Eco. Env. & Cons. 30 (2) : 2024; pp. (505-509)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i02.013

Genetic Variability, Heritability, Genetic Advance and Identification of Trait-Specific Accessions from the Tomato (*Solanum lycopersicum* L.) Germplasm

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(Received 7 September, 2023; Accepted 28 November, 2023)

ABSTRACT

Fifty seven genotypes were evaluated for yield and yield attributing characters at farmers field, Mittachinthavaripalle, Punganur, Chittoor District, Andhra Pradesh during Summer, 2023. The experiment was laid out in Randomized Block Design along with three replications. High GCV and PCV were recorded for number of fruits per plant, fruit weight, yield per plant, fruit length, pericarp thickness, fruit width, titrable acidity, plant height and ascorbic acid. This indicates the existence of wider genetic variability, which would be amenable for further selection. Low estimates of genotypic and phenotypic coefficient of variations were observed for days to 50% flowering, number of primary branches and lycopene suggesting the narrow range of genetic variability for these traits. High heritability coupled with high genetic advance over mean were observed for plant height, days to 50% flowering, number of fruits per plant, fruit weight, fruit length, fruit width, pericarp thickness, total soluble solids, lycopene, ascorbic acid, titrable acidity and yield per plant which shown high level of genetic advance indicating opportunity for better selection response. The results of genetic parameters from the present study may helpful to the plant breeder in selection of elite genotypes from diverse genetic populations.

Key words: *Genetic variability, Genetic advance, Heritability, GCV and PCV*

Introduction

Tomato (*Solanum lycopersicum* L.) is a versatile vegetable crop among the solanaceae family and it is having a special economic importance in the horticultural industry in India as well as in the world. It is having a special nutritive value and antioxidant properties due to the presence of lycopene and flavonoids, so it is considered as protective food. In India, the production and productivity is very low compare to the global scenario (Rai *et al.,* 2016). Hence, there is a need to develop superior hybrids/ varieties for various agro-ecological conditions with specific end use. For any breeding programme, improving the productivity, quality and nutritional value of the crop is the base line. Therefore, evaluation of germplasm under different climatic conditions is needed to be checked to ascertain their adaptability under various environmental conditions (Agarwal *et al.,* 2014).

Among the various traits, yield is a complex character which is highly influenced by environmental

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fluctuations (Pooja *et al.,* 2022). For a confirmative study, it is desirable to estimate the components of genetic variability using more number of test genotypes covering wide geographical distribution. Furthermore, it is essential to confirm the previous results using new accessions and at other locations. In this context, the present investigation was carried out to unravel the components of genetic variability, heritability and genetic advance of yield traits among 57 genotypes of tomato representing an indigenous and exotic germplasm.

Materials and Methods

The experiment was conducted at Farmers field of Punganur, Chittoor district of Andhra Pradesh, India in summer season, 2022-2023. The experimental material comprised of 57 genotypes, details of germplasm given in table 1. The experiment was laid out in Randomized Block Design (RBD) with three replications. A spacing of 60 x 30 cm and all the recommended agronomic package of practices were followed (staking, earthing up, irrigation, weeding, fertilizers applications) as recommended for commercial tomato production. The data were recorded on five randomly selected plants per replication for all the 13 characters *viz.,* plant height (cm), number of primary branches, days to 50% flowering, number of fruits per plant, fruit weight (g), fruit length (cm), fruit width (cm), pericarp thickness (mm), total soluble solids (°Brix), lycopene content (mg/100g), ascorbic acid (mg/100g), titrable acidity (%) and yield per plant (g).

Results and Discussion

The analysis of variance for various characters of 57 genotypes of tomato were presented in Table 2. The results revealed that differences due to various genotypes were highy significant for all the characters

Assessments of various statistical and genetic parameters like mean, genotypic coefficient of variation (GCV), phenotypic coefficient of variation, heritability, genetic advance and genetic advance as percent mean are existing (Table 2). High (>20%) GCV and PCV were recorded for plant height, number of fruits per plant, fruit weight, fruit length, fruit width, pericarp thickness, ascorbic acid, titrable acidity and yield per plant signifying the presence of broader genetic variability for these attributes in the genotypes under the study. The PCV was higher than GCV for all the characters studied signifying that environmental factors inducing their expression to some degree. Slight alterations between GCV and PCV for all the characters advised their comparative resistance to environmental variation. The results in accordance with the Taiana *et al.* (2015), Triveni *et al.* (2017), Anuradha *et al.* (2020), Eppakayala *et al.* (2021). The moderate (10-20%) GCV and PCV were recorded for total soluble solids and lycopene content which specifies the existence of limited amount of variation for these attributes. Low (<10%) GCV and PCV were recorded for number of primary branches and days to 50% flowering. This specifies the lack of ample variability in the genotypes. Henceforth, variability has to be generated in these attributes either through introduction or hybridization to recover the transgressive segregants or by mutation breeding. Similar results were also reported by Pooja *et al.* (2022).

The heritability in broad sense ranged from 51.90 for number of primary branches to 99.64 for ascorbic acid. Higher values of heritability (>60) has been observed for plant height, days to 50% flowering, number of fruits per plant, fruit weight, fruit length, fruit width, pericarp thickness, total soluble solids, lycopene content, ascorbic acid, titrable acidity and yield per plant. Moderate values of heritability (30-60) have been observed for number of primary branches are observed in Table 3. Higher values of heritability for the attributes simplified that they were less affected by environmental changes and selection based on phenotypic performance would be reliable Pidigam *et al.* (2019), Anuradha *et al.* (2020), Titus *et al.* (2020).

Genetic advance as percent mean (GAM) ranged from 10.40 for days to 50% flowering to 80.53 for fruit weight. High GAM were observed for plant height, number of fruits per plant, fruit weight, fruit length, fruit width, pericarp thickness, total soluble solids, lycopene content, ascorbic acid, titrable acidity and yield per plant. Moderate GAM were observed for number of primary branches and days to 50% flowering.

Heritability assess the prediction of response to selection. Studying heritability in broad sense along with genetic advance may reveal the occurrence of specific components (additive or non-additive) of genetic variance and therefore, aid in judging the efficiency of selection for the attributes more precisely (Johnson *et al.,* 1955). High heritability (>60%)

Table 1. List of tomato genotypes used for evaluation

S. No	EC No.	Source	S. No.	EC No.	Source
1	EC-620.88	NBPGR, New Delhi	31	EC-631404	NBPGR, New Delhi
2	EC-638302	NBPGR, New Delhi	32	EC-635533	NBPGR, New Delhi
3	EC-620378	NBPGR, New Delhi	33	EC-631412	NBPGR, New Delhi
4	EC-692338	NBPGR, New Delhi	34	EC-687604	NBPGR, New Delhi
5	EC-631359	NBPGR, New Delhi	35	EC-635526	NBPGR, New Delhi
6	EC-615039	NBPGR, New Delhi	36	EC-615040	NBPGR, New Delhi
7	EC-631406	NBPGR, New Delhi	37	EC-617060	NBPGR, New Delhi
8	EC-620495	NBPGR, New Delhi	38	EC-620376	NBPGR, New Delhi
9	EC-620484	NBPGR, New Delhi	39	EC-631438	NBPGR, New Delhi
10	EC-620510	NBPGR, New Delhi	40	EC-631415	NBPGR, New Delhi
11	EC-631957	NBPGR, New Delhi	41	EC-638522	NBPGR, New Delhi
12	EC-620414	NBPGR, New Delhi	42	EC-620508	NBPGR, New Delhi
13	EC-692347	NBPGR, New Delhi	43	EC-620404	NBPGR, New Delhi
14	EC-620489	NBPGR, New Delhi	44	EC-636877	NBPGR, New Delhi
15	EC-631409	NBPGR, New Delhi	45	EC-620385	NBPGR, New Delhi
16	EC-620552	NBPGR, New Delhi	46	EC-692388	NBPGR, New Delhi
17	EC-632926	NBPGR, New Delhi	47	EC-62516	NBPGR, New Delhi
18	EC-617055	NBPGR, New Delhi	48	EC-631351	NBPGR, New Delhi
19	EC-620531	NBPGR, New Delhi	49	EC-620498	NBPGR, New Delhi
20	EC-620543	NBPGR, New Delhi	50	EC-620361	NBPGR, New Delhi
21	EC-631371	NBPGR, New Delhi	51	Local Kerala	Kerala
22	EC-631369	NBPGR, New Delhi	52	Anagha	KAU, Kerala
23	EC-632944	NBPGR, New Delhi	53	PKM-1	TNAU, Tamilnadu
24	EC-631401	NBPGR, New Delhi	54	Kashi Tomato	Chittoor, AP
25	EC-631427	NBPGR, New Delhi	55	Miryalaguda	Telangana
26	EC-631378	NBPGR, New Delhi	56	Khori Leikai	Manipur
27	EC-688516	NBPGR, New Delhi	57	Kasi Adarsh	IIVR, Varanasi
28	EC-620425	NBPGR, New Delhi			
29	EC-690982	NBPGR, New Delhi			
30	EC-620382	NBPGR, New Delhi			

Table 2. Analysis of variance mean performance of 13 characters

S. No.	Characters	Source of Variation		
		Replication	Treatment	Error
	Degree of freedom	2	56	112
1	Plant Height	12362.609	2540.932**	162.644
2	Number of Primary Branches	38.110	2.128**	0.502
3	Days to 50% Flowering	131.172	33.261**	5.600
4	Number of fruits per plant	13761.162	1512.041**	58.883
5	Fruit Weight	0.022	958.287**	8.277
6	Fruit Length	0.058	4.894**	0.077
7	Fruit Width	0.134	2.995**	0.087
8	Pericarp Thickness	6.737	5.771**	0.105
9	Total Soluble Solids	1.736	1.333**	0.019
10	Lycopene Content	0.833	0.551**	0.186
11	Ascorbic Acid	3.182	38.200**	18.816
12	Titrable Acidity	0.003	0.025*	0.007
13	Yield Per Plant	25359984.000	973642.313**	663431.688

** Significant at 1%, * Significant at 5%, NS: Non significant
GCV, PCV, Heritability and Genetic Advance as percent Mean

Table 3. Estimates of variability, heritability and genetic advance as percent of mean for 13 characters in 57 genotypes of tomato

S. No	Character	Range	Mean	GCV (%)	PCV (%)	h² (%)	GA	GAM (%)	
1	PH	79.530	192.810	128.819	21.857	23.995	82.976	52.834	41.014
2	NPB	4.800	8.870	7.637	9.638	13.378	51.906	1.092	14.304
3	DFF	40.670	57.470	47.400	6.406	8.122	62.213	4.934	10.409
4	NFPP	36.000	159.500	53.214	41.359	43.801	89.161	42.811	80.451
5	FW	7.800	82.100	44.936	39.602	40.116	97.453	36.188	80.534
6	FL	0.830	6.290	4.083	31.032	31.767	95.429	2.550	62.448
7	FWD	1.240	6.070	3.948	24.938	26.039	91.726	1.942	49.202
8	PT	2.330	7.830	4.915	27.960	28.724	94.751	2.756	56.065
9	TSS	3.070	5.200	4.035	16.399	16.758	95.759	1.334	33.057
10	LC	2.330	4.110	3.456	13.375	13.979	91.539	0.911	26.361
11	AA	14.200	29.520	22.764	20.633	20.670	99.643	9.658	42.429
12	TA	0.290	0.850	0.464	22.927	23.669	93.830	0.212	45.749
13	YPP	846.000	3908.730	2180.581	33.596	39.126	73.731	1295.846	59.427

PH: Plant height; NPH: Number of primary branches; DFF: Days to 50% flowering; NFPP: Number of fruits per plant; FW: Fruit weight; FL: Fruit length; FWD: Fruit width; PT: Pericarp thickness; TSS: Total soluble solids; LC: Lycopene content; AA: Ascorbic acid; TA: Titrable acidity; YPP: Yield per plant; GCV: Genotypic coefficient of variation; PCV: Phenotypic coefficient of variation; h^2: Heritability; GA: Genetic advance; GAM%: Genetic advance as percent of mean

coupled with high GAM (>20%) were observed for plant height, number of fruits per plant, fruit weight, fruit length, fruit width, pericarp thickness, total soluble solids, lycopene content, ascorbic acid, titrable acidity and yield per plant are observed in Table 3. This shows that these characters are controlled by additive gene effect and are less influenced by environmental factors. Similar results were also reported by Reddy *et al.* (2019), Anuradha *et al.* (2020), Choline *et al.* (2021), Pooja *et al.* (2022). High heritability (>60%) coupled with moderate (10-20%) GAM were observed for days to 50% flowering. This indicates the prevalence of non-additive components and there can slight response to selection and these characters can exploited through hybridization programme. Moderate heritability couples with moderate GAM was observed for the number of primary branches. The results were in agreement with the findings of Somraj *et al.* (2017), Rai *et al.* (2016), Sushma *et al.* (2020).

Conclusion

Therefore, the evaluation of 57 genotypes of tomato indicated a wide range of variability for yield and yield attributes. From the above study, it can be concluded that plant height, days to 50% flowering, number of fruits per plant, fruit weight, fruit length, fruit width, pericarp thickness, total soluble solids, lycopene content, ascorbic acid, titrable acidity and yield per plant are significant attributes for which conventional selection might get worthy development in recognizing superior genotypes of tomato.

Conflict of Interest

None

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