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Correlations among the component traits of yield in minicore collection of tomato (*Solanum lycopersicum* L.)

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ABSTRACT

Yield is a quantitative character influenced by a number of contributing component traits. Maximining desirable allele available in germplasm is a key in order to breed a desirable genotype with targeted utility. Determining simple correlation for yield with quality traits aids in designing a breeding strategy in crop improvement. A set of 260 minicore accessions of tomato (Solanum Lycopersicum L.) were field evaluated followed with recommended packages and practices. Among the traits, fruit yield per plant and number of fruit per plant (0.431) were positive and significantly correlated with yield. Fruit yield per plant was also positive and significantly correlated with number of locules per fruit (0.513), plant height (0.302), whereas, it was negative and significant with days to 50 per cent flowering (-0.613) and total soluble solids (-0.621). The genetic correlations among these traits not only help to get deeper biological relation but also in breeding for general consumer and industrial purposes in tomato. These characters can be explored directly to enhance fruit yield in tomato crop.

Keywords: *Correlation, yield and quality traits*

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INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is a self-pollinated diploid crop species of Solanaceae family with twelve pairs of chromosomes (2n = 24). It is cultivated throughout the world including India. Being a day neutral species, it is highly suited for intensive cultivation throughout the year. In most of the Asian countries tomatos are used regularly as part of curry and a number of other preparations. Further, the fruits are rich in vitamins (A and C), minerals (Ca, P and Fe) and antioxidant that fright against cancer and heart diseases [2]. Being a crop of Central America and moved on to different countries, tomato crop has accumulated large genetic diversity and a number of cultivars were introduced to India for genetic improvement. Systematic characterisation of minicore accessions is essential to understand and estimate the character association, which will eventually, forms the basis of crop improvement.

Knowledge of inter-character relationships is important in plant breeding for indirect selection to the characters that are not easily measurable and particularly for those that exhibit low heritability [11]. Further, correlation studies between characters are important for determining the effective breeding procedure to be adopted to achieve maximum gains during crop improvement endeavour. Genetically complex character like yield is governed by multiple genes, highly influenced by the environmental factors. Yield is determined by a number of quantitative characters that contribute in different ways in

tomato [5]. A chain of linear and non-linear associations among yield components have been documents in tomato [1, 8]. In order to increase the genetic yield potential, maximum utilization of the desirable alleles for synthesizing of new genotypes is required. Understanding the nature of relationships among the components can augment selection of new genotypes among the segregating populations. This helps to choose desirable genotypes so that elite types with increase in yield through inter related characters. Information on such aspect across genetic pool such as cultivars, elite lines, minicore accessions and landraces of tomato would help to consolidate the trait-trait relationships and their further utilisation in crop improvement through appropriate plant breeding method. Degree of association between the various characters and direct and indirect effects of characters contributing to total fruit yield are of paramount significance in formulator appropriate breeding strategy. In this paper we present interrelationship among various component traits of fruit yield in a set of 260 minicore accessions of tomato.

MATERIAL AND METHODS

A set of 260 constituting minicore accessions was evaluated in an Augmented Block Design (ABD) with three checks repeated. The list of minicore accessions used in study presented in Table 1. The twenty one day old seedlings were transplanted from nursery to the field keeping the plant-to-plant and row-to-row distances of 45 and 60 cm, respectively. Recommended package of practices for tomato were followed although the experimental period including plant protection practices. The observations were recorded on randomly selected ten plants per entry following the methodology described in tomato descriptor. Traits related to growth, yield and quality parameters on each accession were recorded. Simple correlation coefficient was computed following standard procedure [10]. The observation was recorded for following traits *viz.,* plant height (cm), number of branches per plant, number of fruits per plant, number of locules per fruit, average fruit weight (g), days to 50 per cent flowering, total soluble solids (B^0), test seed weight (g) and total yield per plant (kg).

RESULT AND DISCUSSION

The simple correlation between fruit yield, its contributing characters and combined effect of several component characters and environment was worked out. Results of correlation analysis of yield components are presented in Table 2. Simple correlation studies provided information on the nature and extent of association between two pairs of characters studied. A positive correlation occurs due to coupling phase of linkage between characters and negative correlation arises due to repulsion phase of linkage of genes controlling different traits [6]. No correlation indicates that genes concerned are located far apart on the same chromosome or they are located on different chromosomes.

The correlation coefficient analysis for yield and yield components showed that the two fruit yield parameter such as fruit yield per plant and number of fruit per plant (0.431) was positive and significant. The similar findings were reported [1]. The yield contributing trait such as fruit yield per plant is also positive significantly correlated with plant height (0.302) and number of locules per fruit (0.513) whereas, it is negative significantly correlated with days to 50 per cent flowering (-0.613) and total soluble solids (-0.621). These results are in conformity with the findings [3]. This phenomenon also can be explained in a way that total fluctuations in yield are governed principally by changes in one or more components. However, number of fruit per plant is also positive significantly correlated with number of branches per plant (0.209), number of locules per fruit (0.267). The results are in accordance [11]. Therefore, these characters can be explored directly to enhance fruit yield in tomato through appropriate breeding strategy.

Days taken to 50 per cent flowering exhibited negative significant correlation with total soluble solids (-0.435), total yield per plant (-0.613) and plant height (-0.205). The same results were observed [4]. Plant height at maturity stage is positively significant correlated with number of branches per plant (0.369), total soluble solids (-0.223) and total yield per plant (0.302). The plant height at maturity stage is positively correlated with fruit yield per plant [7], and number of fruit per plant [12]. In the present study, number of branches per plant showed positively significant correlated with number of fruit per plant (0.209). A total soluble solid is positively correlated with plant height (0.223). In situations where any two characters exhibiting genetic correlation, it is possible to achieve a gain in one of them through indirect selection of the other trait. Particularly it is advantageous if high economic value but has low heritability, when compared to the associated trait. Hence, selection could be based on either the character having high heritability or the one that is more easily measurable [13].

Some parameters are negatively correlated such as fruit yield per plant is significant negatively correlated with days to 50 per cent flowering (- 0.613) and total soluble solids (- 0.621). The character like test seed weight negatively correlated with plant height (-0.357), total soluble solids negatively correlated with

number of locules per fruit (-0.473) and day to 50 per cent flowering (-0.435). With respective to, day to 50 per cent flowering with plant height (-0.205), average fruit weight with number of branches per plant (-0.359) and number of locules per plant with plant height (-0.493) association were recorded. Negatively correlated traits also play an important role in tomato breeding programme [9]. Negative association between any traits means that an increase in one trait attributes results in decrease in attributes of another trait. Analysis of the other correlations involving such traits helps to further deeper understanding their architecture in the germplasm. In order to improve these kinds of the approach has to be though out carefully.

Table 1: List of minicore accessions used in the present study

Sl. No	Accessions	Sl. No	Accessions	Sl. No	Accessions
1	Ageta-32	41	DVRT-1	81	ECs-538439
2	Angoorlata	42	DVRT-2	82	ECs-538440
3	ArkaAbha	43	ECs-4-3	83	ECs-538441
4	Arka Alok	44	ECs-2791	84	ECs-538455
5	ArkaMeghalli	45	ECs-13904	85	ECs-552141
6	ArkaVikas	46	ECs-317-6-1	86	ECs-560340
7	Avinash-2-2-1	47	ECs-273966	87	ECs-570028
8	Azad T-2	48	ECs-381263	88	ECs-605694
9	Azad T-5	49	ECs-381554	89	ECs-605695
10	Improved B-4-1	50	ECs-501574	90	ECs-605696
11	Improved B-7-2	51	ECs-501575	91	ECs-620362
12	Bhillai	52	ECs-501576	92	ECs-620366
13	Improved BL-1208	53	ECs-501577	93	ECs-620370
14	Improved BTH-9 M	54	ECs-501580	94	ECs-620373
15	Improved C-1-4	55	ECs-501582	95	ECs-620374
16	Improved C-3-2	56	ECs-501583	96	ECs-620375
17	Improved C-4-1	57	ECs-519730	97	ECs-620383
18	Improved C-8-1	58	ECs-520046	98	ECs-620386
19	Improved C-9-2	59	ECs-520059	99	ECs-620398
20	Improved C-10-2	60	ECs-520061	100	ECs-620401
21	Improved C-11-1	61	ECs-520071	101	ECs-620403
22	Improved C-11-2	62	ECs-520074	102	ECs-620406
Sl. No	**Accessions**	**Sl. No**	**Accessions**	**Sl. No**	**Accessions**
23	Improved C-11-3	63	ECs-520075	103	ECs-620409
24	Improved C-20-1	64	ECs-520078	104	ECs-620410
25	Improved C-20-2	65	ECs-521039	105	ECs-620411
26	Improved C-26-1	66	ECs-521056	106	ECs-620413
27	Improved CHRT-4	67	ECs-521078	107	ECs-620419
28	Improved CH-155	68	ECs-526139	108	ECs-620421
29	Co-3 Local	69	ECs-528372	109	ECs-620438
30	CLN-2026 Local	70	ECs-528374	110	ECs-620444
31	CLN-2116 Local	71	ECs-529080	111	ECs-620446
32	CLN-1621 Local	72	ECs-529083	112	ECs-620455
33	CLN-2366 Local	73	ECs-538138	113	ECs-620456
34	D-1-1 Local	74	ECs-538155	114	ECs-620464
35	D-2-2-1 Local	75	ECs-538380	115	ECs-620469
36	D-3-2 Local	76	ECs-538404	116	ECs-620470
37	D-5-1 Local	77	ECs-538405	117	ECs-620474
38	DARL-66	78	ECs-538408	118	ECs-620476
39	Dhrubya	79	ECs-538419	119	ECs-620480
40	DT-10 Local	80	ECs-538423	120	ECs-620486
121	ECs-620500	161	H-88-78-5	201	NDT-1
122	ECs-620502	162	Hawai	202	NDT-8
123	ECs-620514	163	Hisar Anmol	203	NDT-4
124	ECs-620519	164	Hisar Arun (Sel-7)	204	NDTVR-60

125	ECs-620530	165	Hisar Lalit	205	NDTVR-73
Sl. No	**Accessions**	**Sl. No**	**Accessions**	**Sl. No**	**Accessions**
126	ECs-620533	166	Improved I-4-4	206	NF37SB-8
127	ECs-620540	167	Improved IC-373378	207	Palam Pink
128	ECs-620556	168	Improved IC-427766	208	Pant T-3
129	ECs-620568	169	Improved IC-447708	209	Pant T-5
130	ECs-620575	170	Improved IC-469626	210	Parul
131	ECs-620598	171	IIHR-01	211	Pb-Chhuhara
132	ECs-625644	172	IIHR-2202	212	Pb.Upma
133	ECs-625645	173	INDAM-2102	213	Persia Bed
134	ECs-625651	174	INDAM-2103	214	PDT-3-1 Local
135	ECs-625652	175	INDAM-2103-1	215	PDVT-14
136	ECs-625660	176	INDAM-2103-1-1	216	PKM-1
137	ECs-6202041	177	INDAM-2103-4	217	PS-1
138	Improved F-5020	178	INDAM-2103-6	218	Prestige
139	Improved F-6022	179	INDAM-2103-6-1	219	Pusa Gaurav
140	Improved F-6050-1	180	INDAM-2103-6-4	220	Pusa Ruby
141	Improved F-6059	181	Jawahar-99	221	Pusa-120
142	Improved F-7012	182	Kashi Hemant	222	Punjab Barkha Bahar-2
143	Improved F-7025	183	Kashi Sharad	223	Pusa Hybrid-2
144	Improved F-7028	184	Kashi Vishesh	224	Roma
145	Improved F-6009	185	Kashi Amrit	225	Sanjeevani
146	Improved FEB.-02	186	Kashi Anupam	226	Sankranti
147	Improved FEB.-04	187	Kajla	227	Sel-18
Sl. No	**Accessions**	**Sl. No**	**Accessions**	**Sl. No**	**Accessions**
148	Improved FLA-7171	188	Kalyanpur Type-1	228	Sioux
149	Improved FLA-7421	189	Kashmiriya	229	Solan Gola
150	Flora-dade	190	LA-3772 Local	230	SolanVajr
151	G-4-5 Local	191	LA-3957 Local	231	Sun-Cherry
152	G-5-4 Local	192	LA-3997 Local	232	Swarna Naveen
153	G-6-3 Local	193	M-1-4 Local	233	Swarna Vaibhav
154	GT-1 Local	194	M-3-2 Local	234	TLBR-6
155	GT-2 Local	195	Mukthi	235	TLH-17 Local
156	GT-3 Local	196	Money Maker	236	TLH-27 Local
157	H-88-78-1	197	Monte Favet	237	TLH-30 Local
158	H-88-78-2	198	N-2-2 Local	238	Tripura Local
159	H-88-78-3	199	N-2-3 Local	239	UtkalPragyan
160	H-88-78-4	200	Nandi	240	Utkal Raja
241	VRT-32-1	247	97/384 Local	253	Switzerland
242	VRT-101A	248	97/753 Local	254	Utkal Urvashi
243	WIR-3957	249	97/754 (Kewalo)	255	WIR-13717
244	WIR-5032	250	15 SB	256	Pallavi
245	WIR-13706	251	Rio Grande	257	Punjab Keshri
246	WIR-13708	252	S.Lalima	258	V. Pragyan
259	DMT1	260	DMT3		

Table 2: Correlation co-efficient for yield component and quality traits during in minicore accessions

Traits	**X_1**	**X_2**	**X_3**	**X_4**	**X_5**	**X_6**	**X_7**	**X_8**	**X_9**
X_1	1	0.369**	0.181	-.493**	0.183	-0.205*	0.223*	-0.357**	0.302*
X_2		1	0.209*	0.203	-0.359**	0.183	-0.127	0.112	0.213
X_3				0.267*	-0.183	0.191	-0.127	-0.163	0.431**
X_4				1	0.173	0.197	-0.473**	0.163	0.513**
X_5					1	0.215*	-0.191	0.193	0.195
X_6						1	-0.435**	-0.189	-0.613**
X_7							1	-0.167	-0.621**
X_8								1	0.173
X_9									1

X_1: Plant height (cm); X_2: Number of branches per plant ; X_3: Number of fruits per plant; X_4: Number of locules per fruit; X_5: Average fruit weight (g); X_6: Days to 50 % flowering; X_7: Total soluble solids (B^0) X_8: Test seed weight (g); X_9: Total yield per plant (kg)

CONCLUSION

Thus based on the finding of present investigation it can be concluded that strong association was present for nine characters indicating that considerable scope existed for the improvement of tomato cultivars through selections. The yield contributing traits like number of fruits per plant, average fruit weight, number of branches per plant was found to have positive and significant correlation with yield per plant. Hence, these characters could be reliably looked for, while selecting high yielding genotypes.

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CONFLICT OF INTEREST

There is no conflict of interest from authors

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