecticide, resistance management is critical to extending the usable life of present and future insecticides.

It is so critical to understand the efficacy of any insecticide against its target pests, monitor resistance development, identify potential mechanisms by which pests develop resistance, and implement intelligent counter-strategies. According to a 2013 survey, five pesticide classes, namely neonicotinoids (27 percent market share), pyrethroids (16 percent), organophosphates (11 percent), diamides (8 percent), and avermectins (7 percent), account for 70 percent of the global market (Sparks & Nauen, 2015). Compared to other pesticide classes, diamides grew their market share in India by 2% between 2017 and 2019, the quickest growth rate (FMC, 2021).

India is an agrarian country with 2.4% of the world's arable land. The country feeds roughly 15% of world's population. The horticulture sector, particularly vegetables, may play a significantrole in feeding the millions by increasing productivity. India is second largest producer ofvegetables after China, accounting for 9.4% of overall production (Hedge et al., 2012). The majority of Indians arevegetarian, with a per capita consumption of 135g/day compared to recommended 300g/day (Dandapani and Shelkar, 2013). As a result, increasing vegetable production and productivity requires a high level of importance.

Brinjal (Solanum melongena L.), also known as eggplant or aubergine, is most extensively produced vegetable in India & around world. It stands out among vegetables for a variety of reasons, including its constant availability to poor communities when other vegetables are scarce, farmers' ability to grow it throughout the season, and its high concentration of nutrients, vitamins, minerals, dietary fibre, and body building proteins (Choudhary et al., 2018). Eggplant, belongs to Solanaceae family & is a popular vegetable crop farmed all year in India and around the world. It is a popular vegetable crop in Central, South, and Southeast Asia, as well as various African countries and South Africa (Harish et al., 2011). Because of its great nutritional content, the crop is important in and of itself. It's high in iron, calcium, phosphorus, potassium, and vitamin B. Its fresh weight contains 92.7% moisture, 1.4% protein, 1.3% fibre, 0.3% mineral, 4.0% carbs, and vitamins A and C (Aykroyd, 1963).

Aside from its nutritional significance, brinjal is also important in the medical industry.Eggplant fruits are also commonly utilized in a variety of culinary preparations, including bharta, stuffed curries, chatri, and pickles. It has gained widespread use in the pickling and dehydration industries. It is an effective treatment for people who suffer from hepatic and cardiovascular problems. It also works well as a laxative, and eggplant roots are used to make diabetic medications.

It is indigenous to India and is planted on an area of 730.4 Mha with an annual yield of 12800.8 MT (NHB, 2018). In India,it is primarily grown in West Bengal, Odisha, Bihar, Uttar Pradesh, Maharashtra, and Karnataka. According to data from the National Horticulture Board (2018), Odisha is also considered the leading state in India for brinjal, covering an area of 117.92(000) hectares and producing 2013.02(000) MT, however this output level is insufficient to meet domestic demand.During wet monsoon season, when other vegetables are scarce, this is the sole vegetable available to both urban and rural residents at a reasonable cost. As a result, this vegetable is significant in terms of social fairness (Alam and Baral 2016). Brinjal has been cultivated in India for over 4000 years, with its origins in the Indo-Burma region (Vavilov, 1928). It is often referred to as "King of Vegetables" due to its widespread use in daily life & Indiancuisine. India is world's secondlargest brinjal grower,following China, with anannual output of 12.87 milliontons from 0.74 million hectareswith an averageyield of 17.2 tonnes/ha(Indiastat, 2021).

Despite its tremendous importance and promise, brinjal productionis limited by a variety of biotic & abiotic issues. Amongthese variables, insect pests such as brinjal shoot and fruit borer (L.orbonalis) pose a significant danger, with output losses ranging from 70 to 92% (Sharayu Patil and Uttam Hole, 2021). In Tamil Nadu alone, it results in a loss of 20-60%. If no control measures are implemented, it may result in a yield loss of approximately 95%.

The morphological and biophysical properties of shoots and fruits have been linked to pest attraction, feeding, and oviposition. As a result, identifying the biophysical features of pest resistant cultivars is extremely important in practice. Many researchers in India have sought to screen brinjal cultivars against L. orbonalis in a variety of settings. However, genotypes in a specific region must be tested, & efforts were undertaken to discover morphological basisof resistance in brinjalgenotypes to damage caused byLeucinodes orbonalis.

REVIEW OFRELATED LITERATURE

According to Hazra et al. (2004), the least vulnerable brinjal genotypes have the shortest calyx length. In contrast, the most vulnerable genotypes possessed the longest calyxes. Hazra et al. (2004) analyzed 72 germplasm at AICRP, Vegetable Science, and BCKV and found that eggplants with thin shoots and green fruit were more susceptible to BSFB attack than their counterparts with thick shoots and purple fruit. As a result, shoot thickness was an important factor in determining the biophysical foundation of resistance. Elanchezhyan et al. (2009) discovered that the brinjal hybrid Swetha had the the greatest ash content (12.3%) and total compounds (7.6 mg/g), as well as the the smallest moisture materials (78.4%), total chlorophyll (1.2 mg/g), and total sugars (5.8 mg/g), while Bejo Sheetal had the the lowest ash content (10.1%) and total compounds (1.9 mg/g), as well as the highest liquid (89.2%), total chlorophyll (1.9 mg per g), and total sugars (18.0%). Total sugars (r = 0.9976), total chlorophyll (r = 0.9904), and moisture (r = 0.9514) content had a significant and positive association with shoot damage, whereas total phenol (r = -0.8868) and ash (r = -0.9176) content had a strongly negative relationship with brinjal plant and fruit borer contamination.

According to Chandrashekhar et al. (2009), moisture (r = 0.84), crude protein (r = 0.68), and nitrogen (r = 0.69) contents in fruits have positive and significant correlations, whereas total sugars (r = -0.67) and phenol (r = -0.80) contents in fruits have a significant and negative correlation with percent fruit infestation by shoot and fruit borer. Potassium and magnesium were found to have a deleterious effect on the occurrence of shoot and fruit borers. Chandrasekhar et al. (2009) conducted a field experiment and found a negative link between the amount of seeds in the mesocarp and fruit infection by BSFB. Fruits having a higher number of seeds in their mesocarp were shown to be more resistant than those with fewer seeds. According to the authors, the amount of seeds in the mesocarp was a significant biophysical characteristic in identifying BSFB infection.

Prasad et al. (2014) reported from NBPGR, New Delhi that out of 23 eggplant accessions, germplasm with green fruits were less liked by BSFB, resulting in 7.89-16.32 percent fruit damage compared to other genotypes with a greater fruit boring percentage. Thus, the scientists concluded that the green hue of the fruits served as a biophysical basis for brinjal's resistance to BSFB. Prasad et al. (2014) examined 23 brinjal genotypes for biophysical resistance to BSFB. The scientists discovered that brinjal variants with rectangular fruits and a high quantity of seeds in the mesocarp were less preferred by BSFB than kinds with round shapes and fewer seeds.

According to Niranjana et al. (2015), a non-significant & negative connection was found b/w fruit infestation & fruit characteristics such as length (r = -0.25) & diameter (r = -0.04). The shape & colour of

the fruithad no significant effect on extent of infestation.Niranjana et al. (2015) sought to determine the association between biophysicalcharacteristics & infestation percentages. They conducted an experiment at the Vegetable Research Station in Palur, Tamil Nadu, using 35 germplasm samples, and found that brinjal shoot and fruit borer infection was inversely connected with trichome density on leaves. However, it showed a favourable correlation with shoot thickness.

Rishi (2018) his coworkers conducted a field study at the Vegetable Research Station in Kalyanpur, Uttar Pradesh, with 40 brinjal genotypes and found no significant link between fruit length and pest infestation. According to the authors, although fruit length is an important biophysical characteristic, it has no link with insect infestation.

A field trial with 36 brinjal cultivars was conducted at TNAU in Coimbatore. According to Kumar and Ram, (2019), out of all the varieties tested, Sevathampatti x Spiny Local and Sevathampatti Local x Seetipulam Local had the lowest percentage of fruit infestation (14.68%), while Manaparai Local x Marthandam Local had the highest percentage of fruit infestation (29.28%).

Kumar and Ram (2019) of Tamil Nadu Agricultural University in Coimbatore reported in 2019 that the highly sensitive varietyRHRB-20 had the highest sugar content (5.26 mg/100 mg of dry weight), while the resistant genotypeRHRB-68 had the lowest (2.63 mg/100 mg of dry weight). According to the authors, because sugar is regarded one of the most important nutrients in plants, the difference in relative sugar levels between genotypes indicated their susceptibility to fruit borer. As a result, sugar may act as a phagocytic stimulator for BSFB feeding on eggplant.

Muhammadet al. (2020) tested eight brinjal varieties forresistance to brinjal shoot & fruit borer. Shoot infestation rangedfrom (10.59 ± 0.95) on egg-plant LongPurple sky 384 to (52.46 ± 2.92) on egg-plant F1 Chaya-704.The level ofresistance in Long Purple Sky384 is classified as resistant. Shoots ofall types screened werelikely to contain L. orbonablis. Among the seven cultivars, none were completely immune to shoot and fruit borer.

Leela Praveen and Mallikarjunarao (2020) confirmed that the heavy pubescence on leaves of Elokshi, Black Beauty, GiantBanaors, and H-165 rendered them less appealing to adult L.orbonalis moths to deposit theireggs, and newly born larvae were unable to access the boring sites.

According to Sharayu Patil and Uttam Hole (2020), shot thickness can range from 0.28 to 0.68 cm. Genotype IAB-83 had the least shoot thickness, whereas genotype DBSR-95 had the highest shoot thickness of 0.65 cm. The Pearson's correlation coefficients for shoot thickness of different genotype in relation to L. orbonalis infection revealed a positive relationship (r = 0.591) between shoot thickness (cm) and percentage of L. orbonalis infestation. As a result, genotypes with thick shoots allow for more larval movement, as well as enhanced development and growth, while making thick shoots more susceptible to shoot borer attack.

Lispa Dash et al. (2021) discovered that resistance check,CHES-WS-1, had highest trichome density (365.50), whereas susceptible checkhad lowest density (95.67). As a result, trichomedensity was identified as astrong morphological attribute responsible for high resistance in brinjal to the target pest; the fruit infestation percentage was higher in germplasm with the lowest trichome density than in germplasm with the highest density.

Lipsa Dash et al. (2021) studied the ovipositional behaviour of various brinjal germplasms based on egg laying preference (number basis), and found that the variety Jamusahi Local had 94.12 eggs,which wasstatistically distinct from other germplasms assessed. The resistance check assessed 28.64 eggs,which was statisticallydifferent from other germplasms. There was nodifference in oviposition between resistant & moderately resistant germplasms (48.67 vs. 58.67 eggs per plant).

Amit Kumat et al. (2022) investigated seasonal incidence ofL. orbonalis in brinjal between 2014 & 2015. The peak larval population was detected during the 24th & 30th standard weeks, with maximum weekly mean larvae of 14.33 and 14.00 per fifteen plants, respectively.

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.

Sun et al. (2023) showed cross-resistance to tetraniliprole (27.7- to 806.8-fold RRs) in all field-collected populations of the rice stem borer C. suppressalis, which demonstrated 28- to 607-fold resistance to chlorantraniliprole between 2020 and 2022. Sun et al. (2023) found that RyR mutations (Y4667C, Y4667D, I4758M, and Y2891F) cause resistance to tetraniliprole and chlorantraniliprole in rice stem borers collected in the field. CRISPER-associated protein 9-mediated genome-modified flies revealed that the order of resistance contribution was Y4667D>G4915E>Y4667C≈I4758M>Y4891F. They also reported that combined mutations Y4667C and I4758M conferred greater resistance than Y4667C alone.

OBJECTIVES OF THESTUDY

The main aim of the study is to investigate the biophysical mechanisms ofresistance to the brinjal shoot & fruit borer, L. orbonalis.

RESEARCH METHODOLOGY

The current study, "Evaluation of the biophysical 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.

BIOPHYSICAL BASES OF RESISTANCE

Various biophysical characteristics in the selected accessions were investigated. Among the biophysical characteristics, trichome density on the shoot was discovered to influence L. orbonalis preference. Table 1 shows the density of trichomes on the shoots of selected brinjal accessions.

TABLE 1: ANTIBIOSIS STUDIES ON BRINJAL ACCESSIONS AGAINST *L. ORBONALIS*

SN	ACCESSIONS	LARVAL MORTALITY	LARVAL WEIGHT (G)	PUPAL WEIGHT(G)	TENUREOF LIFE STAGES(DAYS)*			
					LARVA	PUPA	ADULT	
							FEMALE	MALE
1	IC 546016	41.96 (6.44)	0.55 (0.74)	0.38 (0.63)	10.91 (19.15)	6.11 (14.23)	4.33 (11.93)	3.03 (9.96)
2	Banthar	40.17 (6.27)	0.58 (0.76)	0.43 (0.65)	11.01 (19.18)	6.31 (14.46)	4.54 (12.25)	3.06 (10.05)
3	IC 136297	38.33 (6.21)	0.61 (0.76)	0.43 (0.65)	11.71 (20.05)	6.51 (14.74)	4.27 (13.17)	3.26 (10.35)
4	IC 154571	37.61 (6.07)	0.65 (0.81)	0.45 (0.65)	11.91 (20.04)	6.61 (14.76)	5.36 (13.33)	3.52 (10.74)
5	IC 136302	30.15 (5.46)	0.68 (0.83)	0.46 (0.65)	12.02 (20.15)	6.71 (14.92)	5.47 (13.42)	3.58 (10.83)
6	IC 136177	24.91 (4.96)	0.74 (0.85)	0.47 (0.68)	12.97 (21.06)	7.01 (15.21)	5.68 (13.85)	3.84 (11.32)
7	Indiranagar Local	10.14 (3.16)	1.04 (1.01)	0.84 (0.91)	15.01 (22.66)	7.11 (15.51)	6.08 (14.17)	4.55 (12.25)
	SEd	0.12	0.01	0.01	0.37	0.25	0.24	0.18
	CD	0.27	0.04	0.03	0.81	0.56	0.48	0.41

The accession IC 546016 (941.05) had the most trichomes, followed by IC 136297 (880.58). Indiranagar Local (205.73) and IC 136177 (721. 06) had the fewest trichomes, whereas IC 546016 had the thinnest shoot (2.04 cm). The susceptible check Indiranagar Local had the highest shoot thickness (3.03 cm) (see Table 2).

TABLE 2: TRICHOME CHARACTERS OF SHOOTS OF SELECTED BRINJAL ACCESSION

SN	ACCESSIONS	TRICHOME DENSITY IN SHOOT/SQ.CM. (no.)	SHOOT THICKNESS (cm)	PERCENT SHOOT INFESTATION (%)*
1	IC 546016	941.05 (30.06)	2.04 (1.42)	10.06 (18.38)
2	Banthar	910.88 (29.92)	2.06 (1.44)	12.84 (20.78)
3	IC 136297	880.58 (29.76)	2.16 (1.45)	13.07 (21.26)
4	IC 154571	803.38 (28.15)	2.26 (1.47)	14.53 (22.24)
5	IC 136302	743.43 (27.13)	2.24 (1.48)	14.62 (22.35)
6	IC 136177	721.06 (26.78)	2.53 (1.58)	14.96 (22.72)
7	Indiranagar Local	205.73 (14.25)	3.03 (1.73)	20.16 (26.46)
	S Ed	0.53	0.03	0.38
	CD	1.11	0.05	0.83

When the trichome density of the selected shoots of brinjal accessions was estimated for the movement of third instar L. orbonalis larvae, it was discovered that the larvae spent the most time on the shoots of Banthar (16.86 sec.), followed by two accessions that were comparable, IC 546016 (15.74 sec.) and IC 136297 (13.04 sec.). The larvae spent the least amount of time on the shoots of Indiranagar Local (5.55 seconds), followed by IC 136177 (9.74 seconds). On trichome-removed shoot surfaces, larvae spent the most time on Banthar (11.32 sec.), followed by IC 546016 (9.34 sec.), IC 136297 (8.29 sec.), while the other two accessions, IC 154571 (7.21 sec.) and IC 136302 (7.19 sec.), were comparable. Among the accessions, IC 136177 inhibited larval mobility the most. (Table 3)

TABLE 3: IMPEDANCE OF *L. ORBONALIS* ON THE SHOOT ACCESSIONS

SN	ACCESSIONS	TIME TAKEN(SEC.)*	
		TRICHOME PRESENT	TRICHOME REMOVED
1	IC 546016	15.74 (3.95)	9.34 (3.04)
2	Banthar	16.86 (4.07)	11.32 (3.34)
3	IC 136297	13.04 (3.62)	8.28 (2.87)
4	IC 154571	10.37 (3.21)	7.22 (2.65)
5	IC 136302	10.03 (3.15)	7.18 (2.65)
6	IC 136177	9.74 (3.11)	6.91 (2.63)
7	Indiranagar Local	5.55 (2.34)	5.05 (2.22)
	SEd	0.06	0.05
	CD	0.14	0.12

An entrapment test was used to determine the effect of trichome density on L. orbonalis neonates. When neonates were permitted to move on the shoot surface after six hours of discharge, the accession Banthar had the highest mortality rate (47.05%), followed by IC 546016 (35.75%). Among the accessions, Indiranagar Local had the lowest mortality (10.97%), followed by IC 136177 (22.94%), while the trichome removed shoot surface had the highest mortality Banthar (15.33%), followed by 10.47 percent

in IC 546016 (10.47) and IC 136297 (10.47%). The susceptible check indiranagar Local showed no mortality, followed by IC 136177 (7.01%). (Table 4)

TABLE 4: ENTRAPMENT OF *L. ORBONALIS* ON THE SHOOT OF ACCESSIONS

SN	ACCESSIONS	LARVAL MORTALITY (%)	
		TRICHOME PRESENT	TRICHOME REMOVED
1	IC 546016	35.75 (36.48)	10.47 (17.73)
2	Banthar	47.05 (42.86)	15.33 (22.92)
3	IC 136297	28.84 (32.58)	8.35 (16.76)
4	IC 154571	25.56 (30.14)	7.98 (16.28)
5	IC 136302	23.21 (28.63)	7.21 (15.46)
6	IC 136177	22.94 (28.56)	7.01 (15.22)
7	Manapaarai Local	10.97 (19.18)	0.00 (0.00)
	SEd	0.78	0.41
	CD	1.66	0.86

Among the other plant characteristics, the highest plant height was measured in Indiranagar Local (110.21 cm) and IC 136177 (96.98 cm). The accession IC 546016 has a minimum height of 79.22 cm. The vulnerable check Indiranagar Local had the most primary branches (11.35), while IC 546016 had the fewest (5.85), followed by IC Banthar with 5.93. The susceptible check Indiranagar Local had more leaves and leaf area (99.11 & 79.02 cm^2), while IC 546016 had the shortest calyx length (3.47 cm) and the longest calyx length (5.16 cm) (Table 5).

TABLE 5: PLANT CHARACTERS OF BRINJAL ACCESSIONS

SN	ACCESSIONS	PLANT HEIGHT (cm)	NO. OF PRIMARY BRANCHES PER PLANT	NO. OF LEAVES PER PLANT	LEAFAREA (cm^2)	LENGTHOF PEDICEL (cm)	LENGTH OFCALYX (cm)
1	IC 546016	79.22 (8.85)	5.85 (2.41)	68.57 (8.24)	62.86 (7.87)	3.48 (1.85)	3.47 (1.86)
2	Banthar	83.03 (9.04)	5.93 (2.42)	78.05 (8.76)	64.75 (7.96)	3.63 (1.87)	3.48 (1.86)
3	IC 136297	88.94 (9.46)	6.31 (2.52)	80.16 (8.91)	70.94 (8.45)	3.86 (1.96)	3.57 (1.87)
4	IC 154571	92.53 (9.55)	6.71 (2.56)	83.27 (9.11)	73.27 (8.48)	3.87 (1.95)	3.58 (1.86)
5	IC 136302	96.37 (9.78)	6.96 (2.64)	87.26 (9.26)	73.86 (8.55)	3.91 (1.95)	3.62 (1.87)
6	IC 136177	96.98 (9.76)	7.32 (2.67)	90.17 (9.45)	73.98 (8.57)	3.96 (1.96)	3.66 (1.91)
7	Indiranagar Local	110.21 (10.44)	11.35 (3.35)	99.11 (9.85)	79.02 (8.83)	4.56 (2.13)	5.16 (2.23)
	SEd	0.16	0.04	0.16	0.16	0.04	0.04
	CD	0.35	0.11	0.35	0.34	0.06	0.07

Regarding the fruit characteristics, the fruit length was high in IC 136177 (6.62 cm), followed by IC 136302 (6.57 cm) and the accessions IC 154571 (6.56 cm), and the lowest fruit length was Indiranagar, IC 546016 whereas IC 136297, IC 136302, and IC 136177 all had similar fruit visual characteristics,

including a greenish purple colour in the fruit. IC 546016 had the smallest diameter (4.53 cm), while Indiranagar Local had the largest (6.32 cm), followed by IC 136177 (5.36 cm) and IC 154572. The quantity of exit holes indicates the level of infestation of shoot and fruit borer. The susceptible check Indiranagar Local had the most exit holes (7.51), while accession IC 546016 had the fewest (1.81) (Table 6).

TABLE 6: FRUIT CHARACTERS OF BRINJAL ACCESSIONS

SN	ACCESSIONS	LENGTH OF THE FRUIT (cm)	DIA. OF THE FRUIT (cm)	FRUIT COLOUR	FRUIT SHAPE	FLOWER COLOUR	NO. OF EXIT HOLES
1	IC 546016	6.25 (2.47)	4.53 (2.12)	Green	Oblong	Light violet	1.81 (1.34)
2	Banthar	6.28 (2.47)	4.93 (2.18)	Greenish purple	Oblong	Light Violet	2.21 (1.47)
3	IC 136297	6.52 (2.56)	4.97 (2.24)	Green	oval	White	2.31 (1.51)
4	IC 154571	6.56 (2.55)	4.55 (2.12)	Greenish purple	Oblong	Light violet	3.11 (1.76)
5	IC 136302	6.57 (2.56)	4.88 (2.25)	Green	Oval	White	3.61 (1.86)
6	IC 136177	6.62 (2.55)	5.36 (2.31)	Green	Oblong	White	3.71 (1.92)
7	Indiranagar Local	5.98 (2.41)	6.32 (2.45)	Greenish purple	Round	Light Violet	7.51 (2.05)
	SEd	0.04	0.04				0.03
	CD	0.11	0.07				0.06

After estimating the ash, moisture, wax, and total chlorophyll content of the selected brinjal accessions, it was discovered that the ash content was highest in accession IC 546016 (10.42%), followed by Banthar (9.95%), and the moisture content was highest in susceptible check Indiranagr Local (93.03%), followed by IC 136177 (84.93%). Accession IC 546016 had a high wax content (3.57 mg), followed by Banthar (3.05). In terms of chlorophyll content, Indiranagar Local had the highest concentration (7.21 mg), followed by IC 136177 (3.52 mg) (Table 7).

TABLE 7: ASH, MOISTURE, WAX AND CHLOROPHYLL CONTENTS OF BRINJAL ACCESSIONS AGAINST *L. ORBONALIS.*

SN	ACCESSIONS	ASH CONTENT (%)*	MOISTURE CONTENT (%)*	WAX CONTENT (mg/g)**	TOTAL CHLOROPHYLL CONTENT (mg/g)**
1	IC 546016	10.42 (18.72)	80.55 (63.31)	3.57 (1.87)	2.38 (1.54)
2	Banthar	9.95 (18.24)	81.26 (63.85)	3.05 (1.74)	2.65 (1.62)
3	IC 136297	9.06 (17.57)	81.53 (64.42)	2.94 (1.68)	2.93 (1.72)
4	IC 154571	8.74 (17.05)	81.95 (64.12)	2.76 (1.66)	3.42 (1.84)
5	IC 136302	8.67 (17.05)	82.05 (64.36)	2.54 (1.56)	3.48 (1.86)
6	IC 136177	8.56 (16.97)	84.93 (66.16)	2.37 (1.54)	3.52 (1.85)
7	Indiranagar Local	5.28 (13.23)	93.03 (75.45)	0.77 (0.86)	7.21 (2.66)
	SEd	0.35	2.13	0.04	0.04

	CD	0.73	4.43	0.06	0.06

In terms of nitrogen, phosphorous, potassium, and total soluble sugar content of selected brinjal accessions, indiranagar Local had the highest levels of nitrogen and phosphorous (2.02 mg and 1.03 mg, respectively), followed by IC 136177 (1.84 mg and 0.58 mg, respectively), while IC 546016 (0.36 mg) and Banthar (0.32 mg) had higher levels of potassium. The total soluble sugar concentration was lower in IC 546016 (6.57%) than in susceptible check Indiranagar Local (20.98%). (Table 8)

TABLE 8: NITROGEN, PHOSPHOROUS, POTASSIUM AND TOTAL SOLUBLE SUGAR CONTENTS OF BRINJAL ACCESSIONS

SN	ACCESSIONS	NITROGEN CONTENT (mg/g)*	PHOSPHORUS CONTENT (mg/g)*	POTASSIUM CONTENT (mg/g)*	TOTAL SOLUBLE SUGAR (%) #
1	IC 546016	1.03 (1.01)	0.37 (0.61)	0.36 (0.61)	6.57 (14.77)
2	Banthar	1.41 (1.15)	0.41 (0.63)	0.32 (0.55)	6.98 (15.18)
3	IC 136297	1.63 (1.25)	0.45 (0.66)	0.26 (0.52)	7.27 (15.71)
4	IC 154571	1.66 (1.27)	0.47 (0.67)	0.24 (0.46)	7.51 (15.76)
5	IC 136302	1.68 (1.28)	0.53 (0.72)	0.22 (0.46)	7.57 (15.88)
6	IC 136177	1.84 (1.35)	0.58 (0.75)	0.21 (0.45)	7.73 (16.08)
7	Indiranagar Local	2.02 (1.41)	1.03 (1.01)	0.04 (0.15)	20.98 (27.05)
	SEd	0.03	0.02	0.02	0.33
	CD	0.05	0.03	0.03	0.67

DISCUSSION

The biophysical characteristics of every insect pest determine its choice or non-preference for a particular crop type. The current investigation found that accession IC 546016 has the most trichomes, followed by Banthar. Indiranagar Local (Fig. 1, and 2) had the fewest trichomes, whereas IC 546016 had the thinnest shoots. The susceptible check Indiranagar Local has the highest shoot thickness recorded. (Fig. 3) The current findings are consistent with those of Amin et al. (2014), whotested six brinjal cultivars against L. orbonalis & discovered that the sensitive cultivar BARI brinjal-1 contained fewer trichomes (116.7) than the resistant variety BARI brinjal-6 (256.7).

Furthermore, Niranjana et al. (2015) discovered that less infested genotypes had the highest trichome density, while highly preferred genotypes had the fewest trichomes. The correlation analysis also revealed that L. orbonalis infestation was significantly negative correlated with number oftrichomes (r = -0.52) & positively correlatedwith shootthickness (r = 0.05).

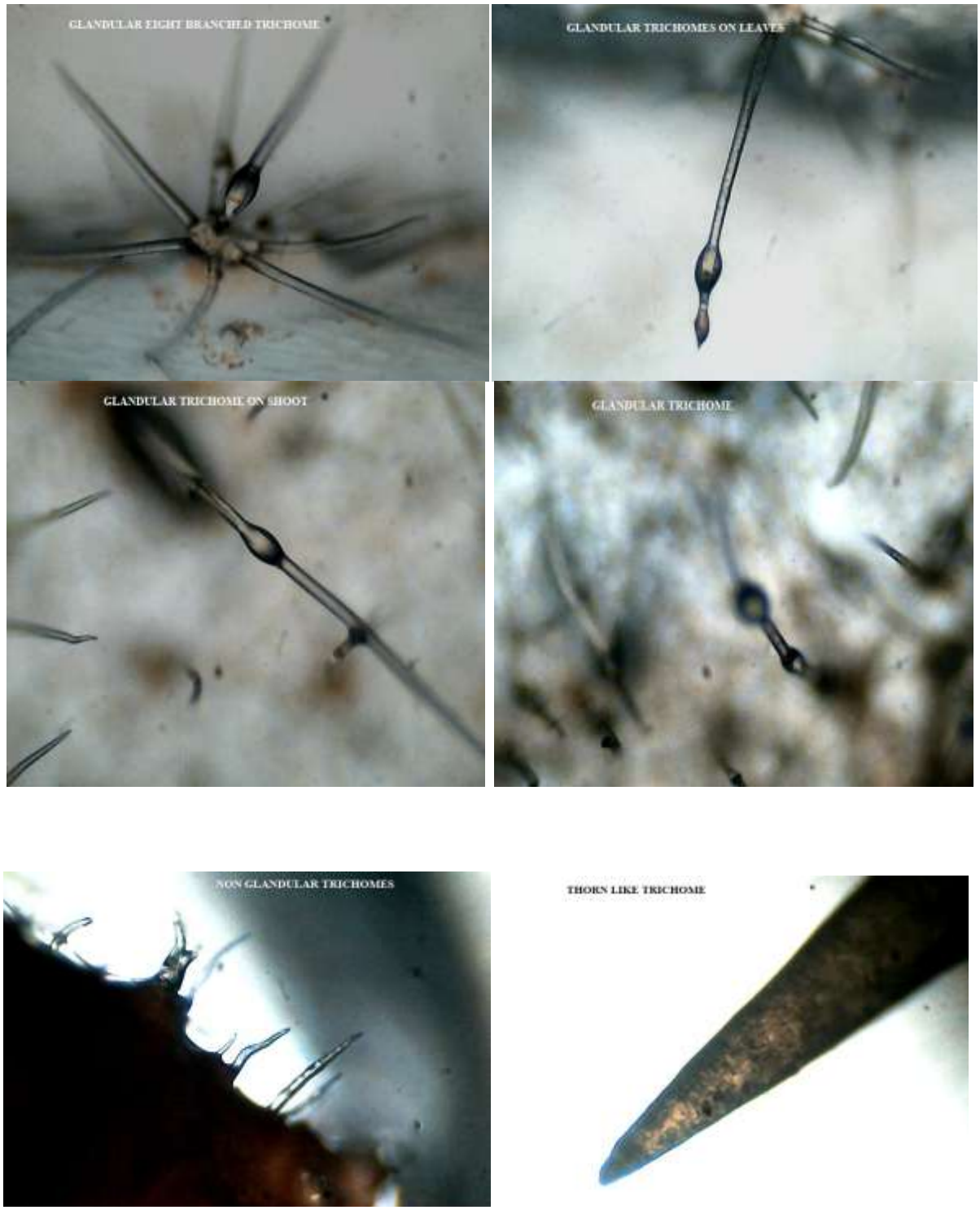
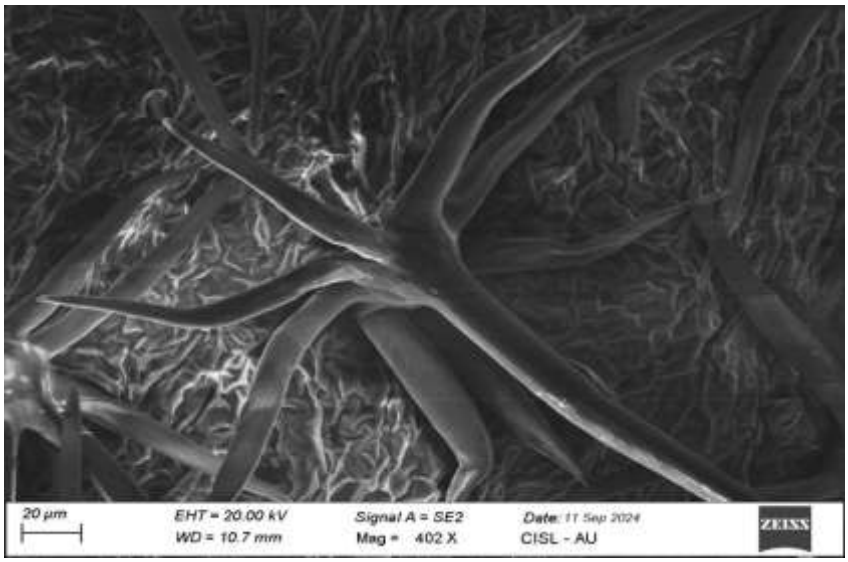
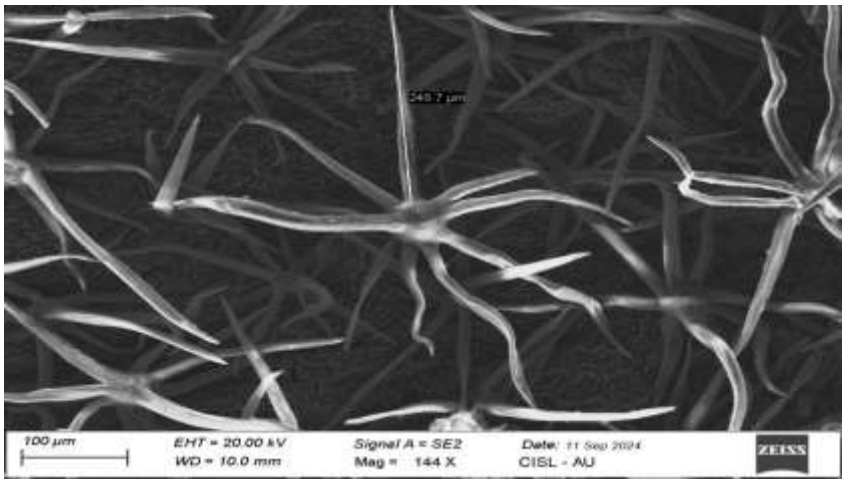
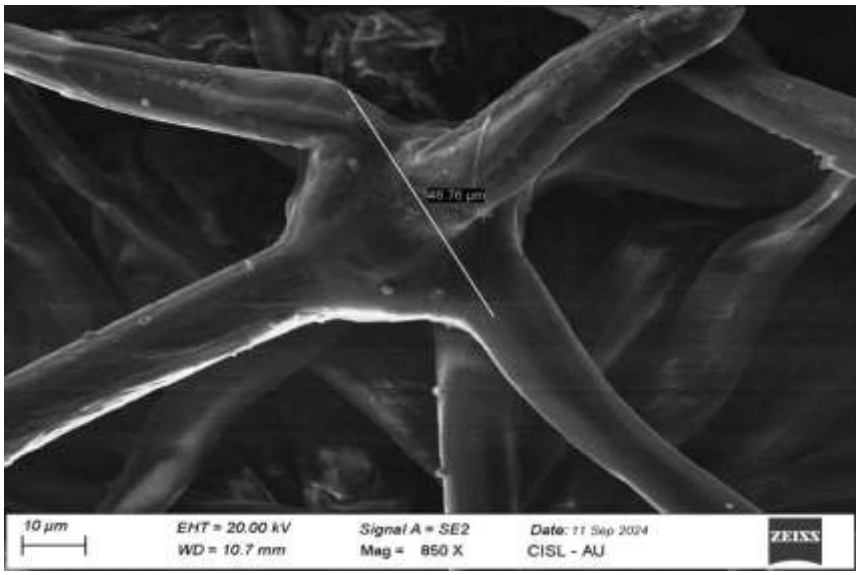


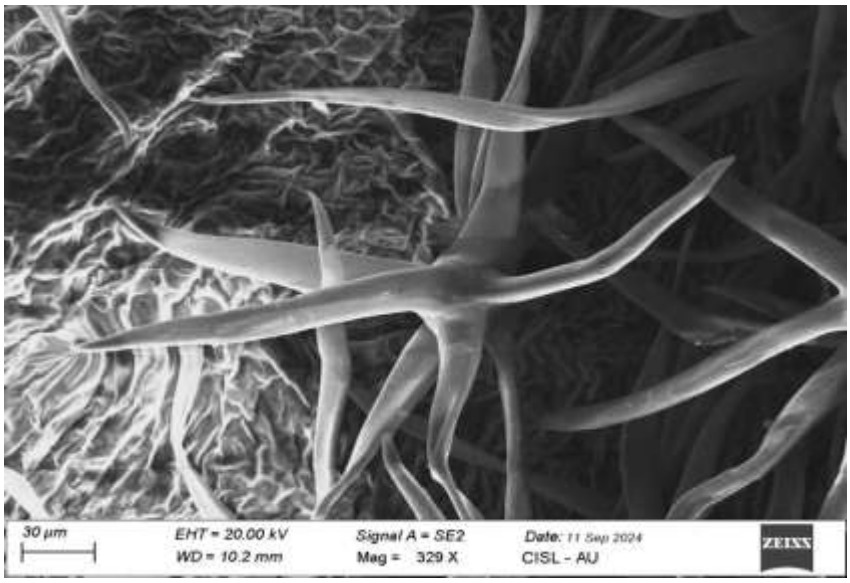
FIG. 1: TYPES OF TRICHOMES ON BRINJAL ACCESSIONS



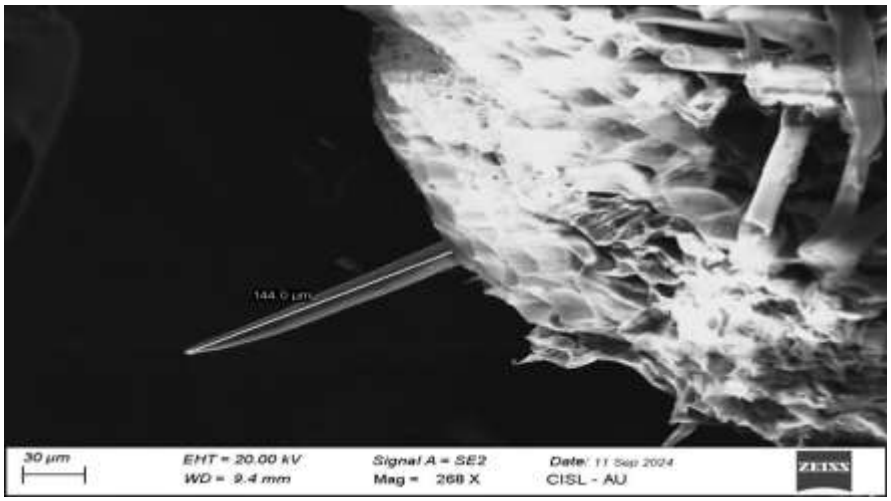


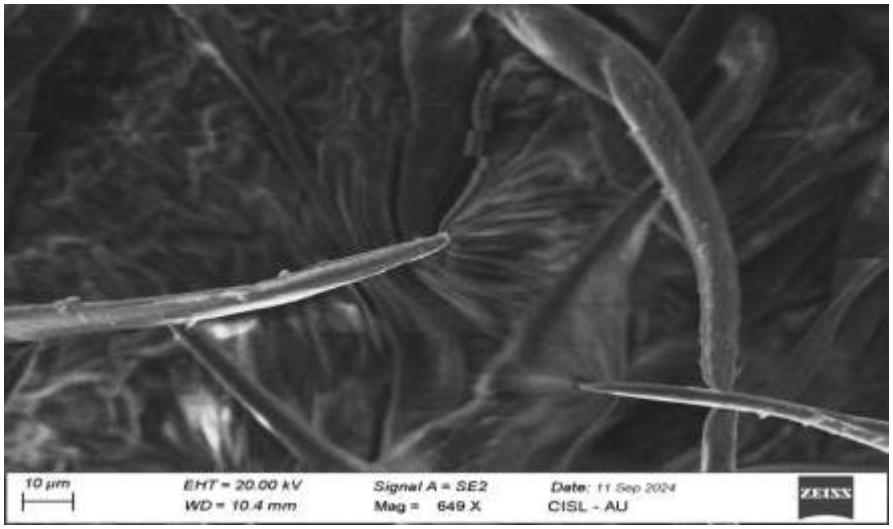
A)- EIGHT BRANCHED TRICHOME





B)- FOUR BRANCHED TRICHOME





C)- SINGLE NON GLANDULAR TRICHOME

FIG. 2: SCANNING ELECTRON MICROSCOPIC VIEW OF TRICHOMES ON SELECTED BRINJAL ACCESSIONS

Naqvi et al. (2009),Javed et al. (2011), & Wagh et al. (2012) all observed a negative,non-significant connection b/w shoot infestation & trichome density. Kale et al. (1986) and Ishaque Chaudhuri (1984a) proposed that presence of a largenumber of trichomes acts as abarrier for freshly hatched larvae from reaching boringsite, as seen inresistant brinjal types. Pandaet al. (1971), Ishaque & Chaudhuri (1984b),

& Patil and Ajri(1993) all found a substantial positive association between shoot thickness and L. orbonalis infection percentage. According to Jat & Pareek (2003); Naqvi et al. (2009); & Waghet al. (2012), thick shoots facilitate larval movement by providing more space, as well as enhance larval growth & development, making thick shoot vulnerable to L. orbonalis attack. In the entrapment test, accession IC 546016 had the highest neonatal mortality rate, followed by Banthar. This could be because the accessions' shoots have a higher amount of trichomes. Among the accessions, Indiranagar Local had the lowest death rate, followed by IC 136177. (Fig. 3) Furthermore, the findings are consistent with Oatman's (1959) observation that the resistance mechanism connected with structural plant features inhibits normal insect eating and oviposition, resulting in the action of mortality factors. Simmons et al. (2004) reported that

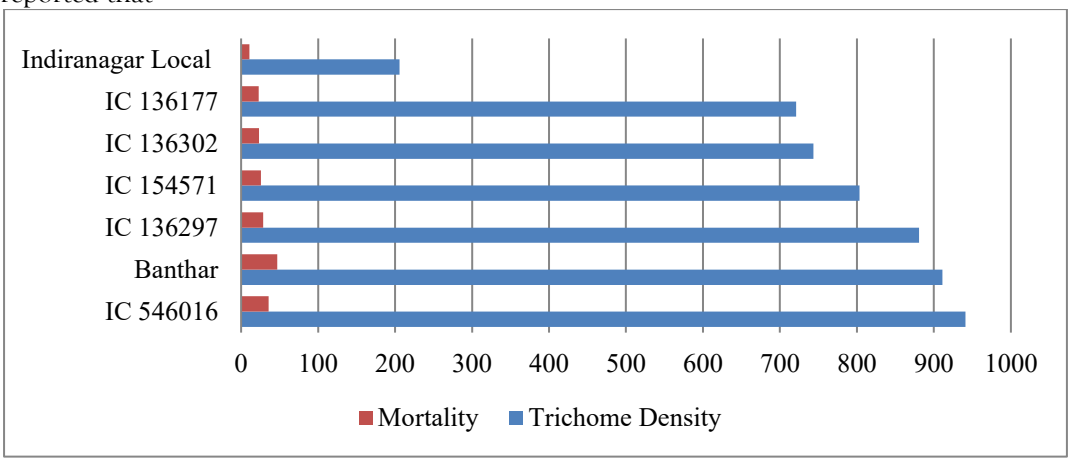


FIG. 3: INFLUENCE OF TRICHOMES ON IMPEDANCE OF LARVAE OF L. ORBONALIS

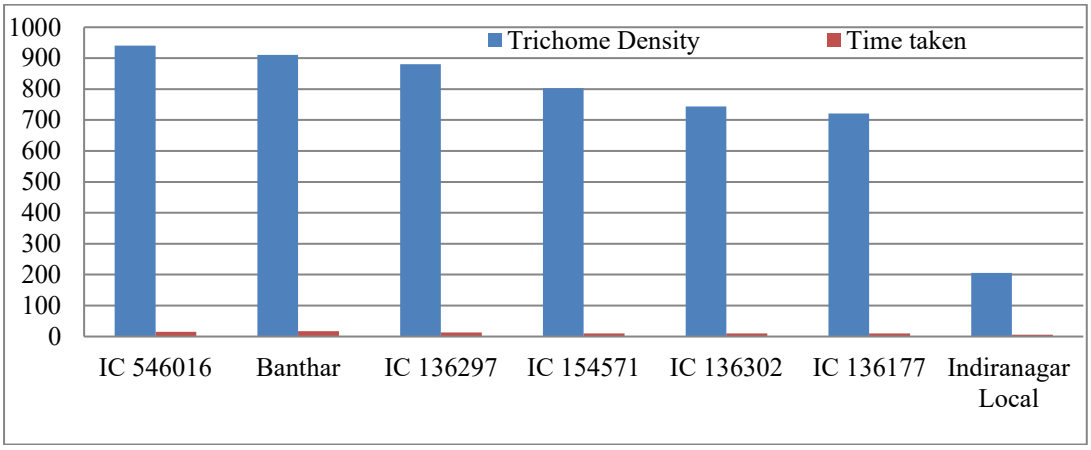


FIG. 4: INFLUENCE OF TRICHOMES ON ENTRAPMENT OF L. ORBONALIS

Landular trichomes also impede herbivore mobility by releasing sticky or toxic exudates that have the potential to capture insects on contact, resulting in death from starvation or toxicity. Leela Praveen and Mallikarjunarao (2020) discovered that Elokeshi, Black Beauty, Giant Banaors, and H-165 had extensive pubescence that makes them less appealing to freshly hatched L. orbonalis larvae. In terms of trichome density and shoot thickness, the resistant genotype O1 green had the most trichomes and the thinnest shoots, whereas the susceptible genotype PBSR-52 had the fewest trichomes and the thickest shoots (Patil and Hole, 2020). The susceptible check Indiranagar Local had more leaves and leaf area, whereas IC 546016 had a short calyx, with Indiranagar Local having the longest (5.16 cm).The simple correlation study revealed a substantial positive association between biophysical characteristics and % shoot infection of L. orbonalis. Plant height (r = 0.98), number of primary branches (r = 0.883), number of leaves per plant (r = 0.952), leaf area (r = 0.918), and length of pedicel (r = 0.978), as well as fruit diameter (r = 0.858), length of the fruit (r = 0.848), calyx length (r = 0.867), and exit holes (r = 0.906), all had asignificant positive correlationwith percent fruit infestation of L. orbonalis. The current findings areconsistent with those of Ahmad et al. (2009), who investigated the relationship between brinjal biophysical characteristics and L. orbonalis infestation levels. The shoot infestation ratewas shown to bepositively linked with plantheight (r = 0.407), stemdiameter (r = 0.520), & the numberof branches per plant (r = 0.478). In terms of fruit characteristics, the fruit length was highest in IC 136177, followed by IC 136302, and the

lowest in IC 546016. The diameter of the fruit was greatest in susceptible check Indiranagar Local, followed by IC 136177, while the smallest diameter was found in IC 546016.(Fig. 5) Other fruit visual characteristics, such as fruit hue green, were similar across five accessions (Banthar, IC 546016, IC 136297, IC 136302, and IC 136177). Greenish purple fruit was discovered in two accessions: Banthar, and Indiranagar Local. The accession IC 546016 was green, while IC 136297 was green with white streaks. The presence of exit holes is an indicator of the infection intensity of shoot and fruit borer, with the maximum number of exit holes are noted in susceptible check Indiranagar Local, and accession IC 546016 has the fewest exit holes.

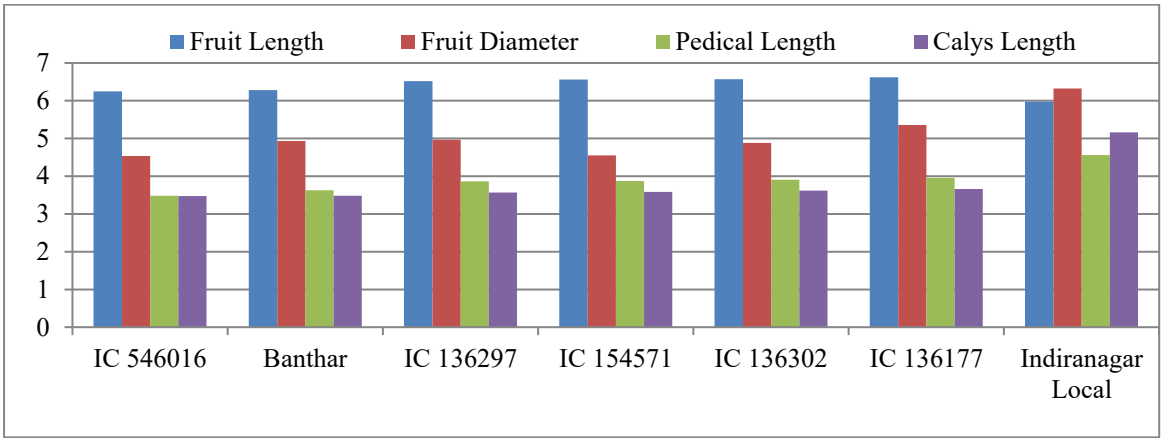


FIG. 5: FRUIT CHARACTERS OF SELECTED BRINJAL ACCESSIONS

CONCLUSIONS

This paper summarizes the data from the study titled "Evaluation of the biophysical basis of resistance against brinjal shoot and fruit borer, L. orbonalis." L. orbonalis feeding and ovipositional preferences show a significant negative connection with trichome density. A significant negative association was found between trichome density, impedance, and entrapment of L. orbonalis larvae. Indiranagar Local and IC 136177 plants had the highest plant height, primary branch count, and calyx length. IC 136177 had the longest fruit length, followed by Indiranagar Local, which also had the largest fruit diameter. Indiranagar Local had the highest moisture content, while IC 546016 had the most wax and ash content. Indiranagar Local also had the most chlorophyll. Total chlorophyll and moisture content were shown to have a strong positive connection with L. orbonalis infestation rates. A significant negative connection was found between surface wax and ash content and mean percent infestation of L. orbonalis. A negative association was found between total soluble sugar, nitrogen, and phosphorus levels and L. orbonalis infestation rates. Potassium levels showed a substantial negative connection with L. orbonalis infestation rates.

REFERENCES

1. FMC Corporation [Food, Machinery, and Chemical Corporation]. 2021. Annual report 2021. Food, Machinery, and Chemical Corporation, Philadelphia, 104 p.
2. Hedge JN, Girish R and Swami K. 2012. Integrated management of brinjal shoot and fruit borer. Proceeding International Conference on Horticulture on Horticulture for livelihood security and economic growth, Nov 9-12, 2009, University for Agricultural Sciences, 1103-1107.
3. Dandapani N and Shelkar R. 2013. Biointensive pest management in major vegetable crops: An Indian perspective, Food, Agriculture and Environment. 1(2): 333-339.
4. Choudhary, R. S., Rana, B. S., Kumar, A., Murdia, A and Singh, B. 2018. Screening of brinjal varieties against, Leucinodes orbonalis (Guenee) infestation. Journal of Entomology and Zoology Studies. 6(2): 194-198.
5. Harish, D. K., Agasimani, A. K., Imamsaheb, S. J., Patil and Satish, S. 2011. Growth and yield parameters in brinjal as influenced by organic nutrient management and plant protection conditions. Research Journal of Agricultural Sciences. 2 (2): 221-225.
6. Aykroyd WR. 1963. The nutritive value of Indian foods and the planning of satisfactory diets. ICMR, Special Report. Series No. 42.
7. National Horticultural Board. 2018. Area and production of Horticultural Crops. Available: https://nhb.gov.in/statistics/State Level/2018- 19%20(3rd%20Adv. Est)%20-%20Website.pdf [05 Nov. 2022]
8. Vavilov, N. I. 1928. Proceedings of the 5th International Congress of Genetics. New York. p. 34-69.
9. Indiastat. Ministry of Agriculture and Farmers Welfare, Government of India, 2021. (https://www.indiastat.com/table/agriculture/season wise), Accessed on 01/06/2022.
10. SharayuPatil and Uttam Hole. 2021. Biochemical basis of resistance in brinjal to Leucinodes orbonalis Guenee and their correlation with shoot and fruit damage. The Pharma Innovation Journal. 10(7): 556-573.

11. Hazra, P., Dutta, R and Maity, T. K. 2004. Morphological and biochemical characters associated with field tolerance of brinjal (Solanum melongena L.) to shoot and fruit borer (Leucinodes orbonalis G.) and their implication in breeding for tolerance. Indian Journal of Genetics and Plant Breeding. 64 (3): 255- 256.
12. Elanchezhyan, K., Murali Baskaran, R. K. and Rajavel, D. S. 2008. Field screening of brinjal varieties on major pests and their natural enemies. Journal of Biopesticides. 1(2):113-120.
13. Chandrashekhar, C. H., Malik, H. S and Singh, R. 2009. Morphological and biochemical factors of resistance in eggplant against Leucinodes orbonalis G. (Lepidoptera: Pyralidae). Entomologia Generalis. 31 (4): 337-345.
14. Prasad, T. V., Bhardwaj, R., Gangopadhyay, K. K., Arivalagan, M., Bag, M. K., Meena, B. L and Dutta, M. 2014. Biophysical and biochemical basis of resistance to fruit and shoot borer (Leucinodes orbonalis Guenee) in eggplant. Indian Journal of Horticulture. 71(1):67-71.
15. Niranjana, R. F., Devi, M., Shanika, W and Philip Sridhar, R. 2015. Influence of biophysical characteristics of brinjal varieties on the infestation of brinjal shoot and fruit borer, Leucinodes orbonalis Guenee. Journal of University of Ruhuna.1: 21-28.
16. Rishi RK, Singh TK and Shah MAS. 2018. Biology of brinjal shoot and fruit borer, Leucinodes orbonalis Guen (Lepidoptera: Pyralidae). National journal of Life Sciences, 7: 77-79.
17. Kumar M and Ram HH. 2019. Path analysis for shoot and fruit borer resistance in brinjal (S. melongena), Annual Agricultural Research, 19: 269-72.
18. Muhammadet Abdullah Shauket, Muhammad Waquar Hussan, Umar Hayat and Gulraiz Malik. 2020. Screening of different eggplant (Solanum melongena L.) varieties for resistance against eggplant shoot and fruit borer Leucinodes orbonalis G. (Lepidoptera: Pyralidae) under semi-arid conditions. Pakistan Entomologist. 42(1): 17-24.
19. Leela Praveen, S and Mallikarjunarao, K. 2020. Assessment of biophysical and biochemical bases of resistance in brinjal against major insect pests. Journal of Pharmacognosy and Phytochemistry: sp9(2): 428- 433.
20. Patil, S. K. 2020. Screening of brinjal varieties for resistance to major insect pests. Journal of Entomolgy and Zoology Studies. 8(1): 1484-1489.
21. Lipsa Dash, Ladu Kishore Rath and Gouri Shankar Sahu. 2021. Antixenosis mechanism of resistance in certain selected brinjal germplasm for resistance to brinjal shoot and fruit borer. The Pharma Innovation Journal. 10(8): 443-447.
22. Amit Kumar, Uma Shankar and VirendarKaul. 2022. Seasonal incidence of brinjal shoot and fruit borer and red spider mite with their natural enemies' fauna in brinjal crop ecosystem. International Journal of Tropical Insect Science. 42(1): 133-144.
23. Elias Oliveira Padovez, F., Hideo Kanno, R., Omoto, C., and Sartori Guidolin, A. 2022. Fitness costs associated with chlorantraniliprole resistance in Spodoptera frugiperda (Lepidoptera: Noctuidae) strains with different genetic backgrounds. Pest Manag. Sci.78(3): 1279-1286.
24. Sun, H., Wang, S., Liu, C., Hu, W. K., Liu, J. W., Zheng, L. J., Gao, M. Y., Guo, F. R., Qiao, S. T., Liu, J. L., and Sun, B. 2023. Risk assessment, fitness cost, cross- resistance, and mechanism of tetraniliprole resistance in the rice stem borer, Chilo Sci. [e-journal]. suppressalis. Insect Available: https://onlinelibrary.wiley.com/doi/full/10.1111/1744-7917.13282.