

Floral descriptors of field evaluated tomato germplasm

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Abstract

The frequency of same level as stamen type of flower with simple, hairy style was more (40.39) in 119 tomato accessions evaluated at Hyderabad. The average petal length, stamen length, number of flowers per inflorescence and number of fruits per cluster were more in highly exerted type of flowers. The same level as stamen type of flowers recorded highest fruit set, early and maximum yield.

Key words: Tomato, accessions, petal length, sepal length, stamen length, fruit set, yield, germplasm

Introduction

Tomato fruit is almost universally treated as a vegetable and a perennial plant that is almost universally cultivated as an annual (Rick, 1978). The tomato inflorescence is a cyme initiated by the apical meristem and consisting of a main axis bearing lateral flowers without bracts. For high fruit set, as a sequence of processes including pollination, germination of pollen grains, pollen tube growth, fertilization and fruit initiation must take place successfully and pollination is facilitated by flower structure. Hence the present study was carried out to find out variability existing in exotic tomato germplasm based on flowering descriptors, to use in future breeding programs.

Materials and methods

A total of 188 exotic tomato germplasm was field grown for characterization and evaluation at NBPGR Regional Station, Hyderabad during 1997-98 and descriptors of 119 accessions was used for analysis. The climate was semi-arid with a range of 3.5-283.4 mm rainfall. The minimum and maximum temperature range was 10.1-26°C and 28.2-39.8°C, respectively. The soil type was red sandy loam.

Seeds were sown in well prepared plastic pots of 5.5" diameter and seedlings were raised in a glass house. A month old seedlings were transplanted at a distance of 60 x 60cm spacing. Recommended cultural practices were followed during the cropping season. Each germplasm accession was planted in three rows of 3 m each in an augmented design. Five competitive plants per accession were tagged and data was recorded as per IPGRI descriptor (1996). The fruit set(%) was estimated by the following formula:

$$\text{Fruit set (\%)} = \frac{\text{No. of fruits per cluster}}{\text{No. of flowers per inflorescence}} \times 100$$

Yield was computed based on cumulative data from different harvesting dates. Days to 50% flowering was calculated when 50% of the plants in an accessions has come to flowering. Petal, sepal and stamen length was recorded by digital vernier calipers.

Results and discussion

The flowers were pentamerous, bisexual, complete, ebracteate, hypogynous. Based on the style position, four types of flowers were identified in tomato germplasm as per IPGRI descriptor, 1996 *i.e.*, highly exerted, slightly exerted, same level as stamen and inserted. Usually style is shorter than anther cone and high degree of self pollination takes place (Kalloo, 1996). The data presented in Table 1 revealed that more number of accessions possessed same level as stamen type of flowers (40.34%), followed by inserted (24.37%), slightly exerted (22.69%) and highly exerted type of flowers (12.61%). Many (96.64%) accessions possessed simple style shape and style hairiness.

Table 1. Diversity in style position, style shape, style hairiness and dehiscence in tomato germplasm

Descriptor	Frequency	Per cent
Style position		
a) Highly exerted	15	12.61
b) Slightly exerted	27	22.69
c) Same level as stamens	48	40.34
d) Inserted	29	24.36
Style shape		
a) Simple	115	96.64
b) Fasciated	4	3.36
Style hairiness		
a) Present	115	96.64
b) Absent	4	3.36

The average petal, stamen length was more in highly exerted type of flowers (9.96 and 7.59 mm) than other flower types. Sepal length was more in inserted type of flowers (7.8 mm) and less in highly exerted (5.69 mm). The variability in petal was more in inserted, where as variability in sepal and stamen length was more in highly exerted type of flowers. The petal and stamen length were significantly different from each category, whereas sepal length of same level as stamen and slightly exerted type of flowers was not significantly different unlike other flower types.

When tomato plants are grown under favourable light conditions, floral transition occurs during the fourth week and the first inflorescence appears macroscopically around 45th day, two

Table 2. Quantitative characters of exotic tomato germplasm based on flower structure

Flower structure	Days to 50% flowering	Petal length (mm)	Sepal length (mm)	Stamen length (mm)	No. of flowers /cluster	No. of fruits / cluster	Fruit set (%)	Yield (g)
Slightly exerted								
Average	64.6	9.65	6.8	7.57	6.79	3.5	51.1	2197
Range	56-84	6.97-11.45	3.74-8.36	5.41-8.24	5-12.25	1.8-10.5	30.03-73.07	1342.8-3331.03
SEd±	6.3	1.04	1.19	0.649	2.03	1.7	12.2	568.2
C.V.	9.76	10.7	17.6	8.57	29.4	48.6	23.9	25.86
S.E.	1.21	0.2	0.23	0.13	0.39	0.33	2.36	109.36
Same level as stamen								
Average	61.8	9.77	6.8	7.48	6.44	3.6	55	2115.7
Range	53-74	7.68-12.25	4.6-9.8	5.33-7.3	5-9.5	1.8-6.8	31.4-89.0	1115.9-3532.0
SEd±	10.7	0.92	1.12	0.65	1.15	1.21	14.36	476.0
C.V.	17.3	9.46	16.39	8.68	17.86	33.45	26.1	22.54
S.E.	1.55	0.13	0.16	0.09	0.17	0.17	2.07	68.8
Inserted								
Average	64.4	9.77	7.81	7.478	6.49	3.01	47.43	1993.9
Range	53-77	7.4-12.128	4.9-11.73	5.66-8.15	3.8-14.5	1.66-4.88	19.3-65.625	1234.65-2780.7
SEd±	7.25	1.3	1.68	0.495	11.89	0.8	10.92	428.9
C.V.	11.26	13.42	21.5	6.62	29.03	26.67	23.02	21.5
S.E.	1.35	0.24	0.31	0.09	0.35	0.15	2.03	79.65
Highly exerted								
Average	63.2	9.96	5.69	7.59	7.17	3.9	54.34	1967.6
Range	53-84	7.97-12.50	3.92-7.32	6.09-9.19	5.0-13.0	2.5-9.4	33.33-72.38	1255.3-3331.0
SEd±	9.21	1.29	1.24	0.79	2.53	1.8	11.3	595.4
C.V.	14.57	12.98	21.81	10.46	35.26	46.71	21.05	30.26
S.E.	2.38	0.33	0.32	0.205	0.653	0.47	2.95	153.74

weeks later *i.e.*, two months after sowing, anthesis of most flowers of the inflorescence occur in sequence. The only one or two last initiated floral buds invariably abort (Kinet, 1997). The range of days to flower was 56-84, 53-74, 53-77 and 53-84 in case of slightly exerted same level as stamen, inserted and highly exerted type of flowers. Accessions EC 162601 (same level as stamen), EC 338735 (inserted), EC 164334 (highly exerted) has flowered earlier *i.e.*, 53 days. The reason for variation in days to flower even within the same category could be alteration of starch/sucrose synthesis by increasing the capacity for sucrose synthesis, resulting in a reduced time to 50% blossoming and in an earlier fruit maturation (Micallef *et al.*, 1995). Data presented in Table 2 revealed that the average number of days to flower was more in slightly exerted type of flowers (64.6) followed by inserted (64.4) type of flowers. The average days to flower was 61.8 and 63.2 in same level as stamen and highly exerted type of flowers, respectively. The variability for days to 50 % flowering was more in same level as stamen type of flowers. Number of days taken to flower was significantly different in different types of flowers.

The number of flowers per inflorescence varies from three to several in tomato (Kalloo, 1996). The average number of flowers per inflorescence and the average number of fruits per cluster was more in highly exerted type of flowers *i.e.*, 7.17 and 3.9 respectively. Accessions EC 313466 (11.20), EC 151568 (12.25) possessed more number of flowers per inflorescence in slightly exerted type of flowers. The variability in number of flowers per inflorescence and number of fruits per cluster was more in highly exerted and slightly exerted type of flowers, respectively. The number of flowers and fruits per cluster was significantly different in different flower structures.

Table 3. Significant difference ($p \leq 0.05$) of different floral descriptors in different flower structure

Floral descriptor	Slightly exerted	Same level as stamen	Inserted	Highly exerted
Days to 50% flowering	A	D	B	C
Petal length(mm)	A	B	C	D
Sepal length(mm)	B	B	A	C
Stamen length(mm)	B	C	D	A
No. of flowers/ Inflorescence	B	D	C	A
No. of fruits/ Cluster	C	B	D	A
Fruit set (%)	C	A	D	B
Yield(g)	A	B	C	D

* Same letters indicate no significant difference between different flower structure.

The key to yield success is to obtain a good fruit set on each cluster and to ripen the fruit as quickly as possible. The loss of one or two fruit per cluster or missing cluster will significantly reduce yield. Thus, genetic traits, environmental conditions and cultural practices predisposing plants to unfruitfulness, physiological disorders and fruit defects have also significant limitation to productivity. Fruit set is defined as the proportion of flowers that produce a fruit of a minimal size in the population of flowers which appear to reach anthesis normally (Picken, 1984). The per cent fruit set was more in same level as stamen type of flowers (55.1%) followed by highly exerted (54.3%). The highest set was recorded in EC 176933 (73.1%) of slightly exerted type of flowers and EC 179083 (89%), EC 173854 (72%), EC 175957 (72%) and EC 177329 (72%) of same level as stamen type of flowers and EC 251694 (72.38%) of highly exerted type of flowers. The variability in fruit set (%) was more in same level as stamen type of flowers. The

fruit set (%) was significantly different in different flower structure.

The average fruit yield per plant was more in slightly exerted and same level as stamen type of flowers *i.e.*, 2197-2115g, respectively. EC 176933 (3126g) and EC 260639 (3331g) of slightly exerted type of flowers ; EC 173854 (3532g), EC 338717 (3146g) of same level as stamen type of flowers was recorded higher yields. The variability in yield was more in highly exerted type of flowers. Tomato yield can be increased by keeping the plant alive and productive during a longer period of time. The genetic potential of tomato plant is being achieved and that any dramatic yield increase per plant must come from some factor or groups of factors which will break the genetic yield potential (Jones,1980).

Based on the above results, it can be concluded that the frequency of same level as stamen type of flower structure with simple, hairy style was more in the germplasm evaluated . The average petal length, stamen length, number of flowers per cluster and number of fruits per cluster was more in highly exerted type of flowers. The same level as type of flowers recorded highest fruit set, early and maximum fruit yield (Table 2).

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