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ENTOMOLOGY

Physio-Morphic Characters of Different Varieties/Genotypes Against Population Fluctuation of Sucking Pests of Brinjal *Solanum melongena* (L.)

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ABSTRACT

A field experiment was conducted at Agricultural Research Farm of Banaras Hindu University, Varanasi during 2014-15 and 2015-16 to study different varieties/genotypes of brinjal to find out the role of physio-morphic characters of plant on the population fluctuation of sucking pests. The physio-morphic characters of brinjal plant were correlated with the population of sucking pests. The Moisture percentage, leaf area, hair density and length of hairs of different brinjal varieties/ genotypes influenced the population of sucking pests significantly. The moisture percentage in leaves and leaf area showed non-significant positive relation with the sucking insects like aphids, jassids and whiteflies. The hair density had significant negative correlation with the occurrences of jassids but non-significant negative correlation with the occurrences of aphids and whiteflies. The length of hairs had significant negative impact on jassid infestattion and non-significant negative impact on aphid and whitefly infestation.

Highlights

- The hair density had significant negative correlation with the occurrences of jassids but non-significant negative correlation with the occurrences of aphids and whiteflies.
- The length of hairs had significant negative impact on jassids infestation and non-significant negative impact on aphid and whitefly infestation.

Keywords: Brinjal *Solanum melongena* (L.), Correlation, Physio-morphic characters, Sucking pests

Brinjal (*Solanum melongena* L.) belongs to the family *Solanaceae* and denoted by various names *viz.*, *eggplant*, *aubergine*, *garden egg*, *baingan*, *badanekai*, *vangi*etc. Insect pests are the main constraint in the successful cultivation of brinjal. Vevai (1970) has listed as many as 26 pests. Among them the most important pests that affect the yield and quality of brinjal include shoot and fruit borer, *Leucinodes orbonalis* Guenee, hadda beetle, *Epilachna* sp., jassid, *Amrasca biguttula biguttula* (Ishida), aphid, *Aphis gossypii* Glover, stem borer, *Euzophera perticella* Ragonot, whitefly, *Bemisia tabaci* Gennadius and lace wing bug, *Urentius echinus* Distant. In the South East Asia the sucking pests caused approximately 67% yield loss in brinjal crop (Nagia *et al.* 1993). Aphid, jassid and whitefly are cosmopolitan in distribution and are found wherever brinjal is grown. Populations of these insects are often seen on tender parts of the plant, particularly on leaves. The nymphs and adults of these insects suck the cell sap from leaves and tender parts of plants which lead to yellowing, deformation, wilting and ultimately drying of the affected parts. Sucking insects also act as a vector of different diseases of brinjal such as little leaf by jassids and shooty mould by aphids and whiteflies. Sucking pests like leafhopper and whitefly and shoot and fruit borer are main pests of north India and losses due to pests may be up

to 50% (Naik *et al.* 2009). Jassid is becoming second major pest of brinjal considering its infestation, severity and damage to the plants (Mahmood *et al.* 2002; Kalawte and Dethe 2012). Whitefly is an important sucking pest of brinjal that caused a considerable damage to the brinjal plants (Mandal *et al.* 2010). Host plant resistance is an efficient method for the management of insect pests of crops. Targeted pests can be controlled by developing resistance cultivars. Host plant resistance and IPM tactics both are helpful to reduce the pest population and also increase the yield of crop. Any inherited character of the host that limits the effect of pest attack defined as pest resistance (Sidhu and Dhatt 2007). Keeping in view the significance of eggplant, the present research work was directed to explore the role of physico-morphic characters of brinjal cultivars against sucking insects like aphid, jassids and whitefly.

MATERIALS AND METHODS

A field experiment was carried out at the Agriculture Research Farm of Banaras Hindu University, Varanasi to evaluate the role of physico-morphic characteristics of selected brinjal varieties/genotypes viz. IVBL-116-131, JB-8, DBR-31, HABR-4, JB-64, JB-15, Azad Kranti, TRB-9, DBL-9, Surya, Swarna Mani, Kashi Taru and Punjab Sadabahar against infestation of sucking pests like aphid, jassid and whitefly. The crop was raised on ridges and furrows and after transplanting, first irrigation was done immediately followed by subsequent irrigations at 15 days interval, depending upon moisture status and frequency of rainfall during the experimental period. The experiment was conducted in Randomized Block Design with 3 replications during *Kharif* 2014-15 and 2015-2016. The observation regarding infestation of sucking pests recorded from five randomly selected tagged plants per plot. For recording observations on sucking pests viz., aphid, jassid and whitefly, three (one from the top, middle and bottom) leaves of selected 5 plants were carefully examined for the presence of nymphs and adults during early morning hours when the pests were less active. The observations were taken at weekly interval. How the crop was raised? Schedule of irrigation in the field is of outmost importance because moisture content of leaf depends on the soil moisture regime of the field too. Mention at what frequency irrigation was given to the field.

Physio-morphic characteristics of brinjal varieties/ genotypes and the methodology used for their study

Moisture content: Thirty grams of leaves each from upper, middle and lower portion of the randomly selected five plants from each plot was taken and dried in the oven at 65°C for 72 hours. The moisture percentage of leaves was calculated by following formula.

$$\text{Moisture percentage} = \frac{\text{Wt. of fresh leaves} - \text{Wt. of dry leaves}}{\text{Wt. of fresh leaves}} \times 100$$

Leaf area (cm^2): Full grown leaves were taken from five randomly plants of each test entry and leaf area was measured with the help of leaf area meter (CI-202 Portable Laser Leaf Area Meter, CID Bio-science).

Hair density of leaf lamina (cm^2): Three pieces of leaf lamina each of one cm^2 area was cut from each top, middle and bottom portion of the leaves of randomly selected five plants from each experimental unit. A number of hairs/$cm^2$from each piece was counted under stereoscopic zoom microscope (Leica DM 1000) and their average was worked out.

Length of hairs on the leaf lamina (mm): The length of hairs on the leaf lamina was measured under the stereoscopic zoom microscope from the three full-grown leaves taken from the five randomly selected plants of each test entry.

RESULTS AND DISCUSSION

Physio-morphic characteristics of brinjal leaves and their correlation with sucking insects

The data on Physio-morphic characters of brinjal leaves and their correlation with sucking insects were presented in Table 1 during 2014-15 and 2015-16.

Moisture content (%)

In 2014-15, significantly least moisture content was recorded in the brinjal genotype, JB-15 (80.30%). Whereas, significantly maximum moisture content

Table 1: Physio-morphic characters of certain brinjal Varieties/genotypes and their correlation with population of sucking insects during 2014-15 and 2015-16

Tr. No	Varieties/ genotypes	Average*** leaf moisture (%)		Average*** leaf area (cm^2)		Average*** hair density of leaf lamina/ cm^2		Average*** hair length on leaf(mm)		Average*** number of sucking insects per 3 leaves					
										Aphids		Jassids		Whiteflies	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
T_1	IVBL-116-131	88.46	89.17	168.36	166.35	443.80	451.28	0.28	0.29	5.30	5.38	5.12	6.20	4.40	4.80
T_2	JB-8	88.70	88.45	167.23	172.86	620.78	631.78	0.40	0.38	7.00	7.55	2.84	3.30	3.89	4.10
T_3	DBR-31	87.20	86.23	140.78	145.64	640.82	651.75	0.36	0.36	7.30	8.00	4.00	4.27	2.78	3.13
T_4	HABR-4	87.67	85.20	149.24	156.83	493.52	464.45	0.32	0.30	5.00	5.67	5.03	5.79	3.59	3.87
T_5	JB-64	88.63	86.23	130.49	127.09	676.23	455.36	0.33	0.31	4.67	5.30	3.67	4.20	3.90	4.21
T_6	JB-15	80.30	83.67	170.49	182.64	520.76	503.64	0.31	0.32	5.60	5.89	3.50	4.87	4.05	4.40
T_7	AZAD KRANTI	86.67	88.30	175.68	178.43	460.87	478.36	0.32	0.30	5.80	6.20	4.83	5.30	3.66	3.78
T_8	TRB-9	89.44	86.36	163.00	167.00	660.43	668.20	0.36	0.37	3.33	3.68	4.50	4.80	4.80	5.20
T_9	DBL-9	84.20	83.64	157.20	160.28	681.20	704.12	0.41	0.42	3.87	3.98	2.56	2.90	3.10	3.50
T_{10}	SURYA	86.46	84.28	162.31	170.56	456.30	481.64	0.35	0.33	5.43	4.48	4.27	3.85	3.40	3.85
T_{11}	SWARNA MANI	87.64	85.00	158.60	162.38	650.90	684.67	0.37	0.40	4.50	4.30	3.12	3.50	2.65	2.87
T_{12}	KASHI TARU	85.60	86.23	140.50	136.76	610.46	541.23	0.38	0.34	3.27	4.87	3.23	4.00	3.68	3.93
T_{13}	PUNJAB SADABAHAR	89.76	88.00	180.18	182.12	500.12	521.47	0.28	0.29	5.33	6.14	3.89	3.70	3.55	3.83
	SE(m)±	**0.63**	**0.59**	**1.22**	**1.18**	**1.99**	**1.14**	**0.01**	**0.02**	—	—	—	—	—	—
	C.D at 5%	**1.85**	**1.73**	**3.57**	**3.46**	**5.85**	**3.36**	**0.04**	**0.05**	—	—	—	—	—	—
Correlation coefficient (r)							Moisture (%)			0.037	0.447	0.323	0.320	0.139	0.294
							Leaf area (cm^2)			0.199	0.074	0.175	0.089	0.240	0.160
							Hair density on leaf / cm^2			-0.285	-0.123	-0.674*	-0.623*	-0.205	-0.331
							Hair length on leaf (mm)			-0.165	-0.251	-0.696**	-0.691**	-0.343	-0.357

**Significant at 5% level; ** Significant at 1% level; ***Average of three replications.*

89.76% was recorded in Punjab Sadabahar which was statistically at par with the TRB-9 (89.44%), JB-8 (88.70%), JB-64 (88.63%) and IVBL-116-131 (88.46%). The moisture per cent was in between 84.20 - 87.67% among rest of the brinjal varieties. Correlation coefficient revealed that moisture content in leaves of different brinjal varieties/genotypes had non-significant and positive relation with sucking insects like aphids (r= 0.037), jassids (r= 0.323) and whiteflies (r= 0.139).

During 2015-16, the average moisture content of the leaves of brinjal varieties/genotypes ranged from 83.64 - 89.17%. IVBL-116-131 had highest moisture content *i.e.* 89.17 % which was at par with JB-8 (88.45%), Azad Kranti (88.3%) and Punjab Sadabahar (88.00%). The minimum moisture content was recorded in DBL-9 followed by JB-15 (83.67%), Surya (84.28%), and Swarna Mani (85.00%). The range of moisture content of rest of them was exhibited in between 86.23 - 86.36%. Correlation study revealed that moisture content in leaves of different brinjal varieties/genotypes had non-significant and positive relation with sucking insects like aphids (r= 0.447), jassids (r= 0.0.320) and whiteflies (r= 0.294). The present findings are in conformity with Khan *et al.* (2015) who reported that moisture content of brinjal leaves showed non-significant and positive correlation with aphids and jassids. Singh and Agarwal (1988) also found that moisture content had positive correlation with incidence of jassid, *A. biguttula biguttula.* The results of the present investigation does not agree with those of Ali *et al.* (2012) who observed negative significant correlation between moisture content and jassids incidence.

Leaf Area (cm^2)

During 2014-15, the least leaf area was observed in JB-64 (130.49 cm^2) which was at par with Kashi Taru (140.50 cm^2) and DBR-31 (140.78 cm^2). Whereas, the significantly maximum leaf area was observed in Punjab Sadabahar (180.18 cm^2) followed by Azad Kranti (175.68 cm^2) and these were found at par with each other. The rest of genotypes showed moderate leaf area ranged from 168.36 cm^2 (IVBL-116-131) to 149.24 cm^2(HABR-4). Correlation study unveiled the non-significant and positive correlation between the leaf area (cm^2) and population of sucking pests like aphids (r= 0.199), jassids (r= 0.175) and whiteflies (r= 0.240). (Fig. 1)

During second year experimentation lowest leaf area (cm^2) was observed in JB-64 (127.09 cm^2) which was significantly differed with remaining genotypes. The next genotypes having less leaf area were Kashi Taru (136.76 cm^2). JB-15 exhibited highest leaf area *i.e.* 182.64 cm^2 which were found at par with the Punjab Sadabahar (182.12 cm^2). Correlation study during second year showed non-significant positive relation between leaf area (cm^2) and population of sucking insects like aphids (r= 0.074), jassids (r= 0.089) and whiteflies (r= 0.160). The present findings are nearly similar with the findings of Ali *et al.* (2012) who stated that greater the leaf area more will be the jassids population and they have significant positive correlation. Naqvi *et al.* (2008) reported that leaf area had no effect on leafhopper population, while the leaf area had a positive effect on whitefly population.

Hair density of leaf lamina per cm^2

The number of hairs (trichomes) per cm^2 of leaf was highest in DBL-9 (681.20), which was at par with the JB-64 (676.23) during 2014-15. The lowest number of trichomes 443.80 per cm^2 leaf area was recorded in IVBL-116-131 followed by Surya (456.30). The relation between leaf hair density and sucking insects population was non-significant and negative for aphids (r= -0.285) and whiteflies (r= -0.205); while jassids (r= -0.674) showed significant negative correlation with the leaf hair density of brinjal plant in general (Fig. 1).

The number of trichomes on leaves varied significantly between various genotypes and the highest number of trichomes per cm^2 leaf area were present in DBL-9 (704.12) followed by Swarna Mani (684.67) during 2015-16. The genotype IVBL-116-131 recorded significantly lowest number of trichomes (451.28). Remaining genotypes of brinjal had hair density ranging from 455.36 - 668.20 per cm^2. The relation between hair density per cm^2 leaf and sucking insects was non-significant and negative for aphids (r= -0.123) and whiteflies (r= -0.331); whereas, significantly negative with jassids (r= -0.623). The present study can be compared with Ali *et al.* (2012), Naqvi *et al.* (2008) and Giekwad *et al.* (1991). They reported that trichome density have a negative correlation with the population of *A. Biguttula biguttula* in the brinjal crop.

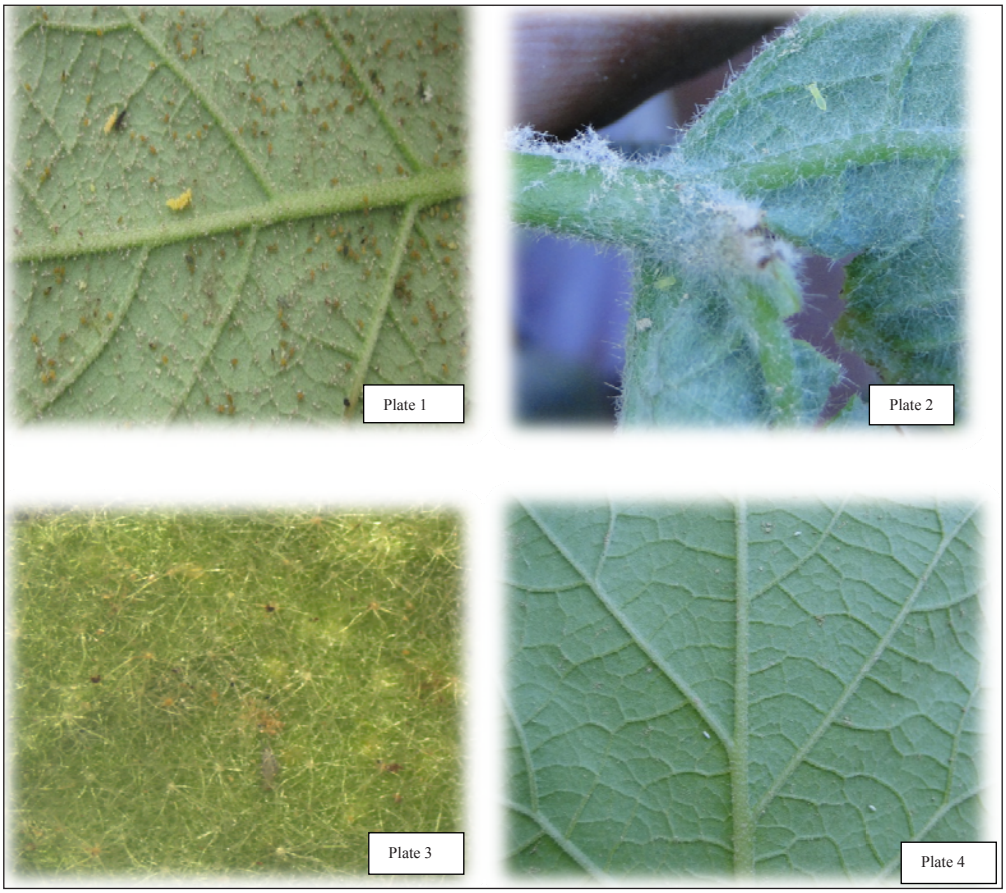

Fig. 1: Plate 1. Aphids, Plate 2. Jassids, Plate 3. Hair density and Plate 4. Whiteflies

Length of hairs on the leaf lamina (mm)

In the first season (2014-15), the maximum length (mm) of leaf hair was observed in DBL-9 (0.41 mm) and was followed by JB-8 (0.40), Kashi Taru (0.38 mm) and Swarna Mani (0.37 mm) but they were found at par with each other. The minimum hair length was recorded in Punjab Sadabahar (0.28 mm). This was at par with IVBL-116-131 (0.28 mm), HABR-4 (0.32 mm), Azad Kranti (0.32 mm) and JB-15 (0.31 mm). The rest of genotypes exhibited more or less similar hair length on the leaf (0.36 mm to 0.33 mm). The present study showed that sucking insects like aphids (r= -0.165) and whiteflies (r= -0.343) showed non-significant negative correlation, whereas jassids (r= -0.696) population was highly negative with the leaf hair length.

During the second year of the study, the genotype DBL-9 exhibited long hair length (0.42 mm) which was at par with Swarna Mani (0.40 mm) and JB-8 (0.38 mm). The genotypes like Punjab Sadabahar and IVBL-116-131 recorded shortest hair lengths (0.29 mm) which were comparable with HABR-4 (0.30 mm), Azad Kranti (0.30 mm), JB-64 (0.31 mm), JB-15 (0.32 mm), Surya (0.33 mm) and Kashi Taru (0.34 mm). Here, hair length showed non-significant negative correlation with sucking insects like aphids (r= -0.251) and whiteflies (r= -0.357), whereas jassids (r= -0.691) showed highly significant and negative correlation with the leaf hair length. The present findings are similar to that of Ali *et al*. (2012) who reported that length of hair showed a highly significant and negative correlation with the jassid population, Giekwad *et al.* (1991) also reported that hair length was negatively correlated with jassid population.

CONCLUSION

From the above study, it can be inferred that resistance/susceptibility is governed by a combination of various physic-morphic factors rather than a single physic-morphic trait only. Therefore, putting the matter, in a nutshell, we can say that as the number of hair and hair length on leaf lamina, midrib and leaf veins increases the population of sucking pests decreases due to not-

liking or non-preference (i.e. antixenosis). Similarly, with the increase of the leaf area and moisture content the population of sucking pests increases.

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