The Pharma Innovation Journal 2021; 10(11): 256-259

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 256-259

www.thepharmajournal.com
Received: 09-09-2021
Accepted: 28-10-2021

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Evaluation of different varieties of tomato (*Solanum lycopersicum* L.) in semi control protected structure

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Abstract
A research investigation was carried out in the polyhouse of Jacob Institute of Biotechnology and Bioengineering, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the Rabi season of 2020-2021 to find out the best treatment for better growth and yield of Tomato. The experiment was laid out in Randomized Block Design comprising of 10 treatments *viz*., T_1-Arka Apeksha, T_2-Arka Rakshak, T_3-Arka Samrat, T_4-NSC- 620 B, T_5-Pusa Ruby, T_6-Heemoshona, T_7-Devika, T_8-PKM-1, T_9-Swarashka, T_{10}-Rajshree with three replications. The parameters relating to growth, yielding attributes and yield parameters were measure to make a critical analysis of the crop as affected by different treatments. The technique of representative sample was adopted for recording the observations on various morphological characters in tomato. At every observation, three plants from each plot were randomly selected and tagged. The results revealed that the treatment T_6 (Heemsohna) was found to be the most suitable over all the other treatments in relation to growth and yield of Tomato.

Keywords: Tomato, varieties, protected structure, growth, yield

Introduction
Tomato (*Solanum lycopersicum* L., 2n=24) belonging to family solanaceae is one of the most important vegetable, widely grown throughout the world for supplying in the fresh market as well as for processing. Tomato is grown worldwide for its edible fruits, with antioxidants benefits. The crop is native to Central and South America. Tomato is considered as healthy food because of its nutritional awareness among people. In recent years, researchers are interested and focused on the identification of bioactive components in food that affects the health, and may also reduce the risk of some diseases. The high nutritional value and potential health benefits of tomato have drawn an increased interest towards tomato-based products among consumers. Hence major emphasis is being given to improve the quality of produce along with higher production. Due to carotenoids, lycopene and β-carotene, tomato has high nutritional value. Tomato decreases the risk from some types of cancer and heart diseases (Dhyani *et al.*, 2017) [1]. β-carotene is provitamin of vitamin A and its deficiency can cause xerophthalmia, blindness and premature death (Ishida, 2000) [3]. It is believed that ascorbic acid is vital in preventing cardiovascular diseases, some cancers, cataracts, and also prevents mutations of DNA caused by oxidative stress (Mitul *et al.*, 2016) [7]. The nutritional importance of tomato indicates that it is necessary to formulate breeding programme and to develop cultivars rich in antioxidant compounds, processing traits with high quality of fruit as well as yield (Wahundeniya *et al.*, 2013). One of the most important factors in the intensification of protected tomato production is the introduction of new high-yielding varieties and hybrids, which have high resistance against diseases and pests adapted to new technologies and unfavourable climatic conditions. The development of high yielding varieties requires detailed knowledge of the genetic variability present in the germplasm of the crop, the association among yield components, input requirements and culture practices. The development of new tomato cultivars has intended to improve productivity, quality and adaptation to different production conditions. Sometimes, this is difficult to achieve due to reduced availability of genetic resources.

Materials and Methods
The present investigation entitled "Evaluation of different varieties of tomato (*Solanum lycopersicum* L.) in semi control protected structure" was carried out in the polyhouse of Jacob Institute of Biotechnology and Bioengineering Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the Rabi season of 2020-2021.

The experiment was laid out in Randomized Block Design comprising of 10 treatments *viz*., T_1-Arka Apeksha, T_2-Arka Rakshak, T_3-Arka Samrat, T_4-NSC- 620 B, T_5-Pusa Ruby, T_6-Heemoshona, T_7-Devika, T_8-PKM-1, T_9-Swarashka, T_{10}-Rajshree with three replications. Seeds of ten genotypes of tomato were sown in lines 10cm apart on the beds on 18th October, 2020. On 12th November 2020 the experimental area was laid out with plot size (1m × 1m) with 30cm bunds between the plots. Irrigation channels of 50cm were provided between rows of plots. 30 days old seedlings were transplanted in the main field on 21st November 2020. During the transplanting soil was pressed firmly around the seedling so that it will not be disturbed by irrigation immediately after transplanting. The parameters relating to growth, yielding attributes and yield parameters were measured to make a critical analysis of the crop as affected by different treatments. At every observation, three plants from each plot were randomly selected and tagged. The data recorded during the investigation were subjected to statistical analysis according to the method of analysis of variance (Panse and Sukhatme, 1967).

Result

Data mentioned in table 1 clearly revealed that the tomato varieties were found to significantly improve plant height at all the growth stages. The maximum plant height (119.12 cm) was recorded in Arka Apeksha followed by Arka Rakshak (116.86 cm) and Pusa Ruby (115.53 cm) while least plant height was found in NSC-620B (95.57 cm). The variation in plant height might be due to specific genetic make up of different cultivars and prevailing environmental condition. Similar finding were reported by Kumar *et al.* (2007) [5]. The maximum number of branches per plant was recorded in Arka Apeksha (14.64) followed by Arka Rakshak (13.83). The minimum number of branches was recorded in PKM-1(8.92). The maximum value associated with Arka Apeksha due to higher intermodal length, better adoptability for the environmental conditions and higher uptake of nutrient. The results are in agreement with the finding of Lekshmi and Celine (2015) [6].

Table 1: Performance of tomato (Solanum lycopersicum L.) genotypes for growth parameters.

Treatments	Plant high (cm)	No. of Branches per plant
T_1 Arka Apeksha	119.12	14.64
T_2 Arka Rakshak	116.86	13.83
T_3 Arka Samrat	112.95	12.13
T_4 NSC-620B	95.57	12.62
T_5 Pusa Ruby	115.53	13.06
T_6 Heemsohna	106.60	11.13
T_7 Devika	110.38	12.32
T_8 PKM-1	114.34	8.92
T_9 Swarashka	108.21	12.27
T_{10} Rajshree	109.26	12.58
S.Ed(±)	1.567	1.836
CD at 5%	0.746	0.874

The data pertaining to flowering and physical characters of fruits of different genotypes differed significantly at various growth stages are presented in (Table 2). The lowest days to first flowering (20.93) was obtained in NSC-620B and the highest days to first flowering (26.12) was recorded in PKM-1. The lowest days to 50% flowering (30.71) was obtained in NSC-620B and the highest days to 50% flowering (35.32) was recorded in PKM-1. The lowest days to fruit set (62.93) was obtained in Heemsohna and the highest days to fruit set (72.76) was recorded in PKM-1. The maximum number of flowers per cluster was recorded in Heemsohna (7.02) followed by Arka Apeksha (6.37), whereas the minimum number of flowers per cluster was recorded in PKM-1(4.97). The maximum number of cluster per plant was recorded in Heemsohna (18.53) followed by Arka Apeksha (17.05), whereas the minimum number of cluster per plant was recorded in PKM-1(7.61). The maximum fruit set per cluster was recorded in Heemsohna (5.91) followed by Arka Apeksha (5.49), whereas the minimum fruit set per cluster was recorded in PKM-1(4.04). The maximum fruit length was recorded in Arka Samrat (5.21 cm) followed by PKM-1(4.64 cm), whereas the minimum fruit length was recorded in Pusa Ruby (3.78 cm). The maximum fruit radial diameter was recorded in Heemsohna (5.21 cm) followed by Arka Rakshak (4.64 cm), whereas the minimum fruit radial diameter was recorded in PKM-1(3.78 cm). The maximum fruit weight was recorded in Arka Samrat (83.50g) followed by Arka Apeksha (73.61g), whereas the minimum fruit weight was recorded in Pusa Ruby (50.85g).

Table 2: Performance of tomato (Solanum lycopersicum L.) genotypes for flowering and physical characters of fruits

Treatments	Days to first flowering	Days to 50% flowering	Days to fruit setting	No. of flowers per cluster	No. of cluster per plant	Fruit set per cluster	Fruit length (cm)	Fruit width (cm)	Fruit weight(g)
T_1 Arka Apeksha	21.05	31.54	66.72	6.37	17.05	5.49	4.53	8.31	73.61
T_2 Arka Rakshak	22.92	32.87	71.59	5.74	12.06	4.48	4.54	9.98	58.16
T_3 Arka Samrat	25.82	34.29	64.82	5.85	10.57	4.60	5.21	5.94	83.50
T_4 NSC-620B	20.93	30.71	64.75	5.54	14.59	5.46	4.39	8.97	60.43
T_5 Pusa Ruby	24.75	31.18	66.43	5.16	15.42	4.50	3.78	10.23	50.85
T_6 Heemsohna	21.75	32.36	62.93	7.02	18.53	5.91	4.26	11.39	61.87
T_7 Devika	22.18	32.84	65.61	5.58	10.99	5.41	4.44	9.16	63.15
T_8 PKM-1	26.12	35.32	72.76	4.97	7.61	4.04	4.64	4.65	65.90
T_9 Swarashka	23.19	33.84	70.24	5.58	13.34	4.59	4.26	9.00	60.68
T_{10} Rajshree	22.70	31.12	70.30	5.08	12.59	5.47	4.31	8.63	60.47
S.Ed(±)	1.291	2.218	5.914	1.46	2.358	0.848	0.469	2.730	4.569
CD at 5%	0.615	1.056	2.815	0.69	1.122	0.404	0.223	1.300	2.175

The data pertaining to fruit yield parameters of different genotypes differed significantly at various growth stages are presented in (Table 3). The maximum number of fruit per plant was recorded in NSC-620B (38.35) followed by Heemsohna (37.52), whereas the minimum number of fruit per plant was recorded in PKM-1(19.78). The results are in agreement with the finding of Rana *et al* (2014) [8]. The maximum fruit yield per plot was recorded in Heemsohna (28.94 kg) followed by Arka Samrat (24.86 kg), whereas the minimum fruit yield per plot was recorded in PKM-1(11.71 kg). These findings are in confirmative with Singh *et al* (2013) [9]. The maximum fruit yield per plant was recorded in Heemsohna (3.22 kg) followed by Arka Apeksha (2.76 kg), whereas the minimum fruit yield per plant was recorded in PKM-1 and Pusa Ruby (1.30 kg). The maximum value associated with Heemsohna may be due to higher individual fruit weight and genetical characters for yield. The results are related with the finding of Sudhakar and Purushotham (2009) [10]. The maximum fruit yield was recorded in Heemsohna (893.23 q/ha) followed by Arka Samrat (767.28 q/ha), whereas the minimum fruit yield was recorded in PKM-1(361.35 q/ha)

Table 3: Performance of tomato (Solanum lycopersicum L.) genotypes for fruit yield parameters

Treatments	No. of fruit per plant	Fruit yield per plot (kg)	Fruit yield per plant (kg)	Fruit yield (q ha-1)
T_1 Arka Apeksha	26.97	15.00	2.76	462.96
T_2 Arka Rakshak	25.62	13.40	1.49	413.48
T_3 Arka Samrat	30.02	24.86	1.67	767.28
T_4 NSC-620B	38.35	16.33	1.81	504.14
T_5 Pusa Ruby	23.19	11.73	1.30	361.97
T_6 Heemsohna	37.52	28.94	3.22	893.23
T_7 Devika	29.96	16.93	1.88	522.48
T_8 PKM-1	19.78	11.71	1.30	361.35
T_9 Swarashka	25.46	12.67	1.41	391.06
T_{10} Rajshree	27.04	14.73	1.64	454.66
S.Ed(±)	5.547	4.014	0.446	123.90
CD at 5%	2.640	1.911	0.212	58.974

The data pertaining to quality aspects of different genotypes differed significantly at various growth stages are presented in (Table 4). The maximum Total Soluble Solid (TSS) was recorded in Swarashka (5.14°Brix) followed by Arka Apeksha (4.91°Brix), whereas the minimum Total Soluble Solid (TSS) was recorded in Pusa Ruby (3.72°Brix). The maximum total soluble solid (°Brix) associated with Swarashka may be due to higher nutrient uptake and heritable characters. The results are related with the finding of Dunshin *et al.* (2016) [2]. The maximum Vitamin C content was recorded in Heemsohna (28.34) followed by Arka Apeksha (26.85), whereas the minimum Vitamin C content was recorded in PKM-1(19.41). The maximum ascorbic acid associated with Heemsohna may be due to higher nutrient uptake and heritable characters. The results are related with the finding of Jalloh *et al.* (2016). Acidity of PKM-1 (0.27%) was maximum and aciditry of Arka Apeksha, Arka Rakshak, NSC-620B, Heemsohna (0.16%) was minimum as observed. On the basis of present investigation, it is concluded that the treatment T_6 (Heemsohna) was found to be the most suitable over all the other treatments in relation to growth and yield of Tomato

Table 4: Performance of tomato (*Solanum lycopersicum* L.) genotypes for quality aspects

Treatments	TSS (°Brix)	Ascorbic acid	Acidity
T_1 Arka Apeksha	4.91	26.85	0.16
T_2 Arka Rakshak	4.19	24.55	0.16
T_3 Arka Samrat	4.41	22.22	0.22
T_4 NSC-620B	4.76	21.16	0.16
T_5 Pusa Ruby	3.72	22.30	0.22
T_6 Heemsohna	4.64	28.34	0.16
T_7 Devika	4.17	24.50	0.25
T_8 PKM-1	4.51	19.41	0.27
T_9 Swarashka	5.14	22.45	0.23
T_{10} Rajshree	4.61	24.26	0.22
S.Ed(±)	0.472	1.750	0.055
CD at 5%	0.224	0.833	0.026

Conclusion

On the basis of present investigation, it is concluded that the treatment T_6 (Heemsohna) genotype was found to be the most suitable over all the other treatments in relation to growth and yield of Tomato.

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