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RESEARCH ARTICLE

Influence of biophysical characteristics of brinjal varieties on the infestation of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenée

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Abstract: A study was conducted during summer 2014 (February – May, 2014) and *Rabi*, 2014 (September, 2014 - January, 2015) at Vegetable Research Station, Palur, Tamil Nadu, India to find the relationship between biophysical characteristics of brinjal genotypes and infestation of *Leucinodes orbonalis* by screening 35 germplasm of brinjal. Thirty five germplasm were planted in the field having three replications of 05 plants for each treatment. The biophysical characteristics of brinjal genotypes *viz*., shoot thickness at 2.5 cm below the tip, number of trichomes on under surface of leaves, length of pedicel, calyx and fruit, and diameter of fruit were measured to correlate them with level of infestation by *L. orbonalis*. At the time of harvesting the per cent infestation of fruit were calculated. The results revealed that the shoot infestation by *L. orbonalis* negatively, but not significantly correlated with number of trichomes on leaves (r = -0.52) and positively correlated with shoot thickness (r = 0.05). Fruit infestation was positively but not significantly correlated with length of pedicel (r = 0.03) and calyx (r = 0.24) whereas non-significant and negative correlation was recorded between fruit infestation and fruit characters *viz.*, length of fruit (r = -0.25) and diameter of fruit (r = -0.04). The shape and colour of fruit had no significant influence on the level of infestation

Keywords: *Biophysical characters, brinjal varieties, Leucinodes orbonalis infestation, Screening varieties*

Introduction

Brinjal (*Solanum melongena* Linnaeus) is an important and widely grown vegetable crop in tropical and subtropical countries of the world (Choudhary, 1967). The brinjal shoot and fruit borer, *Leucinodes orbonalis* is the most destructive pest in major brinjal cultivating countries of South Asia with the yield loss up to 60-80 per cent (Krishnaiah and Vijay, 1975; Kaur et al., 2010). Since the larvae inhabit inside the plant shoots or fruits management of this pest becomes difficult (Alam et al., 2003). Currently, farmers rely solely on the application of pesticides to control *L. orbonalis* and to get maximum yield of blemish-free brinjal.

This practice of indiscriminate use of pesticides threatens the health of farmers and consumers through environmental contamination, bioaccumulation and biomagnification of toxic residues, and disturbance in ecological balance (Dadmal et al., 2004). Hence, there is an urgent need to develop safe pest management strategies in pest control programmes of brinjal. The study was conducted at Vegetable Research Station, Palur, Tamil Nadu, India to find the correlation between biophysical characters of brinjal germplasm and infestation level of *L. orbonalis*.

Materials and methods

Screening of brinjal germplasm

Field experiments were carried out during summer 2014 (February – May, 2014) and *Rabi*, 2014

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(September, 2014 - January, 2015) at Vegetable Research Station, Palur, Tamil Nadu, India. The experiment was laid in a randomized block design (RBD) with three replications. A total of 35 germplasm of brinjal were tested to find out the correlation between biophysical characteristics of genotypes against brinjal shoot and fruit borer infestation.

Thirty days old seedlings were transplanted with a spacing of 90 X 60 cm by maintaining 15 plants per replication and a total of 45 plants per genotype. After transplanting five randomly selected plants from each genotype were tagged to record the total number of shoots per plant and the number of infested shoots (withered tender shoot) per plant. The observations on shoot infestation were taken at fortnightly intervals up to the fruiting stage. To record thickness of the shoot 05 randomly selected shoots per plant were taken for measuring their girth at 2.5 cm below the tip at vegetative phase. To determine the number of trichomes on lower surface of leaves, leaves on the apical region of the brinjal plants were selected as female moths of *L. orbonalis* prefer tender shoots for egg laying. Five plants from each genotype and from each selected plant two leaf samples of 2 cm^2 area were taken to count the number of trichomes (Naqvi et al., 2008).

Five matured fruits per plant were randomly selected to measure the length of pedicel and calyx with the help of a scale. Likewise five brinjal plants were selected from each genotype to do this study. Pedicel length was taken from point of attachment with the plant to the base of calyx whereas length of calyx was measured from the base of calyx up to the tip.

At the time of harvesting, the fruits of each plot were harvested separately and numbers of healthy and infested fruits those had holes or faecal of *L. orbonalis* per plot were counted. The observations were taken at each pick of 10 days interval until 13^{th} pick. At the time of each harvesting, five mature fruits in average size were selected from each germplasm and replication to measure the length and diameter of fruits.

Analysis of data

Trichome density (number/cm^2) of leaves was worked out as per the method suggested by Naqvi et al., (2008). Simple linear correlation analysis was undertaken to find the relationship between biophysical characteristics of brinjal and brinjal shoot and fruit infestation. Besides, Analysis of variance was carried out to determine differences in percentage infestation among the brinjal germplasm.

Results and Discussion

Biophysical characters of brinjal in relation to shoot infestation of *L.* orbonalis

The mean number of shoots infested in 35 genotypes of brinjal ranged 2.97 - 16.42 per cent (Table 1). Kallakurichi germplasm recorded the maximum shoot infestation (16.42%). The lowest infestation of 2.97 % was registered in Sm 143, which was not significantly different to Samrat, Sm 101, Sm 30, Sm 120, Rituraj, Sm 60, Sm 79, Sm 21, Sm 131, Sm 166, Sm 109, Sm 104, Nagarkoil local, Sm 84, Sm 26, Sm 10, Sm 136 and Sm 87. It was revealed that maximum trichome density was found in less infested genotypes and there were four different types of trichomes in those (Plate 1). The correlation analysis showed that shoot infestation by L. orbonalis in brinjal was negatively, but not significantly correlated with the number of trichomes on leaves (r = -0.52) and positively correlated with shoot thickness (r = 0.05) (Table 2).

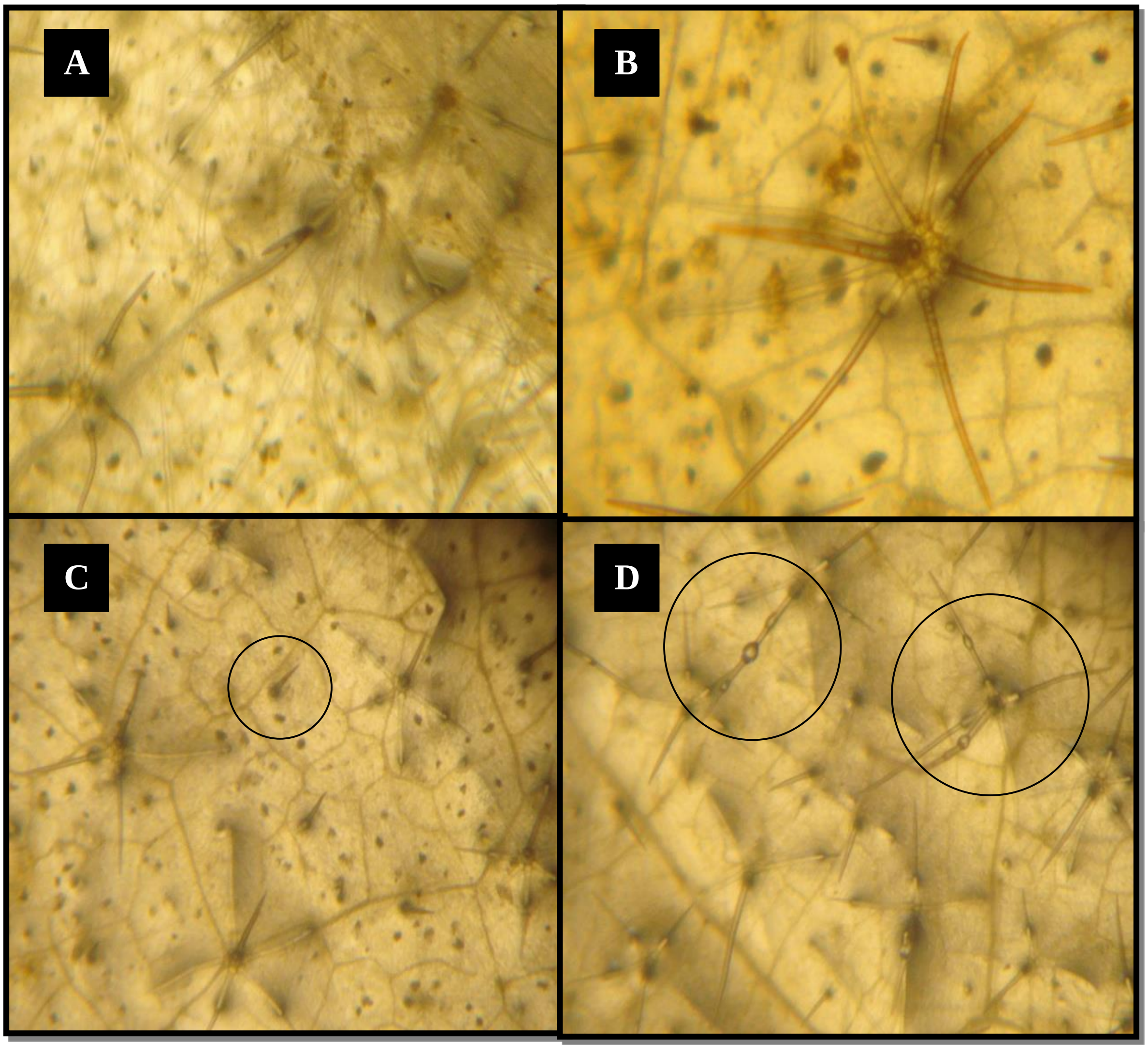
Table 2. Correlation between biophysical characters of brinjal germplasms and infestation of shoot and fruit borer, *L. orbonalis*

Biophysical characters of brinjal germplasms	Correlation coefficient (r)
Trichome density	-0.52
Shoot thickness	0.05
Length of pedicel	0.03
Length of calyx	0.24
Length of fruit	-0.25
Diameter of fruit	-0.04

A negative non-significant correlation between shoot infestation and trichome density was also reported by Naqvi et al., (2009); Javed et al., (2011) and Wage et al., (2012). Further, Kale et al., (1986) observed dense trichomes in immune and wild cultivars. Panda and Das (1974); Ishaque and Chaudhuri (1984); and Kale et al., (1986) suggested that presence of large number of hairs on lower surface of leaf act as a barrier for newly hatched larvae to reach the boring site as observed in resistant varieties.

A positive relationship between the thickness of shoot and the pest infestation was also reported by Panda et al., (1971), Ishaque and Chaudhuri (1984), Patil and Ajri (1993), Jat and Pareek (2003), Hazra et al., (2004); Naqvi et al., (2009) and Wage et al., (2012). The authors has discussed that thick shoots facilitate the movement of larvae by providing more space and also enhance the growth and development of larvae thereby making the thick shoots vulnerable to the attack of shoot borer.

Plate 1. Different types of trichomes found in leaves of less infested brinjal genotypes



A Non-glandular four-branched trichome
B Non-glandular eight-branched trichome
C. on-glandular thorn like trichome
D. Glandular trichome

Table 1. Biophysical characters of brinjal shoots in relation to *L. orbonalis* infestation

Brinjal Germplasm	**Trichome density (no./cm^2)***	**Shoot thickness* (cm)**	**Per cent shoot infestation***
Kallakurichi	825.52 (28.73)^{p}	2.63 (1.60)^{ab}	16.44 (23.88)^{h}
Samrat	1235.63 (35.15)^{j}	2.31 (1.53)^{a}	3.41 (10.67)^{ab}
Nagarkoil local	2125.32 (46.14)^{b}	3.42 (1.84)^{defghijk}	6.32 (14.55)^{abcdef}
Rituraj	1405.67 (37.49)^{f}	3.01 (1.73)^{ce}	5.31 (13.35)^{abcde}
Sm 10	735.66 (27.12)^{s}	3.62 (1.90)^{ghijkl}	6.63 (14.88)^{abcdef}
Sm 11	630.51 (25.11)^{w}	4.23 (2.05)^{n}	7.72 (16.15)^{bcdefgh}
Sm 16	755.60 (27.49)^{r}	3.22 (1.79)^{efg}	6.64 (14.91^{abcdef}
Sm 19	85.92 (9.25)$^{\beta}$	3.81 (1.95)^{klmn}	7.52 (15.88)^{bcdefgh}
Sm 20	825.63 (28.73)$^{'\Omega}$	4.11 (2.02)^{mn}	16.42 (23.90)^{gh}
Sm 21	890.19 (29.84)^{o}	3.23 (1.78)^{efg}	5.63 (13.66)^{abc}
Sm 22	255.64 (15.99)$^{\sim}$	3.87 (1.94)^{jklmn}	7.32 (15.69)^{bcdefg}
Sm 25	325.62 (18.04)^{y}	3.33 (1.81)^{efghi}	13.55 (21.58)^{efgh}
Sm 26	925.23 (30.42)^{m}	3.82 (1.95)^{klmn}	6.52 (14.74)^{abcdef}
Sm 30	1305.25 (36.13)^{i}	3.01 (1.74)^{cdef}	5.01 (12.89)^{abcd}
Sm 40	685.33 (26.18)^{t}	3.83 (1.95)^{klmn}	8.43 (16.83)^{cdefgh}
Sm 46	650.67 (25.51)^{v}	2.72 (1.64)^{abc}	14.21 (22.10)^{fgh}
Sm 60	1210.63 (34.79)^{k}	3.95 (1.97)^{mn}	5.36 (13.34)^{abcdef}
Sm 62	445.66 (21.11)^{z}	3.74 (1.91)^{hijklm}	7.12 (15.48)^{bcdef}
Sm 69	185.12 (13.62)^{c}	2.71 (1.66)^{bcd}	8.63 (17.01)^{cdefgh}
Sm 75	600.10 (24.51)^{x}	3.37 (1.82)^{efghij}	11.11 (19.45)^{defgh}
Sm 79	1325.65 (36.41)^{h}	3.26 (1.78)^{efg}	5.55 (13.50)^{abcdef}
Sm 84	675.63 (25.99)^{u}	3.44 (1.84)^{efghijk}	6.42 (14.63)^{abcdef}
Sm 87	855.72 (29.25)^{p}	3.73 (1.93)^{jklm}	7.09 (15.33)^{abcdef}
Sm 101	1825.61 (42.73)^{c}	3.22 (1.79)^{efg}	4.18 (11.69)^{ab}
Sm 104	925.44 (30.42)^{m}	3.21 (1.78)^{efg}	5.94 (14.02)^{abcdef}
Sm 109	910.11 (30.17)^{n}	3.56 (1.86)^{fghijkl}	5.82 (13.92)^{abcdef}
Sm 120	1625.42 (40.32)^{d}	3.73 (1.92)^{ijklm}	5.17 (13.06)^{abcd}
Sm 131	1485.63 (38.54)^{e}	3.92 (1.97)^{lmn}	5.63 (13.64)^{abcdef}
Sm 132	185.51 (13.62) $^{'\Omega}$	3.73 (1.93)^{jklm}	12.16 (20.33)^{efgh}
Sm 133	260.62 (16.14)$^{\}}$	3.11 (1.76)^{def}	8.84 (17.21)^{bcdefg}
Sm 134	280.73 (16.75)^{z}	3.32 (1.82)^{efighj}	7.26 (15.56)^{bcdefg}
Sm 136	1160.63 (34.07)^{l}	3.14 (1.76)^{def}	6.82 (15.14)^{abcdef}
Sm 141	455.92 (21.35)^{y}	3.55 (1.87)^{fghijkl}	8.94 (17.34)^{defgh}
Sm 143	2385.62 (48.84)^{a}	3.13 (1.75)^{def}	2.97 (9.76)^{a}
Sm 166	1345.34 (36.68)^{g}	3.37 (1.82)^{efgh}	5.76 (13.85)^{abc}
SE	29.86	0.04	1.59
CD (0.05%)	0.23	0.12	7.87

*Values are mean of three replications.

Values in parentheses are arcsine or square root ($\sqrt{x+0.5}$) transformations.

In each column, means with similar alphabets do not vary significantly at P=0.05 by DMRT

Biophysical characters of brinjal in relation to fruit infestation by *L. orbonalis*

The data (Table 3) revealed that the brinjal germplasm, Sm 143 recorded for the lowest fruit infestation (5.04%) which was statistically non significant to the fruit infestation recorded in germplasms, Sm 26 (6.71 %), Sm 60 (8.02 %), Sm 84 (12.31 %), Sm 79 (14.24 %), Sm 87 (15.66 %), Sm 22 (15.96 %), Sm 69 (16.32 %) and Sm 101 (16.74 %). Further, maximum fruit infestation was observed in Nagarkoil local (68.31 %).

The correlation analysis (Table 2) showed that fruit infestation was positively but not significantly correlated with length of pedicel ($r = 0.03$) and calyx ($r = 0.24$) of fruit. It clearly demonstrated that germplasm consisted of long fruits pedicel and calyx was more susceptible than those with short ones helping the neonate larvae to hide and get easily into the fruit through the soft tissue below the calyx.. The present findings are in conformity with studies of Patil and Ajri (1993) and Wage et al., (2012).

Further, the study revealed that there was a negative correlation between fruit infestation and fruit characters viz., length ($r = -0.25$) and diameter ($r = -0.04$) of fruit (Table 2). Grewal and Singh (1995), Gupta and Kauntey (2008) and Wage et al., (2012) has reported that there was no linear correlation between length and diameter of fruits, and degree of fruit infestation although the varieties with narrow pericarp were found less susceptible. In contrast Chandrashekhar et al., (2009) reported highly significant and positive correlation between pericarp thickness and fruit infestation. Ishaque and Chaudhuri (1984) and Naqvi et al., (2009) observed that resistance against *L. orbonalis* infestation in long fruited genotypes whereas Subbaratnam (1982) and Naqvi et al.,, (2009) found highly significant and positive correlation between fruit diameter and degree of fruit infestation.

It was noted from the present study that the shape and colour of fruit had no significant influence on the level of infestation. The germplasms, Sm 143 and Nagarkoil local recorded lowest and highest fruit infestations respectively which had round fruits with light purple with white shaded colour. Lal et al.,, (1976) and Wage et al.,, (2012) also stated that there was no impact of colour of fruits of brinjal germplasms on the infestation of fruit borer.

Conclusion

The brinjal germplasm with low shoot thickness, short pedicel and calyx of fruit with higher trichome density were less susceptible to the infestation of *L. orbonalis.* These findings should be considered in developing resistant varieties for *L. orbonalis* in breeding programmes.

Table 3. Biophysical characters of brinjal fruits in relation to *L. orbonalis* infestation

Brinjal Germplasm	Fruit colour	Shape	Length of pedicel* (cm)	Length of calyx* (cm)	Length of fruit* (cm)	Diameter of fruit* (cm)	Per cent fruit infestation*
Kallakurichi	Light purple with white shade	round	4.16	3.62	6.92	13.66	42.01^{ghijklm}
Samrat	Blakish purple	long	6.12	3.73	9.99	9.54	33.00^{efghijklm}
Nagarkoil local	Light purple with white shade	round	5.13	3.76	5.87	20.11	68.31^{o}
Rituraj	Blakish purple	round	5.26	3.11	6.85	19.94	46.83^{klmn}
Sm 10	Light purple with white shade	oval	5.04	3.38	7.56	17.54	21.36^{cdefghij}
Sm 11	Blakish purple	round	3.92	2.75	5.34	13.93	40.76^{hijklmn}
Sm 16	Blakish purple	round	4.14	2.46	6.16	14.48	25.74^{defghijkl}
Sm 19	White with purple shade	round	3.74	3.74	7.26	20.06	38.02^{efghijklm}
Sm 20	Light purple	long	5.34	3.44	11.58	23.08	22.31^{bcdefghi}
Sm 21	Light purple with white shade	round	5.18	4.56	6.98	22.12	49.34^{lmno}
Sm 22	White	round	4.77	3.36	7.46	21.12	15.96^{abcde}
Sm 25	Purple	oblong	3.84	2.72	5.75	15.12	60.02^{no}
Sm 26	Purple	round	4.08	2.76	5.93	15.36	6.71^{abc}
Sm 30	Light purple with white shade	oblong	4.44	3.22	11.42	17.12	35.96^{fghijklm}
Sm 40	White	round	5.44	3.53	7.72	18.96	49.34^{lmno}
Sm 46	Light purple	round	2.68	3.74	6.74	13.24	44.76^{lmno}
Sm 60	Purple	round	4.39	3.18	11.20	24.34	8.02^{ab}
Sm 62	Greenish white	oval	3.86	3.23	6.31	14.64	20.73^{bcdefgh}
Sm 69	Green	oblong	3.14	2.34	6.22	14.08	16.32^{abcdef}
Sm 75	Light purple	oval	3.62	2.66	6.76	20.68	20.35^{bcdefghi}
Sm 79	Greenish white	oval	4.04	2.88	5.96	14.58	14.24^{abcde}
Sm 84	Light purple with white shade	round	4.94	2.52	7.43	16.44	12.31^{abcde}
Sm 87	Light purple with white shade	oblong	5.52	4.18	6.72	18.94	15.66^{abcde}
Sm 101	White	round	6.26	3.76	6.94	16.46	16.74^{abcd}
Sm 104	White	round	4.46	2.94	7.5	17.32	42.03^{ghijklm}
Sm 109	Blakish purple	oblong	5.74	3.11	6.94	17.74	18.04^{bcdefg}
Sm 120	White	round	4.56	3.34	6.88	18.28	33.74^{efghijklm}
Sm 131	Blakish purple	oblong	4.74	3.16	5.87	17.16	37.96^{ghijklm}
Sm 132	Light purple with white shade	oblong	4.32	2.56	6.14	14.96	55.34^{mno}
Sm 133	Light purple	long	4.74	2.95	10.35	9.98	23.02^{defghijk}
Sm 134	Purple	oblong	5.77	4.06	6.52	19.52	41.74^{ijklmn}
Sm 136	Light purple with white shade	oblong	5.64	3.56	6.32	20.38	36.74^{fghijklm}
Sm 141	White	round	4.24	2.88	5.64	16.23	49.33^{lmno}
Sm 143	Light purple with white shade	round	3.86	3.44	6.88	18.76	5.04^{a}
Sm 166	Purple	oblong	4.48	4.24	7.36	16.52	46.04^{jklmn}
SE			0.07	0.05	0.14	0.29	1.59
CD (0.05%)							15.41

*Values are mean of three replications.
In each column, means with similar alphabets do not vary significantly at P=0.05 by DMRT

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