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Screening of tomato hybrids (*Solanum Lycopersicum* L.) for hot set region

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Abstract
Tomato *(Solanum lycopersicum* L.) belonging to *Solanaceae* family, which is one of the popular vegetable crops of the world including India, grown in most of the parts of the country which is widely used for culinary purpose. Tomato generally grown in three season viz. *kharif*, *rabi* and *summer*. In *kharif* and *rabi* Season due to market glut the price of tomato drastically fall down and farmer couldn't get his even input cost. But in summer season, as it is off season farmer can get high market rate. So there is large scope to find out best suited hybrid which can perform well in the summer season as the net income is increased and the farmer is get benefited. In this present investigation the different hybrids were studied for their performance in the summer season with respect to quality and quantity parameters thorough plot experiment conducted during summer season of 2018. The experiment consisted of twenty-one hybrids and one hybrid check (TO 1057) were planted in Randomized Block Design in two replication. The observations recorded on different quantitative characters such as plant height, number of branches, number of days to 50 percent flowering, fruit set, number of fruits per plant, equatorial and polar diameter, average fruit weight, pericarp thickness, number of locules, yield per plant. The overall result indicates that the hybrids viz. 9 X 6, 9 X 3, 7 X 3, 3 X 6 and 6 X 7 appears to suitable for fruit setting under high temperature as they gave substantially higher yield with more number of good size fruits.

Keywords: Tomato, Hybrid, High temperature, Fruit set, Average Fruit weight, Pericarp, Thickness

Introduction
Tomato *(Solanum lycopersicum* L.) belonging to *Solanaceae* family, which is rich in minerals and vitamins especially it is good source of Vitamins A, B and C. It is helpful in healing wounds because of antibiotic properties found in ripe fruits and it is the top most vegetable crop in processing industries. Tomato generally grown in three season viz. *kharif*, *rabi* and *summer*. In *kharif* and *rabi* Season due to market glut the price of tomato drastically fall down and farmer couldn't get his even input cost. But in summer season, as it is off season farmer can get high market rate. Due to high market in the summer season that is in the off season, it is necessary to produce the off season variety in tomato, so there is large scope for developing variety which can perform well in the summer season as the net income is increased and the farmer is get benefited.

Tomato production under high temperature conditions, such as the summer in Egypt, India, Afghanistan and Bangladesh reduces the product quality and yield. For instance, low fruit setting, reduction in the flower fertilization rate, decrease in the lycopene content and high evaporation are all related to high temperature stress**,** indicated that heat stress in tomato plants occurred at 35^0C. This due to decrease weight and accumulation soluble phenolic compounds and reported that the most plants were suffer from both physiological and biochemical damage by exposure to temperature higher and reduced growth capacity of the crops and commercial yield (Ibrahim, 2009) [8].

High temperature strongly affects the vegetative and reproductive organs and tissues of tomato plants. At high temperature chlorophyll, lutein, carotenoid content decrease and the ratio of various pigments also changes with direct effect on absorption of light energy mainly the activity of PS II, which further influences the electron transport ovule development, fertilization and fruit initiation and limits fruit set in germinating pollen, leading to a decrease in endogenous polyamines below a critical level (Abdelmageed *et al.* 2003) [1]. Many times it is observed that tomato require different temperature for different stages of its development i.e.

for seed germination, vegetative growth, flowering and fruiting the respective temperature range is 15.5 to 29.5^{0}C, 19 to 21^{0}C and 23.8 to 32^{0}C. It is reported that at temperature above 37.08^{0}C, pollen germination is inhibited resulting in poor fruit set (Abdelmageed and Gruda, 2009) [2].

Material and Methods

Seeds of all the tomato hybrids used in the present investigation were obtained from the Tomato Improvement Scheme, Department of Horticulture, MPKV, Rahuri. The list of tomato hybrids is given in Table 1. The hybrids under the study were grown at the Tomato Improvement Scheme, Department of Horticulture, MPKV, Rahuri, during the summer season of 2018. Seeds were sown on the raised beds in February 2018, while the seedlings were transplanted on ridges in March 2018. Randomly five plants were selected from the plots and various parameter like plant height (cm), number of branches per plant, days to 50% flowering, fruit set (%), weight of fruit (g), Number of locules, Pericarp thickness (mm) and yield per plant (kg).

The plant height was recorded in centimeters from earlier selected five plants from ground level to the growing tip of the main stem with the help of metallic strip tape after last harvest. The number of branches per plant counted for randomly selected five plants and average was recorded. Number of days required from the day of transplanting to the day on which 50% of plants flowered was recorded as days to 50% flowering. The number of fruits harvested from the five flower clusters tagged on each of the observational plant was counted and their percentage was worked out in relation to the total number of flowers originally present in the tagged clusters. The five plants from the field are selected randomly and the total number of fruits on each plant counted separately and then the mean of five observations is taken, for the particular plot. Weight of the five randomly selected fruits from each of five observational plant of each treatment was recorded and the average was calculated. Number of locules were counted by taking Transverse cut of the five randomly selected fruit from the observational plant in each treatment as the average was calculated. The pericarp thickness was recorded with help of the vernier caliper in centimeter of the five randomly selected fruit from the observational plant in each treatment and the average was calculated. Total weight of fruits of the five plants was recorded and the average yield of fruits per plant was worked out in kg by summing up of all the pickings.

The data obtained from different treatments under investigation will be subjected to statistical analysis as per procedure prescribed for randomized block design as suggested by Panse and Sukhatme (1985) [13].

Table 1: Hybrids included in the study

Sr. no.	Treatment no.	Name of Hybrid
1	T_1	2 X 6
2	T_2	2 X 7
3	T_3	2 X 9
4	T_4	3 X 4
5	T_5	3 X 5
6	T_6	3 X 6
7	T_7	3 X 7
8	T_8	6 X 7
9	T_9	7 X 8
10	T_{10}	8 X 9
11	T_{11}	6 X 3
12	T_{12}	7 X 3
13	T_{13}	7 X 6
14	T_{14}	8 X 3
15	T_{15}	8 X 5
16	T_{16}	8 X 6
17	T_{17}	8 X 7
18	T_{18}	9 X 3
19	T_{19}	9 X 6
20	T_{20}	9 X 7
21	T_{21}	9 X 8
22	T_{22}	TO 1057 (c)

Results and discussion

Days to 50% flowering

The data in Table 3 indicate that the hybrids differed significantly from each other with regard to the days required for 50 per cent flowering from the date of transplanting. The period varied very widely from 38 to 44 days. The minimum period of 38 days for the days to 50 per cent flowering was recorded by the hybrid 9 X 3. However, it was at par with those recorded by all the hybrids except the hybrids 6 X 3, and 7 X 3. The hybrid 7 X 3 took the longest period of 44 days for 50 per cent flowering.

It is reported by (AVRDC, 1978) [5] i.e. night temperature below and above normal was found to be detrimental to many processes, namely; flower initiation, pollen development, pollen dehiscence leading to low fruit set.

Fruit set (%)

It is revealed from the data presented in Table 3 that all the hybrids differed significantly in their ability to set fruits. The fruit set percentage ranged between 64.99 and 77.54 percent. The hybrid 9 X 6 recorded the highest fruit set of 77.54 per cent. It was at par with those recorded by the hybrids viz. 7 X 3 (77.12%), 9 X 3 (76.82%), 3 X 6 (75.56%) and 6 X 7 (75.01%).Minimum fruit set (64.99%) was found in the hybrid 2 X 7.

The results are more or less similar to the result reported by Iwahori *et al.* (1963) [9] reported very poor fruit set at the higher temperature of 40-45^{0}C. These types of result are also reported by the other worker like Marrero and Krikava (1983) [12], Kuo *et al.* (1979) [11], Arora *et al.* (1982) [4], Sugiyama *et al.* (1966) [14] and Thompson *et al.* (1964) [15].

Jamdhade (2016) [10] conducted the experiment entitled screening of tomato (*Solanum lycopersicum* L.) genotypes under high temperature regimes, reported more or less similar type of result i.e. genotype RHRT-15-3 recorded the highest fruit set of 69.91 per cent.

Number of locules

The data presented in Table 3 revealed that the hybrids differed significantly in the fruit character that is the numbers of locules. The count varied from 2 to 3. The minimum numbers of locules i.e. 2 were found in 2 X 6, 2 X 9, 3 X 4, 3 X 5, 3 X 7, 7 X 8, 8 X 7, 9 X 3, 9 X 6, 9 X 7, 9 X 8 and TO 1057. However these hybrids were at par with those recorded by the hybrids viz. 3 X 6, 8 X 9, 7 X 6, 8 X 5 and 8 X 7.

Garg and Cheema (2011) [7] reported that the high temperature cause significant losses in tomato yield due to lower quality of fruits he also reported that the high temperature adversely affect the fruit character that is number of locules.

Pericarp thickness (cm)

The data presented in Table 3 revealed that the hybrid do not differs significantly in the fruit character that is the pericarp thickness of fruit. The pericarp thickness varied from 0.54 to 0.68 cm. The hybrid 3 X 6 and 7 X 8 was found to have

maximum pericarp thickness i.e. 0.68 cm. The minimum pericarp thickness was found in the hybrids 7 X 3 and 9 X 8 which is 0.54 cm.

Average weight of fruit (g)

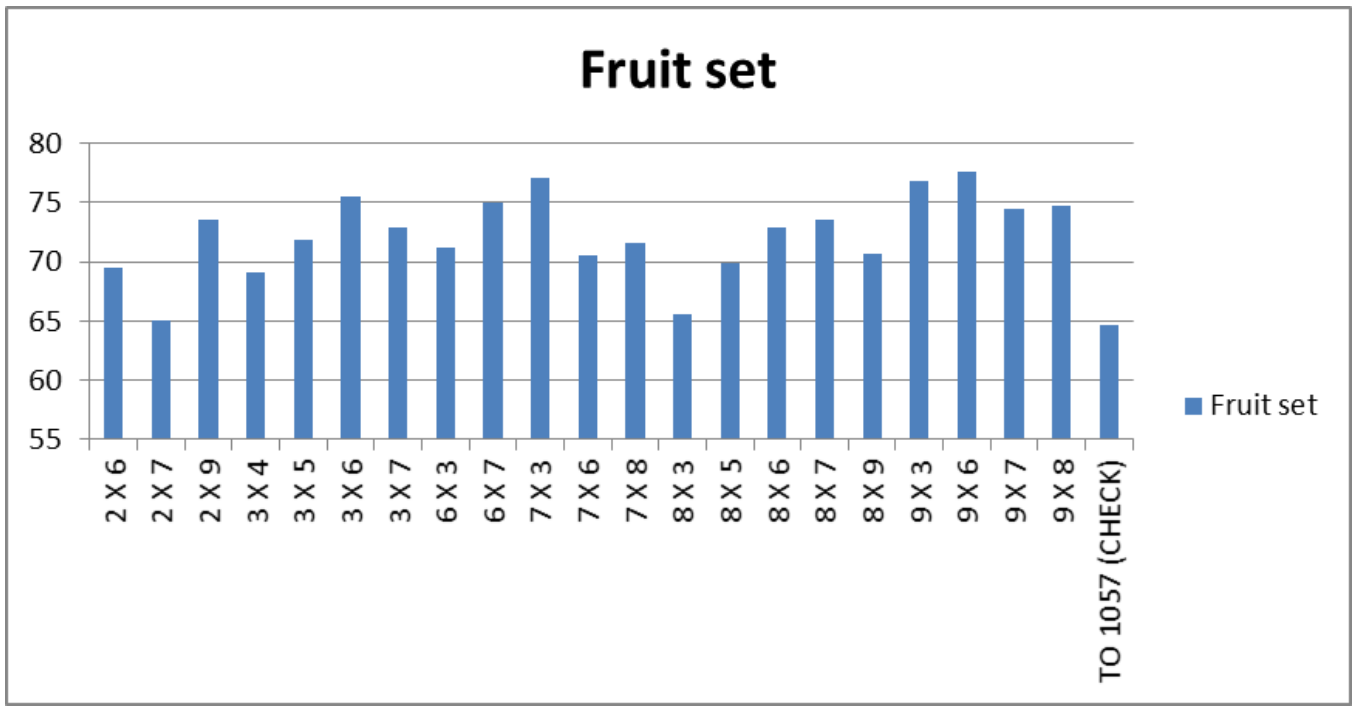
The data presented in the Table 5 revealed that the hybrids differed significantly. The average fruit weight of fruit of the hybrids ranged between 31.51 to 56 g. The hybrid 3 X 6 recorded the highest average fruit weight of 56 g. It was significantly greater than those recorded by rest of the hybrids. This was followed by the hybrids viz. 7 X 3, 9 X 3, 9 X 6 and 6 X 7. The hybrid 2 X 7 recorded the lowest fruit weight of 31.51 g. The fruit weights recorded by rest of the hybrids were in between.

Results are more similar to results obtained by Bharadwaj and Thakur (1994) [6] recorded the maximum fruit weight (56.60 g) in Roma and the lowest (29.86 g) in Pant Bahar. Alam *et al.* (2005) [3] have also reported the same type of results regards to the average fruit weight that he recorded the highest fruits weight of individual fruit was 56.02 g.

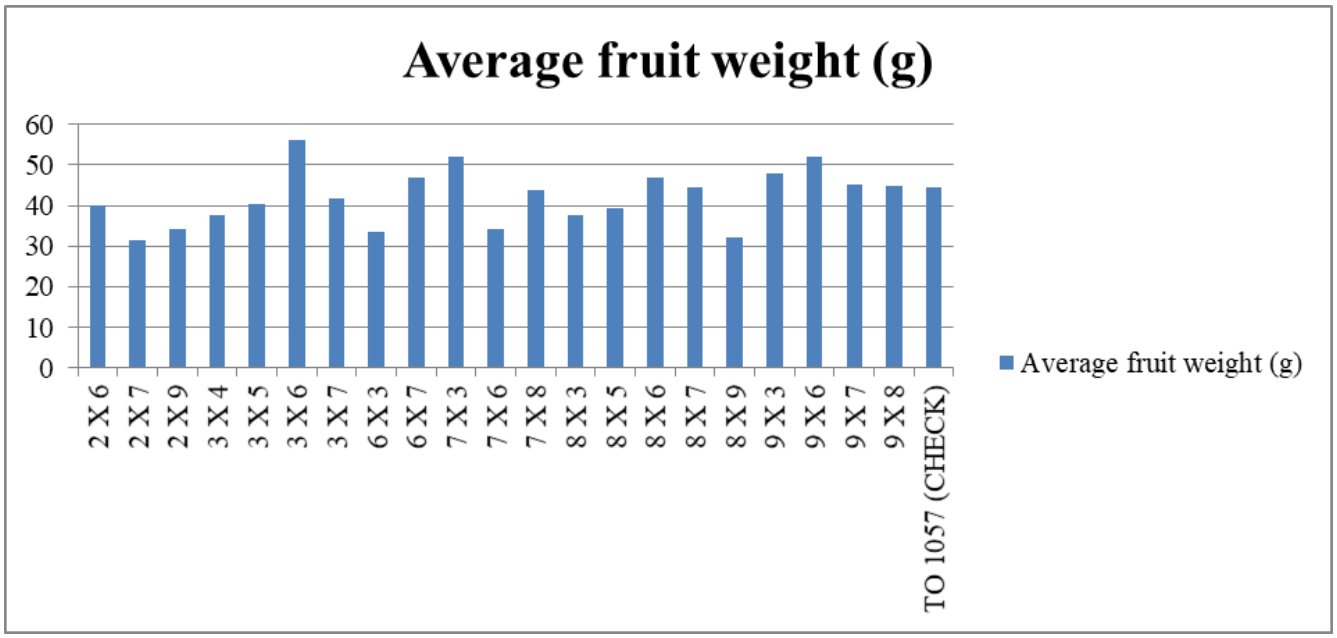
Table 2: Evaluation of tomato hybrids for flower and fruit development characters

Name of the hybrid	Days to 50% flowering	Fruit set (%)	Number of fruits per plant	Pericarp thickness (cm)	Average weight of fruit (g)
2 X 6	40.5	69.44	30.5	0.61	39.90
2 X 7	38.5	64.99	31.0	0.67	31.51
2 X 9	40.0	73.54	41.0	0.66	34.07
3 X 4	39.5	69.05	31.0	0.64	37.58
3 X 5	41.0	71.84	31.5	0.61	40.46
3 X 6	41.0	75.56	29.0	0.68	56.00
3 X 7	39.5	72.85	33.5	0.57	41.90
6 X 3	43.5	71.16	35.0	0.56	33.52
6 X 7	39.5	75.01	35.0	0.60	47.05
7 X 3	44.0	77.12	30.5	0.54	52.12
7 X 6	40.5	70.56	33.0	0.60	34.12
7 X 8	38.5	71.61	29.0	0.68	43.88
8 X 3	39.5	65.61	28.0	0.56	37.78
8 X 5	41.0	69.85	27.0	0.58	39.44
8 X 6	42.5	72.84	28.0	0.60	46.93
8 X 7	41.0	73.54	33.0	0.61	44.46
8 X 9	38.5	70.73	35.5	0.57	32.32
9 X 3	38.0	76.82	34.0	0.49	48.08
9 X 6	40.5	77.54	31.0	0.55	52.15
9 X 7	42.5	74.45	32.5	0.64	45.31
9 X 8	40.0	74.76	34.5	0.54	44.71
TO 1057 (Check)	39.5	64.71	20.5	0.57	44.45
S.Em (±)	1.62	0.91	2.82	N.S	1.11
C.D. @ 5%	4.77	2.68	8.31	N.S	3.27

Graphical representation of the fruit set (%) parameter



Graphical representation of the Average fruit weight (%) parameter



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