Pak. J. Agri. Sci., Vol. 54(4), 753-758; 2017
ISSN (Print) 0552-9034, ISSN (Online) 2076-0906
DOI: 10.21162/PAKJAS/17.6523
http://www.pakjas.com.pk

COMPARATIVE INFESTATION OF BRINJAL STEM BORER (*Euzophera perticella*) ON SIX AUBERGINE CULTIVARS AND CORRELATION WITH SOME MORPHOLOGICAL CHARACTERS

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Brinjal stem borer (*Euzophera perticella* Rag.) is widely distributed in Pakistan and can cause considerable yield losses. In the present study six aubergine cultivars were assessed for their host preference against the pest in field conditions. Significant variations were recorded in infestation of brinjal stem borer on six aubergine cultivars after 40, 70 and 100 days of transplantation as measured in infested tunnel size. Minimum infestation was observed on Nirala followed by Karishma and Black Long while the infestation was found to be the maximum on Neelam. Similarly, the infestation was the minimum after 40 days and significantly increased after 70 and 100 days after transplantation. The correlations between borer infestation and morphological characteristics were also found significant. Brinjal stem borer infestation had positive significant correlation with stem diameter, number of branches per plant and plant height while negative significant correlation with number of hair/cm². However, plant height was negatively non-significantly correlated with yield per plant. It was observed that with an increase in plant height, stem diameter and number of branches per plant, there was a significant increase in infestation. On the other hand the cultivars with maximum number of hair/cm² showed a decrease in infestation and increased yield. As Nirala and Karishma suffered less damage by the borer and are therefore, recommended for cultivation.
Keywords: *Solanum melongena* L., *Euzophera perticella*, physico-morphic, abiotic factors, Nirala and Karishma

INTRODUCTION

Aubergine also known as eggplant (*Solanum melongena* L.) is an important and widely cultivated vegetable in central, southern and south-east Asia, and in a number of African countries (Hazra *et al*., 2003). It is tropical and subtropical in origin. Most of its varieties are perennial in nature. It is extensively grown in Indo-Pak subcontinent and also popular in other countries like Japan, China, Bulgaria, and Indonesia and to very little extent in America (Shammugavelu, 1989). Aubergine has very good nutritive value as 100 g of fruit contains: iron 0.7 mg, sodium 13 mg, potassium 213 mg (Nonneck, 1989), calcium 12 mg, phosphorus 26 mg, ascorbic acid 5 mg and vitamin A 0.5 IU and provides 25 calories (Tindall, 1978). Aubergine has also Ayurvedic medical properties as white brinjal is good for diabetic patients (Baloch, 1996). Delphinidin, a flavonoid pigment, present in its peel inhibits tumor cell invasion (Nagase *et al*., 1998). In India, it is also used for the treatment of diabetes, bronchitis, asthma, dysuria, dysentery etc. (Daunay, 2000). In Pakistan, aubergine is a widely cultivated vegetable and the area under its cultivation was 8864 hectares with 88434 tons production during 2005 autumn season. In Punjab, the area under aubergine cultivation was 4709 hectares which produced 57575 tons of aubergine (GOP, 2006).

The successful production of aubergine is affected by many biotic factors including fungi (Iqbal and Mukhtar, 2014; Iqbal *et al*., 2014), viruses (Ashfaq *et al*., 2014a,b, 2015, 2017), nematodes (Kayani *et al*., 2017; Khan *et al*., 2017; Mukhtar *et al*., 2014; 2017a,b; Tariq-Khan *et al*., 2017), bacteria (Shahbaz *et al*., 2015; Aslam *et al*., 2017a,b) and particularly the insect pests (Humayun *et al*., 2017). Important insect pests are brinjal fruit borer (*Leucinodes orbonalis*), brinjal stem borer (*Euzophera perticella*), leaf roller (*Eublemma olivaceae*), Coccinelid beetle (*Epilachna vigintioctopunctata*) and lace wing bug (*Urentius echinus*). Some minor pests attacking this crop are whitefly (*Bemisia tabaci*), aphid (*Aphis gossypii*), jassid (*Amrasca biguttula biguttula*) and mites. In India another important insect pest, brinjal bud borer (*Scrobipalpa blapsigona*) has also been reported (Patel *et al*., 1971). Brinjal stem borer (*Euzophera perticella* Rag.) (Lepidoptera; Phycitidae) is also a major pest of brinjal and is widely distributed in India. Besides brinjal, it also attacks chili, potato and tomato. Damage is caused by the caterpillars, which measure about 20-22 mm in length, when full-grown (Atwal, 1976). The larvae feed on pith of the stem, causing the apical shoots to die and hang down. Larvae in advanced

stages of development bore into the stem at ground level, killing plants in the field (Mehmood *et al*., 2005).

Host plant characters including morphological or structural qualities interfere with insect behavior such as mating, ovipositing, feeding and food ingestion. Pubescence and tissue hardness limit insect mobility acting as structural barriers (Webster, 1975). Identification of a morphological or biochemical factor governing resistance helps in the development of a rapid screening technique. Resistance may be due to antixenosis or non-preference and appears to have a biochemical basis, although non-preference of selected tolerant, moderately tolerant, susceptible and highly susceptible cultivars has been attributed to anatomical characters (Hossain, 1997). Management of this pest using the insecticides causes several problems and adds the dangerous residues to the fruit. Chemicals are also fatal for the beneficial insects and play their significant role for polluting the environment in all aubergine growing areas of Pakistan. One of the effective and cheapest ways to control this insect pest is the use of resistant cultivars. The use of host plant resistance for insect pest control is an environmental-friendly practice. It can play significant role in integrated pest management programs.

Keeping in view the negative aspects of insecticides, the present study was conducted to evaluate different cultivars of aubergine against the brinjal stem borer. It will also help to increase the aubergine yield and facilitate small farmers for growing of this important vegetable.

MATERIALS AND METHODS

***Research area*:** The experiment to evaluate different cultivars of aubergine for their resistance/susceptibility was conducted at National Agricultural Research Center, Islamabad using Randomized Complete Block Design with three replications. The research area has unique climatic conditions. The winter is cold and dry having average maximum temperature of 24.4°C and average minimum temperature of 3.4°C while its summer season is very hot and rainy having average maximum and minimum temperatures of 34.2°C and 16.4°C respectively (Kayani *et al*., 2013).

***Screening of aubergine cultivars*:** Six aubergine cultivars such as Nirala, Karishma, Black Long, Anmol, Purlpe Long and Neelam were selected for evaluation. The nursery was prepared in green house at PMAS Arid Agriculture University Rawalpindi. Forty five days old nursery was shifted to field area of vegetable section at National Agricultural Research Center, Islamabad. The plant to plant and row to row distance was kept 50 cm and 75 cm respectively and the total plot size was 400 × 375 cm.

***Collection of data*:** The data were recorded from ten randomly selected plants per plot for the infestation of brinjal stem borer on each cultivar.

***Damage on stem/shoot*:** Damage on stem/shoot was determined by measuring the size of tunnel (cm) made by the brinjal stem borer on each cultivar at ages of 40, 70 and 100 days after the transplantation.

***Morphological characters*:** The data for each morphological character were taken as follows.

***Plant height*:** The heights of aubergine cultivars were taken 100 days after the transplantation by measuring tape by randomly selecting ten plants from each replication and the data were correlated with the brinjal stem borer infestation.

***Stem diameter*:** Stem diameters of different aubergine cultivars were taken using the vernier caliper 100 days after transplantation of nursery and compared with the stem borer infestation.

***Number of branches/plant*:** The data on number of branches/plant were taken 100 days after the transplantation from ten randomly selected plants and were compared with the brinjal stem borer attack on different plants.

***Number of hair/cm²*:** A piece of stem measuring 1 cm² was taken from the stem of different aubergine cultivars 100 days after transplantation and the number of hair/cm² was counted under the microscope.

***Yield*:** After 70 days of transplantation the yields (Kg/plot) of different aubergine cultivars were taken at an interval of 15 days and were correlated with the extent of damage to each cultivar.

***Statistical analysis*:** The data regarding the damaging pattern on different auberbine cultivars and physico-morphic characters of various cultivars were subjected to statistical analysis and means were compared by Duncan's Multiple Range test at 5% level of probability. The data were also subjected to simple correlation (Fateh *et al*., 2017).

RESULTS AND DISCUSSION

***Infestation of brinjal stem borer*:** Significant variations were recorded in infestation of brinjal stem borer on six aubergine cultivars after 40, 70 and 100 days of transplantation as measured in infested tunnel size. Minimum infestation was observed on Nirala followed by Karishma and Black Long while the infestation was found to be the maximum on Neelam. Similarly, the infestation was the minimum after 40 days and significantly increased after 70 and 100 days after transplantation as shown in Table 1. In the study, Nirala was found comparatively resistant while the Neelam cultivar proved moderately susceptible towards the preference of brinjal stem borer. Krishma, Black Long, Anmol and Purple Long cultivars showed susceptibility against brinjal stem borer. The results are in agreement with the findings of Hossain *et al*. (2002) and Javed *et al*. (2011).

Morphological characters:

***Number of primary branches per plant*:** Highly significant variations were found in number of primary branches per plant among aubergine cultivars. Minimum number of

Table 1. Infestation of Brinjal stem borer on aubergine cultivars.

Cultivar	Infested tunnel size (cm) after		
	40 days	**70 days**	**100 days**
Nirala	0.27 c	0.81 e	0.93 d
Karishma	0.53 c	0.94 d	0.94 d
Black Long	0.57 c	1.09 c	1.20 c
Anmol	1.05 b	1.89 b	1.50 b
Purlpe Long	1.12 b	2.09 a	2.12 a
Neelam	1.26 a	2.12 a	2.12 a
Analysis	F5, 17 = 0.001 p<26.58**	F5, 17 = 0.002 p<471.11**	F5, 17 = 0.014 p<65.19**

Mean sharing similar letters are not significantly different by DMR Test at p=0.05.

Table 2. Morphological characteristics on aubergine cultivars.

Cultivar	No. of primary branches	Plant height (cm)	Stem diameter (cm)	No. of hair/cm²	Yield (Kg/plant)
Nirala	3.6 a-d	56.0 b-e	1.43 cde	79.63 a	23.00 a
Karishma	3.3 bcd	58.0 abc	1.44 bcd	77.53 b	22.11 ab
Black long	4.0 abc	55.6 cde	1.40 def	74.97 c	20.78 b
Anmol	4.3 ab	55.0 b-e	1.46 bc	73.93 c	19.66 b
Purlpe long	4.0 abc	58.0 abc	1.49 b	69.97 d	18.99 b
Neelam	4.6 a	59.6 a	1.57 a	68.83 d	17.44 c
Analysis	F5, 53=0.644 p<0.8112**	F5, 53 = 3.496 p<2.5132**	F5, 53 = 0.001 p<19.7359**	F5, 53 = 3.041 p<51.8865**	F5, 53 = 1.326 p<28.3762**

Mean sharing similar letters are not significantly different by DMR Test at p=0.05.

branches was recorded on Karishma and maximum number was found on Neelam while the number was intermediate among the rest of the cultivars as shown in Table 2.

***Plant height*:** The cultivars varied significantly regarding plant height. Neelam had the maximum plant height while the heights of other cultivars were statistically similar with each others as shown in Table 2.

***Stem diameter*:** Cultivars showed variations regarding stem diameter. The diameter was found to be the maximum in case of Neelam whereas it was the minimum in case of Nirala. The stem diameter was intermediate among the remaining cultivars (Table 2).

***Number of hair/cm²*:** Significant variations were recorded in number of hair/cm² on six aubergine cultivars. The maximum number of hairs was observed on Nirala followed by Karishma and the number of hair was the minimum on Neelam cultivar followed by Purlpe Long. The cultivars Black Long and Anmol had statistically similar number of hair as given in Table 2.

***Yield (Kg) per plant*:** The yields of eggplant cultivars were found significantly different from each others. Nirala gave the highest yield followed by Krishma while the cultivar Neelam gave the minimum yield followed by Purple Long. The cultivars Black Long and Anmol gave the same yields as given in Table 2.

***Correlation between borer infestation and morphological characteristics*:** The correlations etween borer infestation and morphological characteristics are given in Table 3. The plant height had positive significant correlation with stem diameter, number of branches per plant and brinjal stem borer infestation while negative significant correlation with number of hair/cm². However, plant height was negatively non-significantly correlated with yield per plant (Table 3). The results showed that with increase in plant height, there was

Table 3. Correlation matrix between brinjal stem borer infestation and morphological characteristics.

Morphological characteristic	Stem diameter (cm)	No. of branches	No. of hair/cm²	Yield (Kg/plant)	Brinjal stem borer infestation
Plant height (cm)	0.991	0.775	-0.889	-0.073	0.625
Stem diameter (cm)		0.797	-0.918	-0.048	0.599
No. of branches			-0.692	-0.283	0.639
No. of hair/cm²				0.137	-0.649
Yield (kg)					-0.435

significant increase in infestation. It means that the cultivars with maximum height were more susceptible to the infestation/damage.

The stem diameter had positive significant correlation with number of branches per plant and brinjal stem borer infestation while negative significant correlation with number of hair/cm². However, stem diameter was negatively non-significantly correlated with yield per plot (Table 3). It was noticed that with an increase in stem diameter, there was a significant increase in infestation which means that the cultivars with maximum stem diameter were more susceptible to the infestation/damage.

Similarly, the number of branches per plant had positive significant correlation with brinjal stem borer infestation while negative significant correlation with number of hair/cm². However, number of branches per plant was negatively non-significantly correlated with yield per plot (Table 3). It was found that with increase in number of branches per plant, there was significant increase in infestation implying that the cultivars with maximum number of branches per plant were more susceptible to the infestation/damage.

Likewise, the number of hair/cm² had negative significant correlation with brinjal stem borer infestation while positive non-significant correlation with yield per plot (Table 3). The results showed that with an increase in number of hair/cm² there was a significant decrease in infestation. It means that the cultivars with maximum number of hair/cm² were more resistant to the infestation/damage.

The yield (kg/plot) had also negative non-significant correlation with brinjal stem borer infestation (Table 3). The results showed that with an increase in infestation/damage by brinjal stem borer, there was a significant decrease in yield (kg/plot). It means that the cultivars with maximum yield (kg/plot) were more resistant to the infestation/damage. The results reported in the present study corroborated the findings of previous studies by Bernado and Taylo (1990), Gaikwad *et al*. (1991), Arvind and Ram (1999), Hossain *et al.* (2002), Lokesh and Singh (2005), Iqbal *et al*. (2011) and Khan *et al*. (2017) which stated that physico-morphic characters had significant correlations with infestation of borers.

***Conclusion*:** It is concluded from the present findings that Nirala and Karishma suffered less damage by the borer and therefore, are recommended for cultivation. These cultivars can also be employed as a component of integrated nematode management along with other control strategies like organic soil amendments, biocontrol, soil solarization, heat treatment, and crop rotation with non-hosts for controlling this insect pest. The resistant cultivars will have comparatively better crop yield as compared to susceptible cultivars.

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