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EVALUATION OF TOMATO (*SOLANUM LYCOPERSICUM* L.) GENOTYPES FOR FRUIT, YIELD AND QUALITY TRAITS

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ABSTRACT

The present investigation entitled "Evaluation of tomato (*Solanum lycopersicum* L.) genotypes for fruit, yield and quality traits' was carried out at the vegetable research farm, Guru Kashi University, Talwandi Sabo, Bathinda during year 2020-2021. The experiment was laid out in Randomized Block Design (RBD) with three replications. Thirty genotypes including a check cultivar were evaluated for different horticultural traits. The observations were recorded, number of branches per plant, plant height (cm), average fruit weight (g), equatorial diameter of fruit (cm), polar diameter of fruit (cm), number of locules per fruit, pericarp thickness (mm), fruit pH, fruit TSS (Brix), number of fruits per plant and Average yield per plant (kg). Analysis of variance showed significant differences among genotypes for all the characters under study. Maximum numbers of branches were recorded in Sel Oval (6.01). The maximum plant height 169.00 cm was recorded in the genotype Sel-135. Sel 137 recorded maximum number of fruits per plant (71.30). Maximum average fruit weight was recorded in Sel-137 (104.00g.) as compared to check variety Pb Ratta-167 (68g). Sel IT-8 was found maximum equatorial diameter of fruit (6.13 cm) and maximum polar diameter of fruit (6.10 cm). Maximum number of locules per plant (7) was found in Sel Small Round. Maximum pericarp thickness (7.3 mm) was observed in Sel B_1-9. Maximum value for fruit pH (4.60) was recorded in Sel-136. Maximum value for fruit TSS (4.43^0Brix) was recorded in Sel 15 ob-9. Maximum yield per plant was recorded in Sel B_1-9 (3.75 kg).The genotypes SEL-137, Sel 30 and Sel B_1-9 gave highest fruit yield.

Keywords: Tomato, Selection, Genotypes, Phenotypic correlation and genotypic correlation

ISSN: 2455-6939

Volume: 09, Issue: 01 "January-February 2023"

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is considered as one of the most prominent vegetable across the globe .It was originated in western South America. It is usually cultivated in most of the countries of the world under open field conditions, net houses, greenhouses as well as polyhouses. In India, tomato is grown in an area of 0.81 million hectares with an annual production of 20.51 million tonnes at a productivity of 21.13 t/ha [1]. Tomato is entitled as "poor man's apple" and as "protective food" because of presence of ample amount of vitamins as well as minerals [2]. The total sugar content in ripe fruit is 2.5% and amount of ascorbic acid ranges from 16-65mg/100g of fruit weight and the total amino acid is 100-350mg/100g [3]. Tomato comprises of 93-94% water, vitamins such as thiamine, riboflavin, niacin, vitamin C, vitamin A and carotene [4]. The red colour in tomato is due to a carotenoid known as Lycopene which is considered an antioxidant and it helps in reducing the risk of various cancers, heart diseases and age-related diseases [5].

Taking into consideration the significance of tomato as a potential crop for domestic and international usage, it is pivotal to enhance the productivity along with the desirable characters through the mode of genetic manipulation [6]. In contrast to this, it is mandatory to isolate plant attributes which hold important value towards the crop breeding programme. Identification of promising tomato genotypes is primary requirement for the vegetable industry. Newly bred lines have enriched and advanced the agriculture of many countries. Germplasm evaluation holds immense importance in the genetic improvement of the crops. The production as well as productivity of a crop not only depends upon the cultural practices and area under cultivation but also on the genotypes that have high acclimatization rate in the growing environment [7]. Genetic divergence studies are the main source for grouping the genotypes into various divergent groups which may be considered as the base for selection of suitable parents for hybridization. Inclusion of genetically diverse parents in any breeding programme is essential to generate new variability and desirable recombinants. Hence, evaluation of tomato genotypes is very essential to see the performance of genotypes for their adaptability and agronomic performance like growth and yield traits to identify the potential genotype [8].

Thus, the performance of thirty different tomato genotypes collected from different sources along with some superior lines were studied under the objectives genetic variability, correlation for horticultural traits and path analysis in tomato genotypes.

MATERIAL AND METHODS

The present investigation was carried out at the vegetable research farm of Guru Kashi University, Talwandi Sabo (Bathinda) during year 2020-2021. The experiment was laid out in

ISSN: 2455-6939

Volume: 09, Issue: 01 "January-February 2023"

randomized block design (RBD) comprising of 30 selections including one check cultivar (Punjab Ratta) with three replications of each treatment. Plants were transplanted on first week of January 2021 at a spacing of 30 cm (plant to plant) and 60 cm (Row to Row) in a plot having size 2.5x 1.8 m^2, 10 plants per plot was transplanted. Observations with respect to characters i.e. number of primary branches per plant, plant height (cm), number of fruits per plant, average fruit weight (g), equatorial diameter of fruit (cm), polar diameter of fruit (cm), number of locules per fruit, pericarp thickness (mm), pH, **total soluble solids (^{0}Brix) and average fruit yield per plant (kg)** were recorded on five randomly selected healthy plants from each plot and their means were worked out for statistical analysis. The statistical analysis was carried out for each observed character under study using MS-Excel and SPAR 1.0 packages. The mean values of data were subjected to analysis of variance as described by Gomez and Gomez [9] for Randomized Complete Block Design.

RESULT AND DISCUSSION

Tomato (*Solanum lycopersicum* L.) is one of the important vegetables grown throughout the world and it occupy prime position among processed vegetables [10]. Tomato is most remunerative cash crop in Punjab being grown as an off season vegetable for fresh market and for supply of the produce to the plains of northern India. Realizing this, there is a need for continuous crop improvement in tomato which can be achieved by isolating superior breeding lines/varieties having desirable horticultural traits. Large amount of variation in the germplasm provide better chance of selecting desired genotypes. Hence, knowledge of the magnitude and kind of variability existing in the germ pool for yield and its attribute is essentially important. Heritability examines the extent of heritable portion of variability, while study of genetic advance predicts the possible yield through selection. The fruit yield in tomato is a complex character and is dependent on number of yield components. To incorporate desirable yield and quality traits in a variety/hybrid, there is a need to know the inter-relationship of different characters. Moreover, knowledge of inter character relationship helps in the identification of important attributes which, in other words, is used to design suitable plant type with improved characters and for multiple trait selection. Path coefficient analysis on the other hand; partitioned the correlation coefficients into direct and indirect effects and the information so generated could be utilized in restructuring desirable plant type. Maximum numbers of branches were recorded in Sel Oval (6.01). The maximum plant height 169.00 cm was recorded in the genotype Sel-135. Sel 137 recorded maximum number of fruits per plant (71.30).It has been reported that the mean number of fruits per plant was between 4.46 and 38.30 [11]. Maximum average fruit weight was recorded in Sel-137 (104.00g.) as compared to check variety Pb Ratta-167 (68g). Similar findings had been reported by several other authors [12]; [13]. Sel IT-8 was found maximum equatorial diameter of fruit (6.13 cm) and maximum polar diameter of fruit (6.10 cm) compared

ISSN: 2455-6939

Volume: 09, Issue: 01 "January-February 2023"

to Check variety PbRatta 167. Maximum number of locules per plant was found in Sel Small Round. Maximum pericarp thickness (7.3 mm) was observed in Sel B_1-9 as compared to check variety Pb Ratta-167 (4.33mm). Maximum value for total pH (4.60) was recorded in Sel-136. These results are in conformity with other findings as well [14] and [15]. In the present investigation the results showed a significant difference among the material assessed for all the traits. Maximum value for total soluble solids (4.43^0Brix) was recorded in Sel 15 ob-9. Maximum average yield per plant was recorded in Sel B_1-9 (3.75 kg). It was also observed significant variation for all the characters studied except pericarp thickness and number of locules. Highest genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for fruit yield per plant and number of locules were observed while, lowest GCV and PCV was noticed for fruit pH, fruit TSS and equatorial diameter of fruit. High heritability with high genetic advance as per cent of mean was observed for fruit yield per plant, number of fruits per plant and fruit weight which could be improved by simple selection. The coefficients correlation among ten characters (Table: 4.3) show that fruit yield per plant had positive and highly significant association with number of fruit per plant (0.7594) pericarp thickness (0.7104), equatorial diameter of fruit (0.3912) and highly negative correlation with fruit pH (-0.3682). The estimates indicated that no of primary branches had positive indirect effect no of fruit per plant (0.1252), fruit weight (0.147), fruit TSS (0.0074). Plant height had indirect effect by no of fruit per plant (0.1679), fruit TSS (0.0236) [16] and [17]. Number of fruits per plant had indirect effect on fruit pH (0.2042), Plant height (0.1674) and equatorial diameter (0.1202). Weight of fruit had indirect effect on fruit yield by polar diameter (0.0365). Equatorial diameter had indirect effect by no of fruit per plant (0.2394), fruit pH (0.1536).Polar diameter had indirect effect by equatorial diameter (0.2074). Number of locules per fruit had positive indirect effect by equatorial diameter (0.1775). Pericarp thickness had positive direct effect by fruit pH (0.3059), fruit weight (0.2190), and equatorial diameter (0.1287). The variation in various growth parameters of different genotypes might be due to their genetic makeup, that indirectly governs the morphology of the plant that has a direct impact on the formation of floral buds since all the genotype were grown under the same climatic condition [18]. Fruit pH had indirect effect through fruit TSS (0.1546). Fruit TSS had indirect effect through fruit pH (0.5453), pericarp thickness (0.1567). The correlation studies revealed that fruit yield had significant positive correlation with fruit weight, fruit length, fruit diameter and number of fruits per plant, both at the genotypic and phenotypic levels, indicating mutual association of these traits [19]. Negative correlation of days to flowering and days to first harvest with yield per plant suggested indirect selection for earliness and yield improvement. Study on correlation analysis revealed that total fruit yield (kg) per plant was correlated significantly positively with number of fruits per plant, fruit weight and total sugar [20]. It was concluded from the present studies that the genotypes SEL-137, Sel-30, Sel IT-8 and Sel B_1-9 were the promising genotypes for yield and fruit traits.

ISSN: 2455-6939

Volume: 09, Issue: 01 "January-February 2023"

Therefore these lines can be commercially exploited after thorough testing or can be used in breeding programmes for development of superior tomato hybrids under southern western region of Punjab condition.

ISSN: 2455-6939

Volume: 09, Issue: 01 "January-February 2023"

Table 4.1: Mean performance of tomato genotypes.

Parameters / Selections	No of primary Branches per plant	Plant height (cm)	Number of fruits per plant	Average fruit weight (g)	Equatorial diameter of fruit (cm)	Polar diameter of fruit (cm)	No. of locules per fruit	Pericarp Thickness (mm)	Fruit pH	Fruit TSS (°Brix)	Total Yield per plant (kg)
Sel IT-S_1	5.00	81.00	66.30	52.00	5.50	5.50	5.00	4.00	3.50	3.97	3.41
Sel Male-2	5.00	79.31	35.30	68.36	4.81	4.80	3.64	6.00	3.07	3.53	2.41
Sel B_1-12	5.00	71.62	58.00	64.68	5.18	5.17	6.00	6.80	3.70	4.03	3.44
Sel B_1-9	4.00	80.00	60.30	58.00	5.63	5.64	3.00	7.30	3.40	3.4	3.75
Sel-96	3.00	163.30	47.00	47.00	4.64	4.64	5.00	6.00	3.73	4.17	2.21
Sel-30	5.65	74.65	69.00	51.00	5.24	5.05	3.00	6.61	3.10	4.10	3.54
Sel Medium-7	4.00	82.65	43.64	61.64	5.51	5.52	6.00	5.64	4.07	4.07	2.69
Sel-135	5.64	169.00	50.00	19.34	4.85	3.85	3.31	4.31	4.13	3.87	0.97
Sel-136	5.00	75.00	41.00	60.00	4.71	4.71	2.00	5.61	4.60	4.10	2.46
Sel-137	4.00	89.30	71.30	104.00	5.53	4.53	2.62	6.62	3.40	3.30	3.52
Sel Round Small	4.30	75.61	39.31	67.00	5.74	4.76	7.00	6.64	2.90	2.77	2.64
Sel Round-3	4.00	66.00	40.00	36.00	4.94	4.93	3.00	4.62	3.67	3.87	1.44
Sel Oval	6.01	78.33	34.00	66.00	5.00	3.50	3.62	6.00	3.33	4.00	2.24
SelMastuana Oval	4.33	94.31	22.00	52.00	4.80	4.15	5.00	5.00	3.57	3.40	1.14
Sel Mastuana-12	4.64	63.31	30.00	44.00	5.00	4.89	3.64	5.00	4.00	3.80	1.32
Sel 15-ob-9	4.64	62.65	44.00	75.00	5.31	5.38	5.00	5.31	4.03	4.43	3.31
Sel IT-8	4.34	61.64	11.00	74.00	6.13	6.10	6.00	5.00	3.97	4.13	1.25
Sel -7	3.12	78.34	44.00	56.00	4.23	4.23	4.00	4.56	3.53	3.42	2.12
Sel B_2-17	3.24	65.34	56.00	54.00	4.34	4.56	5.00	4.34	3.47	4.03	1.34
Sel B_2 -14-1	3.12	78.35	54.00	46.00	4.12	5.12	3.46	5.47	3.37	4.01	2.45
Sel B_2-13	3.34	89.56	35.00	58.00	4.89	4.67	4.32	4.67	3.78	3.57	3.24
Sel B_2-4-1	3.43	86.56	42.00	58.00	4.34	4.34	4.00	5.47	3.38	3.67	3.36
Sel 3-9	3.45	89.45	57.00	51.00	4.43	4.56	3.00	4.54	3.89	3.34	2.56
Sel 4-26	3.14	101.12	47.00	49.00	4.65	4.35	4.34	4.53	3.65	4.02	3.13
Sel P_{3-2}	3.46	142.23	38.00	47.00	4.53	4.89	4.56	4.34	3.45	3.68	3.23
Sel P_{5-2}	3.36	92.34	36.00	54.00	5.12	4.36	3.56	4.78	3.76	4.01	2.78
Sel 4-1	3.51	98.23	42.00	34.00	5.16	4.67	4.00	4.45	3.65	3.96	2.73
Sel B_2-16	3.23	109.23	49.00	41.00	4.35	5.12	5.00	5.24	3.44	3.91	2.26
Sel B_1-10-1	3.21	89.23	39.00	39.00	4.64	4.48	3.48	5.14	3.89	3.48	2.56
PbRatta 167	3.64	63.30	35.00	68.00	4.81	4.81	2.00	4.33	3.03	3.10	2.36
Mean	4.60	72.14	43.91	56.97	5.14	5.10	4.18	5.72	3.63	3.75	2.40
$CD_{(0.05)}$	0.85	4.53	4.44	5.44	0.60	0.80	0.70	0.92	0.20	0.21	0.30

ISSN: 2455-6939

Volume: 09, Issue: 01 "January-February 2023"

Table 4.2: Genetic variability, heritability and genetic advance

Characters	Coefficient of variability (%)		Heritability (%)	Genetic advance	Genetic gain (%)
	Phenotypic	Genotypic			
No. of Primary Branches per plant	19.72	16.14	66.98	1.26	27.21
Plant Height (cm)	41.38	41.19	99.19	62.67	84.46
No of fruits per plant	35.29	34.75	96.92	30.96	70.47
Weight of fruit (gm)	30.96	30.41	96.47	35.06	61.52
Equatorial diameter of fruit (cm)	10.04	6.61	43.31	0.46	8.96
Polar diameter of fruit (cm)	20.40	17.97	77.55	1.66	32.59
No. of locules per fruit	38.53	37.12	92.84	3.08	73.68
Pericarp Thickness (mm)	24.23	22.07	83.00	2.37	41.42
Fruit pH	12.85	12.41	93.26	0.90	24.68
Fruit TSS (^{0}Brix)	12.22	11.72	91.95	0.87	23.15
Total Yield per plant (gm)	38.31	37.53	95.54	1.82	75.73

ISSN: 2455-6939

Volume: 09, Issue: 01 "January-February 2023"

Table 4.3: Correlation Genotypic (G) and Phenotypic (P) correlation coefficient of 11 characters in Tomato

Traits		No. of Primary Branches per plant	Plant Height (cm)	No of fruits per plant	Weight of fruit (gm)	Equatorial diameter of fruit (cm)	Polar diameter of fruit (cm)	No. of locules per fruit	Pericarp Thickness (mm)	Fruit pH	Fruit TSS (Brix)	Total Yield per plant (kg)
No. of Primary Branches per plant	P		-0.0574	0.1241	0.0204	-0.0017	-0.1878	-0.1943	0.0934	0.0543	0.1135	0.1461
	G		-0.0750	0.1592	0.0178	-0.1323	-0.2359	-0.3040*	0.1519	0.0123	0.0351	0.1827
Plant Height (cm)	P			0.2084	-0.2587*	-0.4186**	-0.4456**	0.0116	0.0178	0.1073	0.0995	-0.0804
	G			0.2123	-0.2676*	-0.6214**	-0.5118**	0.0171	-0.0267	0.1046	0.1029	-0.0848
No of fruits per plant	P				-0.3922**	0.0018	-0.2081	-0.2235	0.4777**	-0.3594**	-0.1952	0.7540**
	G				-0.3996**	-0.0528	-0.2435	-0.2310	0.5180**	-0.3799**	-0.1999	0.7594**
Weight of fruit (gm)	P					0.3912**	0.0968	0.2943*	0.2154	-0.0198	-0.0084	0.2367
	G					0.5972**	0.0944	0.3015*	0.2477	-0.0156	-0.0231	0.2229
Equtorial diameter of fruit (cm)	P						0.2338	0.2950*	0.1202	-0.1269	-0.0813	0.2369
	G						0.5257**	0.4498**	0.3110*	-0.2070	-0.0994	0.3912**
Polar diameter of fruit (cm)	P							-0.0223	0.1164	0.0641	-0.0227	-0.1697
	G							-0.0023	0.1487	0.1208	-0.0585	-0.1996
No. of locules per fruit	P								-0.0171	0.0232	0.1954	0.0638
	G								-0.0078	0.0095	0.1815	0.0532
Pericarp Thickness (mm)	P									-0.3613**	-0.3679**	0.6176**
	G									-0.4123**	-0.4187**	0.7104**
Fruit pH	P										0.6950**	-0.3475**
	G										0.7350**	-0.3682**
Fruit TSS (Brix)	P											-0.1507
	G											-0.1707

*Significant at 5% level of Significance; ** Significant at both 1% and 5% level of significance

ISSN: 2455-6939

Volume: 09, Issue: 01 "January-February 2023"

Table 4.4: Path analysis: Direct indirect effects of various characters on yield per plant at genotypic (G) and phenotypic (P) levels in tomato.

Traits	No. of Primary Branches per plant		Plant Height (cm)	No of fruits per plant	Weight of fruit (gm)	Equtorial diameter of fruit (cm)	Polar diameter of fruit (cm)	No. of locules per fruit	Pericarp Thickness (mm)	Fruit pH	Fruit TSS (Brix)	Total Yield per plant (kg)
No. of Primary Branches	G	**0.3461**	-0.0592	0.1252	0.0147	-0.0522	-0.0444	-0.0077	-0.0568	-0.0091	0.0074	-0.1827
	P	**0.0305**	0.01	0.1211	0.0103	0	-0.0055	0.0027	0.019	-0.0029	0.0044	
Plant Height (cm)	G	-0.026	**0.7887**	0.1669	-0.2207	-0.2442	-0.0965	0.0005	0.0164	-0.083	0.0236	-0.0848
	P	0.0017	**-0.1749**	0.2033	-0.1312	-0.0006	-..0002	-0.0064	0.0145	0.0041	-0.0025	
No of fruits per plant	G	0.0551	0.1674	**0.786**	-0.3297	0.1202	-0.0313	-0.0023	-0.1446	0.2042	-0.0146	0.7594
	P	-0.0038	-0.0365	**0.9755**	-0.0199	0.0003	-0.0043	-0.0011	0.071	0.0141	-0.0025	
Weight of fruit (gm)	G	0.0062	-0.211	-0.3141	**0.825**	-0.0077	0.0365	0.003	-0.0993	0.0172	-0.0056	0.2229
	P	-0.0006	0.0452	-0.3826	**0.5071**	0	-0.0043	0.0017	0.0449	0.001	-0.0005	
Equatorial diameter of fruit (cm)	G	-0.0458	-0.4881	0.2394	-0.0162	**0.3946**	0.0989	-0.0114	-0.1164	0.1536	-0.0209	0.3912
	P	0.0001	0.0727	0.1674	-0.0132	**0.0015**	0.0068	0.004	0.00244	0.0067	-0.0031	
Polar diameter of fruit (cm)	G	-0.0816	-0.0405	-0.1308	-0.1601	0.2074	**0.1841**	-0.0001	-0.0556	-0.0896	-0.0123	-0.1996
	P	0.0057	0.0782	-0.1437	-0.0748	0.0004	**0.0292**	-0.0003	0.0237	-0.0034	-0.0009	
No. of locules per fruit	G	-0.1052	0.0167	-0.0716	0.0987	0.1775	-0.0004	**0.0254**	0.0029	0.0022	-0.0071	0.0532
	P	0.0059	-0.0029	-0.0818	0.0646	0.0005	-0.0007	**0.0137**	-0.0035	0.032	-0.0012	
Pericarp Thickness (mm)	G	0.0526	-0.0345	0.3038	0.219	0.1287	0.028	-0.0002	**-0.3742**	0.3059	-0.0881	0.7104
	P	-0.0028	0.0055	0.3405	0.112	0.0002	0.0034	-0.0002	**0.2033**	0.019	-0.0142	
Fruit pH	G	0.0042	0.0883	-0.2164	-0.0191	-0.0817	0.0227	0.0002	0.1543	**-0.7419**	0.1546	-0.3682
	P	-0.0017	-0.0196	-0.2614	-0.0099	-0.0002	-0.0019	0.0003	-0.0734	**-0.0526**	0.0268	
Fruit TSS(ºBrix)	G	0.0122	0.0884	-0.0546	-0.0221	-0.0392	-0.011	0.0046	0.1567	0.5453	**0.2104**	-0.1707
	P	-0.0035	-0.0196	-0.0631	-0.006	-0.0001	-0.0007	0.0027	-0.0748	-0.0366	**0.0385**	

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