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Screening of brinjal genotypes resistance against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee)

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Abstract
The present experiment was conducted with fourteen brinjal genotypes from February, 2017 to July, 2017 to identify their characteristics for susceptibility/resistance against brinjal shoot and fruit borer infestation. The shoot infestation mean varied between 23.25 to 56.07%. None of the genotypes were found to be resistant to shoot attack of *Leucinodes orbonalis* infestation but few genotypes shows tolerant were Arka anand (27.99%), 71-19 × RB-2 (23.25%) and BRBL-02 × BRBL-07 (27.94%). The per cent fruit damage varied from 27.35 to 62.31% and minimum fruit infestation was noticed on genotypes Arka anand (27.35%), 71-19 × RB-2 (27.59%) and BRBL-02 × BRBL-07 (23.58%), whereas, maximum fruit infestation recorded on genotypes Muktakeshi×Swarnmani (54.93) and Pusa hybrid- 9 (62.31%). Among fourteen genotypes, six of them Arka anand, 71-19 x RB-2, BRBL-02 x BRBL-07, RB-2 X BRBL-01, BRBR-01 X RB-2 and BRBL-07 x BRBL-02 were found tolerant, six were found susceptible and rest two genotypes were noticed highly susceptible to brinjal shoot and fruit borer.

Keywords: Screening, genotypes, brinjal shoot and fruit borer

Introduction
Brinjal/eggplant (*Solanum melongena*) belongs to the family solanaceae and it is one of the most popular and principal vegetable crops. This is one of the widely used vegetable crops and is well accepted in many countries *viz*. Central, South and South East Asia, some parts of Africa and Central America (Harish *et al*., 2011) [4]. Numerous factors are responsible for the low productivity of brinjal in India and insect pests is one of the major reasons for the lower productivity in brinjal. This crop is vulnerable to attack of as many as 26 insect pests, starting from nursery to harvesting of the crop. Among all, brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. is one of the most destructive one. The losses caused by pest differ from season to season because moderate temperature and high humidity favour the population build-up of brinjal shoot and fruit borer (Shukla and Khatri, 2010) [13] and alone it causes about 16 and 70 percent damage to shoots and fruits of brinjal, respectively (Latif *et al*., 2010) [9]. Due to its high reproductive potential, rapid turnover of generations and intensive cultivation of brinjal in both wet and dry seasons, the pest poses a serious threat. Chemical control is widely used and adapted by farmers for managing this pest and repeated use of broad spectrum synthetic chemicals results in environmental contamination, bioaccumulation and biomagnification of toxic residues and disturbance in ecological balance (Dadmal *et al*., 2004) [2]. Hence, there is an urgent need to look alternate and safer method. Host plant resistance strategy serves as an excellent component when integrated with other approaches as it has numerous advantages over other measures. This strategy is highly compatible with pesticides and biological control agents. Besides its efficiency, selectivity against the pest and relatively long stability makes this tactic a cornerstone of IPM systems. The resistant genotypes can easily be adopted in crop production schemes and reduce the cost of produce.

Materials and methods
The experiment was conducted at Vegetable Research Plot of Bihar Agricultural College Farm under Bihar Agricultural University, Sabour, Bhagalpur, Bihar. The experiments were laid out

in Randomized Block Design (RBD) with three replications. The genotypes were brought from IARI, IIHR and our own BAU, Sabour. The experiment was conducted during *summer*, 2017-18. Total 14 genotypes were screened against brinjal shoot and fruit borer. Transplanting of seedlings was accomplished on 25th February, 2017. The plot size was 3.0 × 3.0 m^2 and spacing was 60 × 60 cm^2. The cultural practices except plant protection measures were followed as per recommendations. Ten plants were tagged at random and observed for the incidence of shoot and fruit borer in each brinjal genotype from transplanting to harvest.

Shoot damage: The total number of terminal shoots drying/drooping from randomly selected ten plants was counted. After each observation, the damaged shoots were removed. The per cent shoot infestation was calculated using the following formula:

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

Fruit damage: The number of infested and un-infested fruits from each cultivar was counted from ten randomly selected plants and per cent fruit infestation was calculated using the following formula:

$$\text{Per cent fruit infestation} = \frac{\text{Number of damaged fruits}}{\text{Total number of brinjal fruits}} \times 100$$

Fruit weight loss: The weight of infested and un-infested fruits from twenty randomly selected plants from each cultivar was recorded and per cent fruit weight loss was calculated using the following formula:

$$\text{Per cent fruit weight loss} = \frac{\text{Weight of damaged fruits}}{\text{Total weight of brinjal fruits}} \times 100$$

Based on fruit infestation on weight basis, grading of genotypes was done as reported by Khan and Singh, 2014 [8] (table-1)

Table 1: Grading of genotypes

Sl. No.	Per cent fruit infestation	Grade
1	0	Immune
2	1-10	Resistant
3	11-20	Fairly resistant
4	21-30	Tolerant
5	31-40	Susceptible
6	>40%	Highly susceptible

Results and Discussion

Per cent shoot infestation

The mean performances of genotypes against per cent shoot infestation under the study have been presented in table 2. Among the genotypes evaluated under field condition, minimum per cent shoot infestation was recorded with Arka anand (27.99%), 71-19 × RB-2 (23.25%) and BRBL-02 × BRBL-07 (27.94%). It was followed by BRBL-07 × BRBL-02 (29.00%), BRBR-01 × RB-2 (29.58%) and RB-2 × BRBL-01 (29.81%). On the other hand, the maximum shoot infestation was observed in Muktakeshi×Swarnmani (56.07%) and Pusa hybrid- 9 (53.05%). It was followed by Muktakeshi× RB-2 (40.66%) and Pusa hybrid- 3 (40.33%).

Table 2: Per cent shoot and fruit infestation in different brinjal genotypes by *L. orbonalis*

Genotypes	Per cent shoot damage	Per cent fruit damage (number)	Per cent fruit damage (weight)
RB-2 × Swarnmani	36.96 (37.42)*	40.54 (39.54)*	37.45 (37.71)*
Muktakeshi× BRBL-02	33.81 (35.53)	35.96 (36.83)	38.50 (38.34)
Pusa hybrid – 6	40.33 (39.42)	39.90 (39.17)	39.00 (38.62)
Arka anand	27.99 (31.90)	27.35 (31.51)	28.44 (32.22)
71-19 × RB-2	23.25 (28.83)	27.59 (31.62)	25.84 (30.52)
Muktakeshi × RB-2	40.63 (39.58)	39.66 (39.01)	37.91(37.98)
BRBL-09 × BRBL 11	36.31 (37.03)	38.04 (38.04)	37.55 (37.77)
BRBL-02 × BRBL-07	27.94 (31.90)	23.58 (29.01)	27.91 (31.87)
BRBR-01 × RB-2	29.58 (32.92)	36.98 (37.34)	28.45 (32.21)
RB-2 × BRBL-01	29.81 (33.04)	28.60 (32.32)	29.25 (32.73)
BRBL-07 × BRBL-02	29.00 (32.57)	29.65 (32.98)	29.27 (32.71)
Muktakeshi × Swarnmani	56.07 (48.49)	54.93 (47.83)	61.16 (51.46)
Pusa hybrid- 9	53.05 (46.76)	62.31 (52.14)	56.68 (48.85)
Muktakeshi × BRBL-01	38.28 (38.21)	38.98 (38.62)	39.79 (39.10)
S.Em (±)	1.33	1.52	1.33
C.D (p=0.005)	3.87	4.41	3.85

* Figures in parentheses are arcsine √ p transformations

Per cent fruit infestation (number basis)

From the concerning to fruit infestation on number basis, it is evident that minimum per cent fruit infestation was found in (Table 2) Arka anand (27.35%), 71-19 × RB-2 (27.59%) and BRBL-02 × BRBL-07 (23.58%). This was followed by RB-2 × BRBL-01 (28.60%) and BRBL-07 × BRBL-02 (29.65%). Whereas, maximum per cent fruit infestation was recorded with Muktakeshi × Swarnmani (54.93%) and Pusa hybrid- 9 (62.31%). It was followed by RB-2 ×Swarnmani (40.54%) and Muktakeshi × RB-2 (39.66%).

Per cent fruit infestation (weight basis)

Data pertaining to per cent fruit infestation on weight basis have been provided in table 2 and indicates that Arka anand (28.44%), 71-19 × RB-2 (25.84%) and BRBL-02 × BRBL-07 (27.91%) shows significant least infestation as compared to other genotypes. It was followed by BRBR-01 × RB-2 (28.45%), RB-2 × BRBL-01 (29.25%) and BRBL-07 × BRBL-02 (29.27%). On the other hand, the maximum fruit infestation was found in Muktakeshi × Swarnmani (61.16%) and Pusa hybrid- 9 (56.68%) followed by Muktakeshi × BRBL-01 (39.79%) and Pusa hybrid – 6 (39.00%).

Grading of Genotypes

Grading of genotypes has been presented in the table 3. Among the fourteen genotypes, six genotypes namely, Arka anand, 71-19 x RB-2, BRBL-02 x BRBL-07, RB-2 X BRBL-01, BRBR-01 X RB-2 and BRBL-07 x BRBL-02 comes under tolerant genotypes (ranges from 25.84 to 29.27%) based on per cent fruit damage on weight basis. However six genotypes namely, RB-2 X Swarnmani, Muktakeshi x BRBL-02, Pusahybrid-6, Muktakeshi x RB-2, BRBL-09 x BRBL-11 and Muktakeshi x BRBL-01 comes under susceptible genotypes (ranges from 37.55 to 39.79%) and two genotypes namely, Muktakeshi x Swarnmani and Pusahybrid-9 comes under highly susceptible genotypes (>40%). None of the genotypes shows immune, resistance or fairly resistance under field condition.

Table 3: Categorization of brinjal genotypes based on the mean percent fruit infestation by *L. orbonalis*

Fruit damage (%)	Genotypes	Grade
0	-	Immune
1-10%	-	Resistance
11-20%	-	Fairly Resistance
21-30% (7)	Arka anand	Tolerant
	71-19 x RB-2	Tolerant
	BRBL-02 x BRBL-07	Tolerant
	RB-2 X BRBL-01	Tolerant
	BRBR-01 X RB-2	Tolerant
	BRBL-07 x BRBL-02	Tolerant
31-40% (6)	RB-2 X Swarnmani	Susceptible
	Muktakeshi x BRBL-02	Susceptible
	Pusa hybrid-6	Susceptible
	Muktakeshi x RB-2	Susceptible
	BRBL-09 x BRBL-11	Susceptible
	Muktakeshi x BRBL-01	Susceptible
> 40% (2)	Muktakeshi x Swarnmani	Highly susceptible
	Pusa hybrid-9	Highly susceptible

Among the fourteen brinjal genotypes, minimum per cent shoot and fruit infestation (number and weight basis) was recorded with Arka anand, 71-19 × RB-2 and BRBL-02 × BRBL-07, whereas, maximum per cent shoot and fruit infestation (number and weight basis) was noted in Muktakeshi × Swarnmani and Pusa hybrid- 9.

Various workers had reported varied degree of shoot and fruit damage in both resistant and susceptible brinjal genotypes which more or less corroborate the present studies (Lit *et al*., 2002; Elanchezhyan *et al*., 2008; Mannan *et al*., 2009 and Javed *et al*., 2011). Mandal *et al*. (2005) [10, 3, 12, 7, 11] reported thirty-one brinjal (aubergine) cultivar, that none of the cultivated/wild species of brinjal were found resistant to *L. orbonalis*. Another screening program involved only 20 accessions, and none of them exhibited significant levels of resistance (Hossain *et al*., 2002) [5].

The ranges of fruit damage among the genotypes were 23.58% to 54.93%. Similarly, Ashoke and Abhishek (2002) [1] while evaluating 12 aubergine cultivars in field conditions reported 33.65- 53.02% fruit infestation of *L. orbonalis* larvae. Comparable range of fruit infestation was 20.23 to 45.61% reported by Jat *et al*., (2003) [6]. Therefore, the present study provides primary resistance source for brinjal shoot and fruit borer which can be incorporate in prevalent high yielding cultivars of brinjal. Developing natural resistant or tolerant cultivars may decrease cost of cultivation of crop by decreasing pesticide application.

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