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Certain Morphological characters imparting resistance in tomato against fruit borer, *Helicoverpa armigera* (Hubner)

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ABSTRACT
Tomato is one of the most preferred vegetable crops in the world with the total global area of 45,82,438 thousand ha and production of around 15,05,13,813 thousand tones. Despite of the good area, production is not up-to the mark as tomato is more prone to insect pests viz., tomato fruit borer, green house whitefly, serpentine leaf miner, etc due to its tenderness and softness as compared to other crops. Among them, the tomato fruit borer, Helicoverpa armigera (Hubner) is main bottle neck and causes heavy loss in yield. Host plant resistance or varietal resistance constitutes an important field of study with the hypothesis that different varieties/lines of tomato possess varied degree of population and per cent damage by H. armigera. The present studies were carried out on Vegetable Research Farm, IAS, BHU, Varanasi during 2017-18. On the selected twenty two tomato varieties/lines morphological characters viz. number of branches per plant, number of calyx per fruit, density of trichomes on the calyx, density of trichomes on the leaf surface, fruit pericarp thickness were measured and compared. The results showed that the correlation of branches per plant (r= 0.674) and number of calyx per fruit (r=0.373) were significantly positive while density of trichomes on the calyx (-0.522), density of trichomes on leaf surface (r= -0.322) and fruit pericarp thickness (r= -0.473) exhibited significantly negative association with the damage of tomato fruit borer. The morphological characteristics used under present studies can be used as marker traits by breeders to develop insect resistant varieties/lines of tomato through breeding programs.
Keywords: *Morphological characters, H. armigera, fruit damage, correlation analysis*

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INTRODUCTION

India is second largest producer of vegetables after China (75 million tonnes) constituting 9.4% of the total production [1]. Tomato (*Solanum lycopersicum* L.) is one of the important and remunerative vegetable crops which is grown around the world belongs to the family Solanaceae. It is believed to have its origin in tropical America [2] was introduced in India by an English trader of the East India Company in 1822 [3]**.** Tomato ranks third in priority after Potato and Onion in India but ranks second after potato in the world. India ranks second in the area as well as in production of tomato. However, among all vegetables tomato, *S. lycopersicum* L. is one of the most important "protective foods" because of its nutraceutical values which belong to Solanaceae family**.** Apart from vitamins, minerals, fibres tomatoes are the richest source of "lycopene" a phytochemical that protects cells from oxidants that have been linked to human cancer [4]**.** It is a rich source of vitamin-A (4.04mg/100g), vitamin-C (15-30mg/100g), total soluble solids (4-7%), acidity (7.5-10mg/100ml) and lycopene (1.82-5.24mg/100g). Due to its tenderness and softness as compared to other crops it is attacked by various insect pests but among all *Helicoverpa armigera* (Hubner) alone is a serious menace as it attacks the cashable part of the plant i.e. fruits and makes them unfit for human consumption causing considerable crop loss leading up to 55 per cent. It has been estimated that the crops worth Rs.1000 crore are lost annually by this pest [5]**.** The indiscriminate use of pesticides for the management of this pest leads to build up of pesticide residues in the produce, destruction of beneficial insects, pest resurgence, pesticide exposure to farm workers and environmental pollution. Host plant resistance (HPR) is the economically sound technique to reduce pest linked damage in tomato as well as to protect the environment from adverse effects of pesticides. Various morphological characteristic in the crop plants, play a major role in imparting resistance against insect

pests. In tomato, trichomes are generally present on leaves and calyx that offers resistance against many insect pest species likewise other factors *viz.* number of branches per plant, density of trichomes on the leaf surface, Fruit pericarp thickness might either attract or deter the pests. Understanding of various morphological characteristics of resistance are essential for developing strategies to breed for resistance to insect pests [6]. Hence, the present studies were carried out to identify the impact of morphological characters of tomato that impart against *H. armigera*.

MATERIAL AND METHODS

Twenty two varieties/lines of tomato were screened for their relative susceptibility to fruit borer. One month old seedlings were transplanted in the field at the spacing of 60×45cm^2. The experiment was laid out in Randomized Block Design with four replications and no chemicals were sprayed on the crop in order to make the crop fully prone to insects. The per cent fruit damage was recorded from ten randomly selected and tagged plants, right from second week after transplanting of tomato seedlings. On the basis of per cent damage of fruits, the variety/line was rated for different levels of resistance by using the formula suggested by Kashyap and Verma, [7].

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

Method observations on morphological parameters

he observations on different tomato varieties/lines for morphological characteristics of the fruits *viz*., number of branches per plant, density of trichomes on the leaf surface, number of calyx density of trichomes on the calyx and the fruit pericarp thickness were be recorded at 30, 50 and 70 days after transplanting as suggested by Amin *et al*. [8]**.** The number of branches per plant and number of calyx present on fruit were recorded by visual counting while the trichome density on calyx were estimated from green fruits after 7 days of first fruit appearance by placing 1 mm-long transverse section of calyx on a clean glass slide and counting the trichomes using a binocular microscope at 10X magnification. The density of trichome on the leaf surface was assessed by excising the top leaf sample and the counting of trichomes was done under binocular microscope on 10mm^2 area. The fruit pericarp thickness was taken with the help of digital vernier's calipers by cutting the fruit transversely. The number of branches per plant, number of calyx per fruit, density of trichomes on the leaf surface and trichomes also the fruit pericarp thickness was correlated with per cent fruit damage.

Randomized Block Design (RBD) - one way analysis of variance (ANOVA) was used to determine the significant differences between morphological characteristics of different varieties/lines of as suggested by Gomez and Gomez [9] and the interrelationships between fruit borer damage and mean values of each studied morphological characteristics statistical analysis program (SPSS) was used.

RESULTS AND DISCUSSION

The data revealed that all 22 tomato varieties/lines were significantly different from each with respect to the per cent of damage. Results revealed that the per cent damage of *H. armigera* ranged from 5.02 to 46.85%. The varieties/lines Pb-Barkha-1, Pb-Barkha-2 DVRT-1, DVRT-2, Kashi Sharad, Pusa Rohit were found resistant against *H. armigera* as the per cent damage was less than 10% and the two varieties/lines KT-8 and H-86 were found highly susceptible as the per cent damage was above 40%. The morphological characteristics in plants defend against herbivores and important role in conferring resistance to fruit borer. Major morphological characteristics of tomato plant and fruits in relation to per cent damage *H. armigera* are given in Table 1. The results showed that, number of branches per plant and number of calyx per fruit varied between 9.04 to 19.31 and 5 to 5.53 respectively, however the correlation co-efficient revealed that both the parameters had positive association (r=0.674 and r=0.373) with per cent damage of fruits. The variety/line Kashi Sharad was found resistant to *H. armigera* by recording significantly minimum number of 9.04 branches per plant with minimum fruit damage 9.04% and it was statistically similar with Pb Barkha-1(9.33 branches per plant), Pb Barkha-2(9.85 branches per plant), DVRT-1(9.07 branches per plant), DVRT-2(9.71 branches per plant) and Pusa Rohit (9.21 branches per plant), consequently the number of calyx on fruits were observed less on resistant varieties/lines therefore, both the parameters showed that lower the number of branches and calyx on fruits, lower will be the per cent fruit damage. The results of both the parameters get support from the earlier works of Archana *at al.* [10].

The mean density of trichomes on the calyx, density of trichomes on the leaf surface and fruit pericarp thickness ranged from 2.15 to 5.85, 9.18 to 16.85 and 0.18 to 0.65 respectively, all three parameters had negative association (r= -0.522, r= -0.322 and r= -0.473) with per cent damage of fruits. The variety/line Pb Barkha-2 had maximum number of trichomes on the calyx (5.85) exhibiting 8.98% per cent fruit damage which was statistically similar with Pb Barkha-1(5.22 trichomes on the calyx), DVRT-1(5.1

trichomes on the calyx), DVRT-2(5.21 trichomes on the calyx), Kashi Sharad (5.3 trichomes on the calyx) and Pusa Rohit (5.19 trichomes on the calyx). However, similar pattern in observation was found for density of trichomes on the leaf surface. Moreover the fruit pericarp thickness was more in resistant varieties/lines i.e. maximum fruit pericarp thickness was found in Pb Barkha-1 (0.65 cm) with 6.75 per cent fruit damage and graded as resistant variety/line, similarly susceptible varieties/lines displayed lesser fruit pericarp thickness. The results are in conformity with previous research [11].

CONCLUSION

It is concluded from the present investigation that morphological characteristics such as number of branches per plant, density of trichomes on the leaf surface, number of calyx, density of trichomes on the calyx and the fruit pericarp thickness can be used as marker traits by breeders to develop insect resistant varieties/lines through breeding programs. Further, research is needed to study the morphological characteristics of tomato fruit in relation to *H. armigera*.

Table: 1 Morphological characters of various tomato varieties/lines in relation to fruit borer damage

S. No.	Varieties/lines	Per cent fruit damage	Number of branches per plant	Number of calyx per fruit	Density of trichomes on the calyx	Density of trichomes on the leaf surface (10 mm^2)	Fruit pericarp thickness (cm)
1.	VRT-2	25.22	12.62	5.21	3.85	14	0.36
2.	Sel-7	11.51	10.04	5.1	4.22	15.04	0.46
3.	VRT-51	20.12	12.45	5.25	3.85	14.15	0.34
4.	VRT-01	22.53	12.92	5.22	3.35	14.02	0.37
5.	KT-8	46.85	19.31	5.51	2.45	9.31	0.18
6.	VRT-50	26.14	12.16	5.26	3.29	14	0.36
7.	ToLCV-32	13.14	10.28	5.18	4.97	15.08	0.48
8.	ToLCV-28	15.24	10.6	5.16	4.71	15.5	0.45
9.	VRT-13	28.10	12.93	5.2	4.33	14.03	0.35
10.	ToLCV-16	16.85	10.87	5.14	4.21	15.07	0.48
11.	VRT-19	22.54	12.03	5.25	3.13	14.24	0.31
12.	H-86	42.10	14.15	5.53	2.15	9.18	0.19
13.	VKT-06	35.77	12.85	5.41	2.85	10.15	0.25
14.	Pb Barkha-1	6.75	9.33	5.01	5.22	16.2	0.65
15.	Pb Barkha-2	8.98	9.85	5.06	5.85	16.85	0.6
16.	Sankranti	18.22	10.35	5.13	4.35	15.05	0.43
17.	Nandi	37.80	12.45	5.47	2.05	10.25	0.22
18.	Vaibhav	31.22	12.29	5.44	2.19	10.71	0.25
19.	DVRT-1	7.11	9.07	5.05	5.1	16.07	0.56
20.	DVRT-2	9.88	9.71	5	5.21	16.71	0.55
21.	Kashi Sharad	5.02	9.04	5.02	5.3	16.33	0.58
22.	Pusa Rohit	9.22	9.21	5.05	5.19	16.21	0.6
Correlation coefficient		-	0.674	0.373	-0.522	-0.322	-0.473

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