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IDENTIFICATION OF THE MOST SUITABLE HYBRID TOMATO (*LYCOPERSICON ESCULENTUM* MILL.) IN TERMS OF GROWTH, YIELD AND QUALITY UNDER GORAKHPUR ARGO-CLIMATIC CONDITIONS

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ABSTRACT

The present investigation was conducted during the *rabi* season of 2021-2022 at the Research farm department of Horticulture. National Post Graduate College Barhalganj (U.P.). The experiment was conducted in Randomized Block Design three replication with 9 treatments (hybrids) viz. JK Nandini, TO- 848, Monika, Abhishek, Lakshmi (NP 5005), Tanuja, ICS – 141, Abhinav and Rajshree. On the basis of investigation TO- 848 was emerged as superior hybrid in the terms of Growth, Plant height 30 DAT (36.00 cm),60 DAT (55.00cm), 90 DAT (78.69 cm) and 120 DAT (83.67cm), Yield (60.23 t/ha), Quality (T.S.S. 5.89 Brix), Ascorbic Acid (35.09mg/100gm).
Keywords : Tomato hybrids, Growth, Yield and Quality.

Introduction

Tomato *(Lycopersicon esculentum* Mill.), Hindi Name "Tamatar", one of most popular and nutritious fruit vegetables; widely grown around the world and second ranked after potato. The fruit are eaten raw or cooked, large quantities of tomato are used to produce soup, juice, ketchup, puree, paste and powder. Tomato is popular also because it supplies vitamin C and adds variety of colours and flavours to the foods (Vegetable Crops Volume 1). Tomato belongs to the family solanaceae is one of the most popular and widely grown vegetables in the world. Tomato is a self-pollinated crop. Nutritive value varies in different cultivars depending upon the agro-climatic condition under which tomato are cultivated. Tomato is a rich source of vitamin, minerals, organic acids, sugars, ascorbic acids, titratable acidity and lycopene. Dried tomato juice retains vitamin C. According to (Aykroyd 1963), 100 g edible portion of Tomato contain moisture about 93.1 g, and protein 1.4 g. Tomato has its origin in Peru, Ecuador and Bolivia on the basis of availability of numerous wild and cultivated relatives of the tomato in this area. From its centre of origin, the tomato first moved to Mexico for domestication and cultivation. From Mexico it arrived in Europe by 1554. It is highly susceptible to frost (Hamner *et al.*, 1945) showed that light intensity is a very important factor for ascorbic acid content in tomato fruits. Under low light intensity, vitamin C is much lower than in higher intensity. Environment factors such as light intensity, temperature, moisture markedly influence the process of fruit set of tomato and subsequent in fruit development and yield (Calvert, 1959).

Material and Method

The experiment was carried out at the Horticulture Research Farm, Department of Horticulture, National Post Graduate College Barhalganj (U.P.). The experimental site is situated at an elevation of 78 meters above sea level at 25.87^0N latitude and 81.15^0E longitude. This region has a sub-tropical climate prevailing in the south-east part of U.P. Soil of the experiment plot was sandy loam in texture, with pH range 6.2, medium in organic carbon, high in nitrogen (nitrate), low in nitrogen (Ammoniacal), phosphorus

and potash. The soil was slightly acidic in nature. The experiment was laid out in Randomized Block Design (RBD) with 9 treatments (genotypes) JK Nandini, TO-848, Monica, Abhishek, Lakshmi (NP 5005), Tanuja, ICS- 141, Abhinav, Rajshree replicated thrice. Treatment was randomly arranged in each replication, divided in to 9 plots.

A normal sized flatbed (2.0 m × 1.0 m) was prepared in the departmental nursery in the month of 16 October 2021. Then the prepared bedding mixture was evenly spread in form of 5.0 cm thick layer over the nursery. Rows were made 1.5 to 2.0 cm deep at 10.0 cm apart and seeds were sown, covered and watered. The seedlings became ready for transplanting within a month and transplanted.

A basal dose of 120 kg N, 60 kg $P_2O_5$and 60 kg K_2O/ha along with 25 tones FYM/ha was applied. One third nitrogen and entire quantity of P and K was applied prior to sowing. Remaining dose of nitrogen was applied in two splits at 30 and 60 days after transplanting. FYM was applied in the soil at the time of field preparation. All the treatments were given the same dose of manure and fertilizer.

One pre-sowing irrigation was given and later on irrigation was given as and when required (since it rained during the plants growing period). Weeding was done thrice given during the crop period. First One was at 15 DAT, second one was at 30 DAT and Last one was at 45 DAT. In order to maintain uniform plant population in each plot the dead seedling was replaced at even 5 days after transplanting. This gap filling was continued till 15 days after transplanting. Sampling was carried out at 30 days interval up to harvest for growth analysis. Five plants were randomly selected from each treatment and replication for the study. The T.S.S. was calculated with the help of Refractometer and take the small amount of sample for the observation. Acid content of juice extracted from fruits were determined by titrating 10 ml of juice against N/ 10 NaOH using phenolphthalein as an in terms of anhydrous citric acids per 100 ml of tomato juice. The juice was filtered through muslin cloth 10 ml (w) of the juice was taken with the help of a pipette in 100 ml volumetric flask and the volume (V_1) was made up with 1.0% oxalic acid solution. The flask was shaken well. The juice was filtered, and known quantity (V_2) of solution was titrated against standard dye (V) solution till a faint pink colour appeared and persisted for 15 second. The amount of ascorbic acid was calculated by the formula (A.O.A.C., 1970).

$1/1 \times V \times V_1 / V_2 \times 100 / W$ = Vitamin C mg/100 mg of fruit.

Where,

V = ml of dye indicator used in titration
V_1 = volume to which the juice is diluted
T = titrate volume of dye with standard solution of vitamin C
V_2 = volume of filtrate taken for titration.
W = volume of the juice initially taken for the determination.

The data were analyzed in randomized block design as per procedure of Cochran and Cox (1995). Interpretation of results was made on the basis of "F" test and critical difference at 0.05 probability calculated to compare the treatments. The data were presented as tables, graphs and photographs.

Table : Analysis of variance (ANOVA)

Source of Variation	Degree of Freedom	Mean Sum of Squares	F-Value
Replications	r-1	Mr	Mr/Me
Treatment	t-1	Mt	Mt/Me
Error	(r-1) (t-1)	Me	
Total	Rt-1		

Where,
Mr = mean sum of squares due to replications
Mt = Mean sum of squares due to treatments
Me = Mean sum of squares due to error
S. Em ± = √Error variance/ number of replications

Critical difference

The significance of differences between the mean values of different treatments for different characters was taken by calculating critical differences (CD) at 5% level of significance as follows:

$$CD = SED \times T$$

$$CD = \sqrt{2} \times EMss/r \times t \text{ value}$$

T = number of error d.f at 5 % level of significance

Where, $SED = \sqrt{(2\ Me/r)}$

t= table value of "t" at error degree of freedom

r = number of replications

Result and Discussion

Plant height was measured at 30, 60, 90 and 120 DAT to evaluate the significant differences in plant height of the various hybrids evaluated in this experiment. The statistically analysed data are presented in Table 1 and graphically shown the results all of the varieties studied in this experiment produced considerable number of changes in plant height.

At 30 DAT out of 9 hybrids studied here, maximum plant height (36.00 cm) was with TO - 848 followed by Lakshmi (32.93 cm). The minimum plant height was with Rajshree (24.73 cm). At 60 DAT out of 9 hybrids studied here, maximum plant height (55.27 cm) was TO- 848 with followed by Lakshmi

(46.19 cm). The minimum plant height was with Rajshree (38.47cm). At 90 DAT out of 9 hybrids, maximum plant height (78.67 cm) was with TO – 848 followed by Lakshmi (68.07 cm), and the minimum plant height was with Rajshree (57.33cm). At 120 DAT similar trend was noticed, where maximum plant height (83.80cm) was with TO-848 followed by Lakshmi (74.00 cm), and the minimum plant height was with Rajshree (53.73cm). The variation in plant height might be due to specific genetic make-up of different cultivars and prevailing environmental condition. Similar finding was also reported by Nantyal and Lal (1983) and Chitram and Kenmard (1989).

The number of branches per plant was measured at 30, 60, 90 and 120 days after trance plantings to evaluate the differences in all hybrids and studied in this experiment. At 30 DAT, the maximum branch was recorded TO-848 (5.07) followed by Lakshmi (4.80) and minimum with Rajshree. At 60 DAT, the maximum branches were recorded TO-848 (10.00) followed by Lakshmi (8.47) and minimum with Rajshree (7.27). At 90 DAT, the maximum branches were recorded TO-848 (13.13) followed by Lakshmi (11.87) and minimum with Rajshree (9.73). The similar trend was also observed at 120 DAT where maximum branches were recorded with treatment TO-848 (13.73), followed by Lakshmi (12.93) and minimum with treatment Rajshree (10.73). The variation in number of branches per plant might be due to specific genetic make-up of different varieties and prevailing environment condition Table 1. Seslras and Jidev (2002) also reported similar findings.

Table 1: Evaluation of various growth parameters in 9 hybrids of tomato.

Sl. No.	Hybrids (Genotypes)	Plant height (cm) 30DAT	Plant height (cm) 60DAT	Plant height (cm) 90DAT	Plant height (cm) 120DAT	Number of branches per plant 30DAT	Number of branches per plant 60DAT	Number of branches per plant 90DAT	Number of branches per plant 120DAT
1	JK Nandini	28.00	42.00	65.13	69.80	3.27	7.73	10.73	11.67
2	TO 848	36.00	55.27	78.67	83.67	5.07	10.00	13.13	13.73
3	Monika	29.20	43.56	66.20	70.53	3.93	8.13	11.40	12.00
4	Abhishek	28.93	43.00	65.33	70.20	3.36	8.07	11.20	12.00
5	Lakshmi	32.93	46.19	68.07	74.00	4.80	8.47	11.87	12.93
6	Tanuja	32.07	44.27	67.67	73.40	4.07	8.27	11.53	12.87
7	ICS-141	26.73	41.20	64.33	68.60	2.73	7.60	9.93	11.60
8	Abinav	26.13	39.93	61.47	65.20	2.67	7.40	9.80	11.47
9	Rajshree	24.73	38.47	57.33	53.73	2.27	7.27	9.73	10.73
	F-Test	NS	S	S	S	NS	S	S	S
	S.Ed (±)	-	0.16	0.32	0.12	-	0.04	0.03	0.03
	C.D.at 5%	-	0.35	0.67	0.26	-	0.08	0.07	0.06

At 30 DAT, the maximum number of leaves were recorded with TO-848 (9.93) followed by Lakshmi (9.73) and minimum with Rajshree (6.93). At 60 DAT, the maximum number of leaves ware observed under treatment with TO-848 (26.07), followed by Lakshmi (25.20) and minimum with Rajshree (21.40). At 90 DAT, the maximum number of leaves ware recorded with treatment with TO-848 (45.27), followed by Lakshmi (42.73) and minimum leaves per plant was observed under treatment Rajshree (38.00), At 120 DAT, the maximum number of leaves ware recorded with treatment with TO-848 (48.47), followed by Lakshmi (45.73) and minimum leaves per plant was observed under treatment Rajshree (41.67). However, as far as number of leaves are concerned maximum of leaves ware recorded in treatment TO-848. The difference in number of leaves in different genotypes may be due to difference in genetic make-up. Similar findings were also reported by Chitram and Kenmard (1989).

All the hybrids showed significant different in (at 5% level) result in the case of days to 50% flowering in different Tomato hybrids.

Days taken to first flowering varied from 49.88 to 53.92 days. The maximum days taken to first flowering was observed in the hybrid Rajshree (53.92 days) and hybrid TO-848 observed minimum (49.88) days of first flowering. The difference in days to first flowering of different genotypes may be due to difference in genetic

make-up and flowering duration. Similar findings were also reported by Dudi and Sanwal (2004).

Table 2 shows that, the maximum polar diameter was recorded with TO-848 (6.47 cm), followed by Lakshmi (6.15 cm) and minimum with Rajshree (3.36 cm).The difference in polar diameter in different hybrids may be due to differences in their genetic make-up and fruiting characters. Similar findings were also reported by Singh (1991); Joshi *et al*. (1998).

The maximum radial diameter was recorded with TO - 848 (6.65 cm), followed by Lakshmi (6.52 cm) and minimum Rajshree (4.57 cm). The difference in radial diameter in different hybrids may be due to differences in their genetic make-up and fruiting characters. Similar findings were also reported by Singh (1991); Joshi *et al.* (1998).

Table 2: Evaluation of various parameters in 9 hybrids of tomato.

Sl. No.	Hybrids (Genotypes)	Number of leaves per plant 30 DAT	Number of leaves per plant 60 DAT	Number of leaves per plant 90 DAT	Number of leaves per plant 120 DAT	Days to first flowering	Polar diameter of fruit (cm)	Radial diameter of fruit (cm)
1	JK Nandini	8.00	24.40	40.33	44.27	52.44	4.98	5.35
2	TO 848	9.93	26.07	45.07	48.47	49.88	6.47	6.65
3	Monika	9.07	24.87	42.07	44.33	51.89	5.19	6.23
4	Abhishek	9.00	24.60	41.13	44.33	52.07	5.12	5.45
5	Lakshmi	9.73	25.20	42.73	45.73	50.27	6.15	6.52
6	Tanuja	9.60	25.00	42.20	44.53	50.77	5.20	6.38
7	ICS-141	7.87	23.73	40.20	44.07	52.88	4.71	5.04
8	Abinav	7.60	21.67	38.87	43.07	53.17	3.81	4.69
9	Rajshree	6.93	21.40	38.00	41.67	53.92	3.36	4.57
	F-Test	NS	S	S	S	S	S	S
	S.Ed (±)	-	0.06	0.05	0.03	0.09	0.03	0.03
	C.D.at 5%	-	0.12	0.11	0.06	0.18	0.07	0.07

Number of fruits per plant was maximum in the hybrid TO - 848 (22.50), followed by Lakshmi (21.73) and the minimum (20.89) fruits per plant was observed in the hybrid Rajshree**.** The difference in number of fruits per plant in different hybrids may be due to difference in their genetic make-up and vegetative characters. Similar findings were also reported by Das and Chakraborty (1984) and Prasad and Singh (1990).

Highest fruit weight was recorded with TO-848 (72.27g), followed by Lakshmi (71.39g) and minimum with Rajshree (65.00g). The difference in average fresh weight of fruit in different hybrids may be due to difference in genetic make-up. Roy *et al.* (1970) also reported similar findings in their experiments.

The Fruit yield per plant was maximum in the hybrid Tomato (1.63kg), followed by Lakshmi (1.55kg) and the minimum (1.36kg) fruit yield per plant was observed in the hybrid Rajshree. The difference in average fruit yield/plant (kg) in different genotypes may be due to difference in their genetic make-up. This may also be due congenial climatic conditions in Gorakhpur for TO-848**.** Similar findings were also reported by Petrikova (1984).

The fruit yield per hectare was maximum in the hybrid TO-848 (60.23 t/ha), followed by Lakshmi (57.45 t/ha) and the minimum (50.29 t/ha) fruit yield per hectare was observed in the hybrid Rajshree. These findings are in conformity with the results reported by Some and Paria (1983).

The maximum T.S.S. ^{0}Brix was recorded in the hybrid Rajshree (7.53), followed by Abhinav (7.33) and ICS – 141 (7.20) and the minimum T.S.S. ^{0}Brix was found in hybrid JK Nandini (5.60). Findings were also reported by Maarkash *et al.* (2007).

The maximum acidity was recorded in the hybrid TO-848 (0.84 %), followed by Lakshmi (0.82 %) and the minimum acidity was found in Rajshree (25.81 mg/100gm). This variation among the cultivars was due to genotypic characters. Similar findings were also reported by Maarkash *et al*. (2007)

The maximum ascorbic acid was recorded in the hybrid TO-848 (35.09 mg/100 gm), followed by Lakshmi (33.30 mg/100gm) and the minimum ascorbic acid was found in Rajshree (25.81 mg/100gm). This may be due to variation in genotypic characters. These findings were also reported by Maarkash *et al*. (2007).

Table 3 : Evaluation of various parameters in 9 hybrids of tomato.

Sl. No.	Hybrids (Genotypes)	Number of fruits per plant	Weight of fruit (g)	Fruit yield per plant (kg)	Fruit yield (t ha^{-1})	Total soluble solids (°Brix)	Acidity (%)	Ascorbic acid (mg/100 g fruit pulp)
1	JK Nandini	21.21	68.01	1.44	53.43	5.60	0.76	28.16
2	TO 848	22.50	72.27	1.63	60.23	5.89	0.84	35.09
3	Monika	21.43	70.13	1.50	55.67	6.27	0.79	30.67
4	Abhishek	21.32	69.13	1.47	54.59	6.54	0.78	29.69
5	Lakshmi	21.73	71.39	1.55	57.45	6.84	0.82	33.30
6	Tanuja	21.53	71.22	1.53	56.78	7.00	0.81	31.53
7	ICS-141	21.11	66.77	1.41	52.20	7.20	0.74	27.57
8	Abinav	21.00	65.36	1.37	50.84	7.33	0.73	26.86
9	Rajshree	20.89	65.00	1.36	50.29	7.53	0.70	25.81
	F-Test	S	S	S	S	S	S	S
	S.Ed (±)	0.04	0.07	0.01	0.26	0.04	0.01	0.10
	C.D.at 5%	0.08	0.15	0.01	0.55	0.09	0.01	0.22

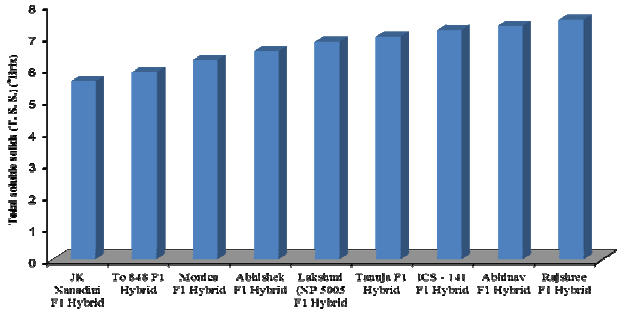

Fig-1: Total soluble solids (T. S.S)(°Brix) of different varieties of Tomato (*Lycopersicon esculentum* Mill.) Gorakhpur agro climatic conditions

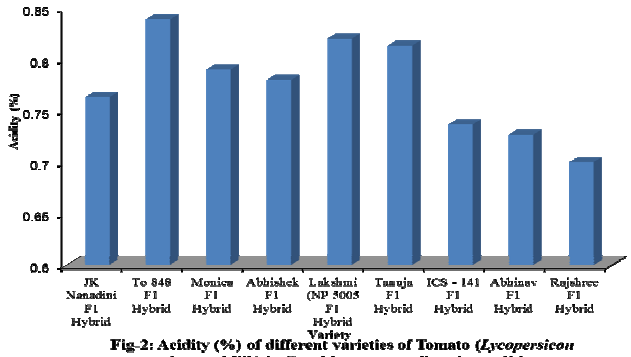

Fig-2: Acidity (%) of different varieties of Tomato (*Lycopersicon esculentum* Mill.) in Gorakhpur agro climatic conditions

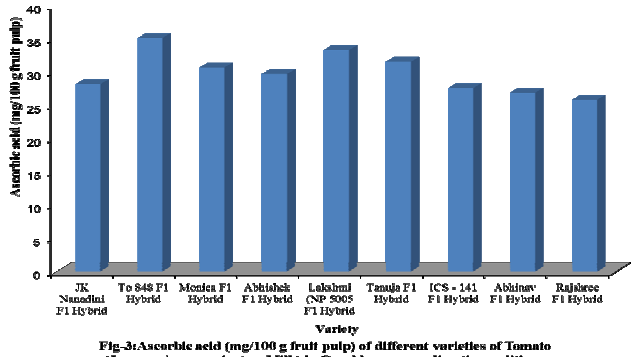

Fig-3:Ascorbic acid (mg/100 g fruit pulp) of different varieties of Tomato (*Lycopersicon esculentum* Mill.) in Gorakhpur agro climatic conditions

Conclusion

On the basis of results obtained in the present study it is concluded that out of 9 cultivars than treatment (2) (hybrid TO-848) was best in respect to growth, yield and quality of Tomato in Gorakhpur Argo-climatic condition.

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