



## SCREENING OF BRINJAL GENOTYPES FOR RESISTANCE BASED ON MORPHOLOGICAL PLANT CHARACTERS AGAINST *LEUCINODES ORBONALIS*

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### ABSTRACT

Ten brinjal genotypes (BR 112, H-8, Arka Keshav, Arka Anand, 30-1, 72-1, 5-3, 28-1, 33-1, Local variety) were screened for resistance against brinjal shoot and fruit borer (*Leucinodes orbonalis*) and the effect of biophysical characters of these varieties on the shoot and fruit infestation were studied in the field. The data on some biophysical characters, i.e. fruit infestation (%), shoot infestation (%), fruit length, fruit diameter, pericarp thickness, pedicel length, fruit shape and colour, seed density and trichome density were gathered on few selected varieties against the infestation of *L. orbonalis*. Genotype screening based on morphological parameters revealed that, genotypes 33-3, Arka Keshav, Arka Anand were found highly resistant to brinjal shoot and fruit borer owing to presence of morphological characters which confers resistance to *L. orbonalis* like fruits length (28.30 cm), less diameter of fruits (8.20 cm), narrow pericarp (0.29 cm), short pedicel (3.03 cm), fruit shape (long), greater number of seeds, high hair density (221.86/cm<sup>2</sup>) and spines. While these factors were found to vary in remaining genotypes which were found susceptible to *L. orbonalis*.

**Key words:** Brinjal, *Leucinodes orbonalis*, shoot infestation, fruit infestation

### INTRODUCTION

Brinjal (*Solanum melongena* L.) or eggplant belongs to family Solanaceae is one of the most popular and versatile crop adapted to different agro-climatic conditions which can be grown round the year especially in subtropics and tropics. A number of cultivars are grown in India which are suited to different regions, consumer preference being dependent upon fruit colour, size and shape. The major constraints in brinjal cultivation is insect pest infestation which is a major bottleneck threat for its economic production (Kaur *et al.*, 2014). Among all these insect pests, the most important and ubiquitous pest is the shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) (Saijan and Rafee, 2015). It is the most destructive and regular pest, causing considerable loss in crop yield and also responsible for deterioration of fruit quality which ultimately affect the market value of the fruits. At times, entire crops may be lost and the yield loss due to this pest may vary from 70-92 per cent and may cause complete damage if no control measures are under taken (Chakraborty and Sarkar, 2011). With the growing realization of hazards and side ill effects connected with the indiscriminate use of pesticides, entomologists have developed an integrated pest management programme to maintain the pest population below economic injury level. Hence, there is an urgent need to develop safe pest management strategies in pest control programmes of

brinjal. Resistant and tolerant cultivars form the basic component of Integrated Pest Management (IPM) over which other components are to be built up. Host plant resistance strategy serves as an outstanding component when integrated with other approaches as it has several advantages over other control measures (Javed *et al.*, 2011). It is highly compatible with biological control agents and pesticides. Besides its effectiveness, selectivity against the pest and relatively long stability makes this tactic a cornerstone of IPM systems. The present investigation was therefore undertaken to find out the resistance/tolerant brinjal cultivars against brinjal shoot and fruit borer.

### MATERIALS AND METHODS

Field experiments were carried out during *kharif* 2017 at Regional Research Station, Bawal CCS HAU, Hisar. Thirty days old seedlings from ten different brinjal genotypes (BR 112, H-8, Arka Keshav, Arka Anand, 30-1, 72-1, 5-3, 28-1, 33-1, Local variety) were transplanted with a spacing of 60 cm X 60 cm in a plot size of 3 m X 3 m. All the agronomic practices were applied according to the recommendation of package of practices of HAU. The experiment was laid out in randomized block design (RBD) with three replications. However, experimental plots were kept free from insecticidal spray during complete crop period.

**Observations:** From the second week after transplanting, the borer infestation in shoot was recorded randomly by selecting ten brinjal plants per plot at weekly interval from each variety by counting the total number of infested shoots/ plant to total number of shoots/ plant. Per cent infested shoots was worked out by the following formula given by Rahman *et al.* (2009).

$$\text{Per cent shoot infestation} = \frac{\text{Number of infested shoots}}{\text{Total number of shoots}} \times 100$$

In case of fruit damage, the observations were recorded in each variety from 10 randomly selected and tagged brinjal plants. At the time of every picking, the observations were recorded on number and weight of healthy and infested fruits. Whereas, per cent fruit infestation was recorded from total number of infested and healthy fruits by using following formula given by Rahman *et al.* (2009).

$$\text{Per cent fruit infestation (No. basis)} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits}} \times 100$$

$$\text{Per cent fruit infestation (Wt. basis)} = \frac{\text{Weight of infested fruits}}{\text{Total weight of fruits}} \times 100$$

Categorization of brinjal genotypes on the basis of fruit damage to *L. orbonalis*

Mishra *et al.* (1988) developed a categorization system for fruit infestation which is followed for assessment of relative resistance/susceptibility.

S. No.	Damage level (%)	Designation
1	0	Immune
2	1-10	Highly resistant
3	11-20	Moderately resistant
4	21-30	Tolerant
5	31-40	Susceptible
6	Above 41	Highly susceptible

### Study of morphological characters of brinjal genotypes in relation to resistance against *L. orbonalis*

During *kharif* 2017, for the estimation of relative resistance of various genotypes against *L. orbonalis*, the observations on morphological factors of fruits *viz.*, trichomes on leaves, length of pedicel, length and diameter of fruits, thickness of pericarp, number of seeds, colour and shape of fruits were recorded from the selected genotypes from every replication. The details of morphological factors were:

**Length of pedicel (cm):** The length of pedicel was measured from 10 mature fruits of each genotype having three replications. It was measured with the help of digital vernier caliper from base of pedicel up to the tip.

**Length and diameter of fruit (cm):** Ten fruits at marketable maturity were selected from each genotype, from three replications at the time of harvest. With the help of digital vernier caliper the length and diameter of fruits were measured and average was worked out for every genotype.

**Thickness of pericarp (cm):** Pericarp was measured with the help of digital vernier caliper at the time of harvest by cutting the fruits horizontally after selecting ten fruits at marketable maturity from each genotype.

**Number of seeds:** For estimating the number of seeds (High, medium, low) visually, fruits were cut transversely and examined.

**Fruit colour:** With the help of standard colour chart, fruit colour was rated as black, green, purple, light purple and dark purple.

**Number of trichomes on leaves:** Leaf samples were brought to the insect culture laboratory of Entomology Department, CCS HAU, Hissar. The leaf samples were collected randomly by selecting 5 plants from each genotype. The leaf samples were cut into one sq. cm pieces. The samples were mounted on slides and put under the binocular microscope and observed through eye piece and number of trichomes was counted and their average was worked out.

## RESULTS AND DISCUSSION

### Morphological factors of brinjal genotypes in relation to resistance against *L. orbonalis*

**Fruit length (cm):** The data (Table 1 & Figure 1) showed that there were significant variation in length of brinjal fruits of various genotypes. The fruit length varied from 10.06 to 28.30 cm. Arka Keshav recorded significantly higher fruit length (28.30 cm) followed by Arka Anand (27.86 cm), 72-1 (14.73 cm) and BR 112 (13.16 cm). Whereas, genotype 33-3 recorded significantly minimum fruit length (10.06 cm) but exceptionally it was more resistant to brinjal shoot and fruit borer than all other brinjal genotypes owing to unique nature like presence of spines on all over the plant and it was statistically at par with 28-1, 5-3 and 30-1 by recording fruit length varied from 10.13 to 10.36 cm. The intermediate fruit length (11.86 to 12.80 cm) was obtained by genotypes Local variety and H-8, respectively. The correlation study showed that length of fruits was negatively correlated ( $r = -0.407$ ) with per cent fruit infestation.

The current findings showed that the resistant brinjal genotypes recorded maximum fruit length as compared to

genotypes which are susceptible which possess intermediate and minimum fruit length. The reason for resistance to *L. orbonalis* in long aubergine fruits might be the fibrousness and toughness of these fruits. However, the maximum length of aubergine fruits confers resistance against *L. orbonalis*. The results are more or less in parallel with Naqvi *et al.* (2009) who noticed that length of brinjal fruits had significant negative correlation ( $r = -0.724$ ) with fruit borer damage. Prasad *et al.* (2014) reported that length of fruits showed negative correlation but non-significant with *L. orbonalis* damage. Ghosh and Senapati (2001) observed that long fruited hybrids recorded lesser fruit borer infestation. The result was in contradiction with Jat and Pareek (2003) and Wagh *et al.* (2012) who reported that no influence of fruit length on damage of fruit borer. Shukla *et al.* (2001) and Chandrashekhar *et al.* (2009) observed that length of fruit was insignificant to establish any relationship with weight of infested fruit caused by shoot and fruit borer.

**Fruit diameter (cm):** Recorded data (Table-1 & Figure-1) revealed that there was a significant positive correlation ( $r = 0.690$ ) between per cent fruit damage and the diameter of fruit *i.e.*, as the diameter of brinjal fruits increased the fruit infestation also increased. The minimum fruit diameter (8.20 cm) was recorded in resistant genotype Arka Keshav followed by Arka Anand (10.86 cm). Genotypes H-8 and BR 112 recorded maximum diameter of fruit 28.03 and 27.33 cm, respectively in comparison to all other genotypes. The intermediate fruit diameter (ranging from 13.43 to 17.56 cm) was recorded in the genotypes *viz.*, 28-1, 72-1, 30-1, 33-3, Local variety. The genotypes 33-3 and Local variety were statistically at par with each other. It is clear from the current findings that the diameter of fruit was maximum in susceptible genotype BR-112 as compared to Arka Keshav (resistant genotype). It might be because of area available for feeding by brinjal shoot and fruit borer was higher in susceptible genotypes of brinjal which increased the growth and development of *L. orbonalis*. The fruit diameter was important morphological parameter which renders the resistance against *L. orbonalis*.

The current observations are more or less parallel with Naqvi *et al.* (2009) and Subbaratnam (1982) who found significantly positive correlation among fruits diameter and brinjal shoot and fruit borer damage. While, Behera *et al.* (1998) reported positive correlation between damaged fruits and fruit diameter. Thangamani *et al.* (2011) observed less fruit girth in resistant genotypes of brinjal as compared to susceptible genotypes to *L. orbonalis*. In contrary, Shukla *et al.* (2001) reported that diameter of fruit had non-significant relationship with per cent fruit infestation caused by shoot and fruit borer. Prasad *et al.* (2014) observed that diameter of fruit showed negative correlation

( $r = -0.09$ ) but it was non-significant with fruit damage caused by *L. orbonalis*. Grewal and Singh (1995) reported that there was no linear correlation between degree of fruit damage and the diameter of fruit.

**Pericarp thickness (cm):** It can be seen from the data (Table 1 & Figure 1) that least per cent fruit infestation (25.25 %) was recorded in brinjal genotype with narrow pericarp thickness (33-3 with 0.29 cm) whereas, significantly wider pericarp thickness (0.83 cm) was noticed in genotype BR 112 followed by 28-1 (0.79 cm) and H-8 (0.76 cm). The narrow pericarp thickness after 33-3, was found in genotype Arka Keshav, Arka Anand and 72-1 by recording 0.38, 0.44 and 0.58 cm, respectively. The genotypes 72-1 and 5-3 were statistically at par with each other. The genotypes *viz.*, 5-3, 30-1 and Local variety recorded average pericarp thickness ranged from 0.59 to 0.72 cm, respectively. However, the thickness of pericarp showed strong and positive correlation ( $r = 0.877$ ) with per cent fruit infestation. It is very clear that least per cent fruit infestation was recorded in brinjal genotype with narrow pericarp thickness. Whereas significantly wider pericarp thickness was noticed in susceptible genotype.

Earlier, Naqvi *et al.* (2009), Chandrashekhar *et al.* (2009), Jat and Pareek (2003) and Subbaratnam (1982) reported highly significant and positive correlation between per cent fruit infestation and pericarp thickness. Similarly, Grewal and Singh (1995) also recorded that varieties with narrow pericarp showed least infestation of *L. orbonalis*. While, Gupta and Kauntey (2008) reported that brinjal fruits with narrow pericarp confers resistance against shoot and fruit borer. Conversely, Wagh *et al.* (2012) reported that thickness of pericarp had no clear cut impact on the preference of *L. orbonalis*.

**Pedicle length (cm):** Observations of the data (Table 1 & Figure 1) showed that length of pedicle of brinjal fruits in various genotypes varied significantly from each other. It was clear from the observations that there was a significantly positive correlation ( $r = 0.778$ ) between the length of pedicle and per cent fruit infestation which means higher the pedicle length higher the infestation of *L. orbonalis*. However, significantly highest pedicle length (4.93 cm) was exhibited by genotype H-8 which was at par with BR-112 (4.86) whereas; genotype 33-3 exhibited a minimum length of pedicle (3.03 cm) followed by Arka Keshav (3.93 cm) which was at par with Arka Anand (4.13). The next group of lowest pedicle length was observed in Arka Anand which was at par with 5-3 (4.23 cm) and 28-1 (4.26 cm). The genotypes *viz.*, Local variety, 72-1, and 30-1 exhibited 4.30, 4.33 and 4.43 cm pedicle length, respectively.

The minimum fruit infestation of *L. orbonalis* was observed in resistant brinjal genotypes which had shorter

**Table 1. Morphological parameters of brinjal fruits in relation to brinjal shoot and fruit borer infestation**

Sr. No	Genotypes	Fruit infestation (%)	Shoot infestation (%)	Fruit length (cm)	Fruit diameter (cm)	Pericarp thickness (cm)	Pedicel length (cm)	Fruit shape	Fruit Colour	Seed density	Presence of spines
1	BR 112	54.50 (47.58)	30.83 (33.72)	13.16	27.33	0.83	4.86	Round	Purple	Medium	No
2	H-8	52.50 (46.43)	29.14 (32.67)	12.80	28.03	0.76	4.93	Round	Purple	Low	No
3	Arka Keshav	27.57 (31.67)	15.73 (23.36)	28.30	08.20	0.38	3.93	Long	Purple	High	No
4	Arka Anand	29.16 (32.68)	17.90 (25.02)	27.86	10.86	0.44	4.13	Long	Green	Low	No
5	30-1	39.91 (39.17)	23.60 (29.06)	10.36	16.83	0.63	4.43	Oblong	Greenish purple	Low	No
6	72-1	32.55 (34.78)	19.64 (26.30)	14.73	15.20	0.58	4.33	Oblong	Greenish white	Medium	No
7	5-3	34.00 (35.66)	21.75 (27.79)	10.26	19.50	0.59	4.23	Round	Purple	High	No
8	28-1	49.74 (44.85)	27.28 (31.48)	10.13	13.43	0.79	4.26	Round	Purplish white	Medium	No
9	33-3	25.25 (30.16)	12.44 (20.65)	10.06	17.43	0.29	3.03	Round	Purplish white	High	Yes
10	Local variety	32.57 (34.79)	19.80 (26.42)	11.86	17.56	0.72	4.30	Round	Black	Medium	No
C. D. at 5%		(2.88)	(1.59)	0.62	0.46	0.03	0.25				
Correlation (r)* with fruit infestation				-0.40	0.69	0.87	0.77				

Figures in parentheses are angular transformed values; \*Correlation significant at 5%

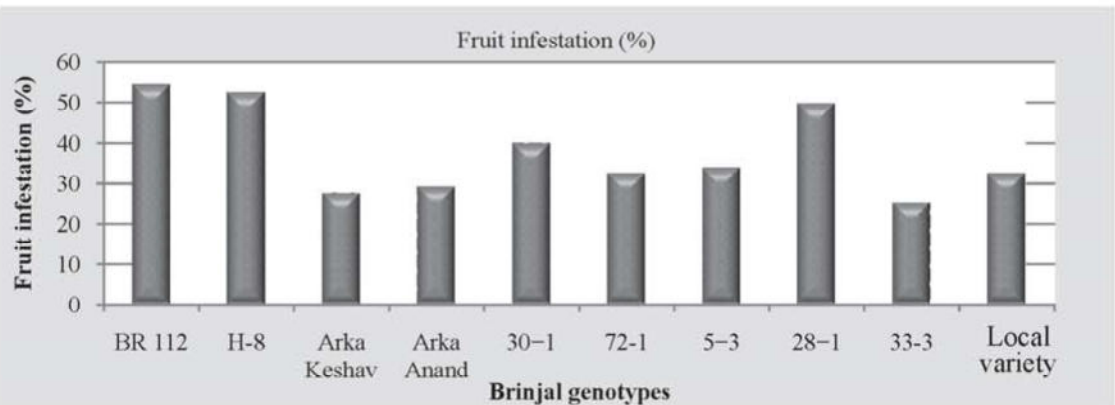
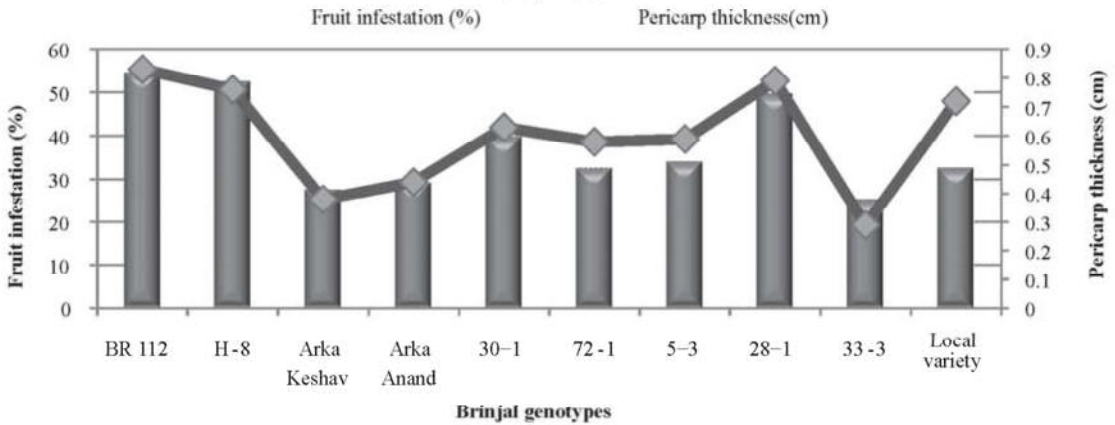
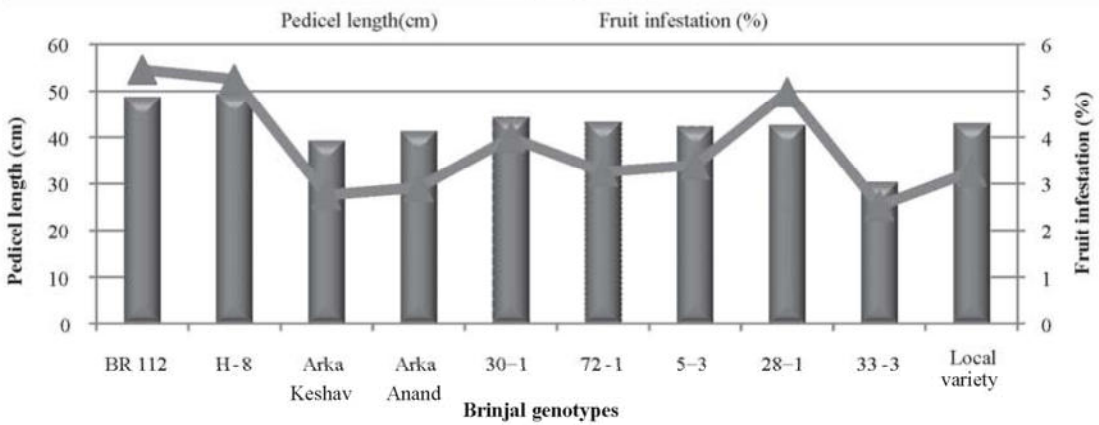
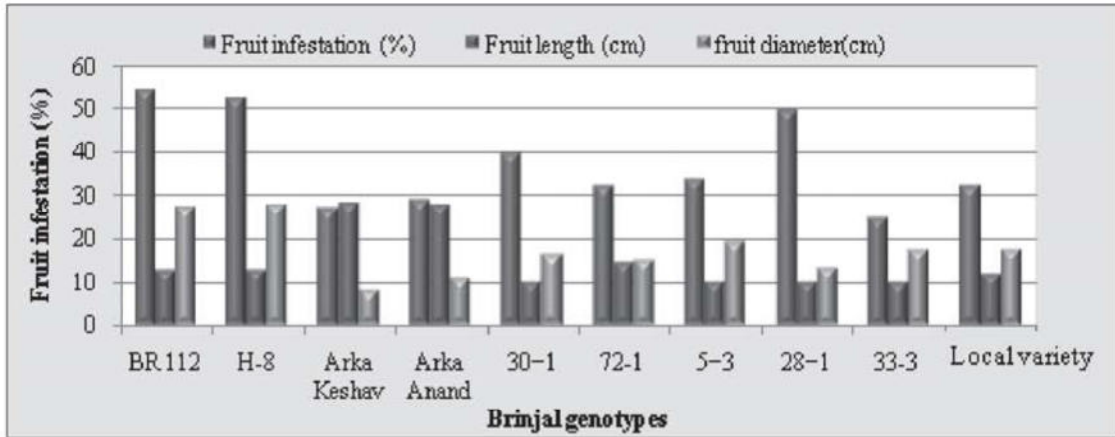


Figure 1. Association of morphological parameters with fruit infestation in different genotypes of brinjal

pedicel whereas, maximum fruit damage of *L. orbonalis* was observed in susceptible genotypes which had longer pedicel. The current findings are in line with Patil and Ajri (1993) who reported that brinjal fruits having shorter pedicel length have lesser shoot and fruit borer infestation. Moreover, Wagh *et al.* (2012) observed the positive correlation ( $r=0.6156$ ) between length of pedicel and per cent fruit infestation.

**Fruit shape, colour and density of seeds:** The present study revealed that round fruits were susceptible while long fruits were relatively resistant to *L. orbonalis*. Darekar *et al.* (1991) and Naqvi *et al.* (2009) reported resistance in genotypes having long fruits. Panda (1999) reported lowest per cent fruit infestation in those brinjal genotypes having long fruits. Ghosh and Senapati (2001) reported that long fruited hybrids recorded lesser shoot and fruit borer incidence. Behera *et al.* (1998) and Karmakar *et al.* (2003) noted that oval and round brinjal fruits were responsible factor for the higher per cent fruit borer infestation. In converse, Wagh *et al.* (2012) showed that fruit shape did not have any clear cut impact on per cent fruit infestation.

The fruit colour in brinjal genotypes did not show any significant correlation with per cent fruit infestation. However, moderate fruit infestation was observed in genotype Arka Anand which had green coloured fruits. While higher per cent fruit infestation was noticed in the genotypes BR 112 and H-8 which had purple coloured fruits. Purple white coloured fruits were reported in genotypes 28-1 and 33-3. Varying fruit colour was noticed in other genotypes *viz.*, Local variety (black), 30-1 (greenish purple) 70-1 (greenish white), Arka Keshav and 5-3 had purple coloured fruits. The highest density of seeds was observed in mesocarp of resistant genotypes whereas less density of seeds was observed in susceptible genotypes. The current findings are parallel with Darekar *et al.* (1991) who observed that fruit colour had no impact on the per cent fruit infestation. Contrary, Naqvi *et al.* (2009) and Jat and Pareek (2003) observed that light green coloured fruits were not preferred by shoot and fruit borer. Thangamani *et al.* (2011) reported that fruits having single colour and uniform distribution were preferred less by shoot and fruit borer.

Resistant brinjal genotype 33-3 showed the highest density of seeds and lesser fruit borer incidence whereas, higher fruit borer incidence was noticed in H-8 with the low density of seeds which suffered heavily because young larvae could easily penetrate into the deep layers of the fruit either through seedless spots of seed rings or through interspaces of seed ring. Highest seed density was observed in mesocarp of resistant genotypes whereas

less seed density was observed in susceptible genotypes. Resistant brinjal genotype 33-3 showed highest seed density and lesser fruit borer incidence whereas, higher fruit borer incidence was noticed in H-8 with low seed density which suffered heavily because young larvae could easily penetrate into the deep layers of the fruit either through seedless spots of seed rings or through interspaces of seed ring.

The present findings are in line with Panda *et al.* (1971), Sharma *et al.* (2001), Sridhar *et al.* (2001), Karmakar *et al.* (2003), Gupta and Kauntey (2008), Chandrashekhar *et al.* (2009) who reported lower incidence of shoot and fruit borer in the brinjal varieties containing highest seed density in mesocarp with closely packed rings.

**Number of trichomes on leaf:** The number of trichomes on the leaves of genotypes was examined by using binocular microscope and compared with their respective per cent fruit infestation. Out of 10 brinjal genotypes for trichomes, 33-3 recorded highest hair density on leaves ( $221.86/\text{cm}^2$ ), followed by Arka Keshav by recording hair density of  $213.67/\text{cm}^2$  on leaves and the lowest per cent fruit infestation (25.25 %) was observed in 33-3. Least hair density of  $140.23$  per  $\text{cm}^2$  on leaves was reported in BR 112, followed by  $147.84$  per  $\text{cm}^2$  on leaves of H-8. The highest per cent fruit infestation (54.50 per cent) was recorded in BR 112. It is clear from the data that (Table-3 and Figure-2), there was a strong negative correlation between the number of trichomes and fruit borer incidence ( $r=-0.980$ ).

**Table 2. Number of trichomes on leaf in relation to shoot and fruit borer infestation**

S. No.	Genotypes	Trichomes on leaves (Number/ $\text{cm}^2$ )	Fruit infestation (%)
1	BR 112	140.23	54.50 (47.58)
2	H-8	147.84	52.50 (46.43)
3	Arka Keshav	213.67	27.57 (31.67)
4	Arka Anand	203.67	29.16 (32.68)
5	30-1	175.63	39.91 (39.17)
6	72-1	191.36	32.55 (34.78)
7	5-3	181.84	34.00 (35.66)
8	28-1	156.57	49.74 (44.85)
9	33-3	221.86	25.25 (30.16)
10	Local variety	189.74	32.57 (34.79)
	Corr. coefficient (r)	-0.980	
	CD at 5%	2.88	

Figures in parentheses are angular transformed values.

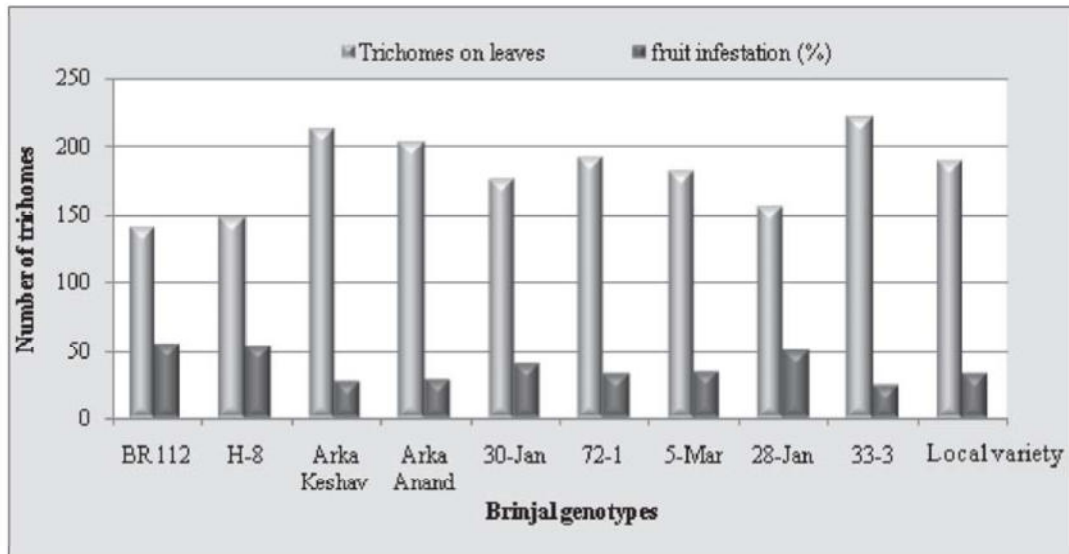


Figure 2. *L. orbonalis* infestation corresponding to number of trichomes of brinjal genotype

The findings are in agreement with Mote (1981) who evaluated 32 varieties of brinjal for resistance against shoot and fruit borer and found lower incidence of brinjal shoot and fruit borer in varieties having maximum number of trichomes. Similarly, Javed *et al.* (2011) observed significantly negative correlation between number of trichomes and fruit infestation ( $r = -0.623$ ).

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