Vegetable Science (2018) 45(2) : 191-196

Genetic variability studies in tomato (*Solanum lycopersicum* L.) under eco-friendly management

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Received: September 2018 / Accepted: January 2019

Abstract

Twenty genotypes of tomato were evaluated for yield, quality and other traits under eco-friendly management. Analysis of variance revealed that highly significant differences among genotypes for all the traits. High magnitude of phenotypic coefficients of variation and genotypic coefficients of variation were observed for traits including fruit yield per plant, plant height and number of fruits per plant. High heritability coupled with high genetic advance estimates were observed for number of fruits per plant, plant height and fruit yield per plant. Fruit yield/plant had positive and highly significant correlation with number of fruits/ plant, fruit weight, fruit shape index and number of primary branches/plant indicating these traits are important yield components. Whereas, negative and significant association with days to 50% flowering, leaf curl and fruit borer incidence, ascorbic acid content and pericarp thickness. Maximum positive and direct effect towards fruit yield/plant was exerted by average fruit weight, number of fruits per plant, leaf curl incidence and plant height. Few genotypes with high yield and other useful traits were identified for future under eco-friendly management.

Keywords: Tomato, Variability, Heritability, Correlation, Path analysis and Eco-friendly

Introduction

Tomato (2n= 24) is an important vegetable of the world and now commonly used in all households. It contains red color pigment called lycopene (a carotenoid formed during ripening) and its presence in plasma has been related in reducing prostate cancer (Giovannucci et al. 1999). It is being grown on 4.8 m ha area in world with annual production of 182.3 mt (Anonymous 2017). In northern plains of India, productivity of main season crop is relatively poor when compared with other productive regions since growing period coincides with harsh summer, uneven rains and heavy incidence of diseases and insect-pests. Therefore, evaluation of germplasm is imperative to understand the genetic background and breeding value for genetic improvement of tomato both under normally sown and eco-friendly managed conditions. Genetic variability is primary requirement for development of suitable varieties or hybrids for various horticultural traits. The phenotypic expression of the plant characters is mainly controlled by the genetic makeup of the plant and environment. The genetic variance of quantitative traits is composed of additive variance (heritable); non-additive variance (non-heritable); dominance and epistasis (non-allelic interaction). Therefore, it becomes important to partition the observed phenotypic variability into its heritable and non-heritable components with suitable parameters such as phenotypic and genotypic coefficient of variation besides heritability and genetic advance. Genetic advance can be used to predict the efficiency of selection. The information on heritability in conjunction with genetic advance is needed for effective selection (Johnson et al. 1955). Correlation coefficient analysis help to know the association between yield and other yield contributing traits, which could be effectively exploited to formulate selection strategies for improving yield components. Path coefficient analysis reveals direct and indirect contribution of character towards yield. On the basis of these studies the quantum importance of individual characters is marked to facilitate the selection programme for better gains. Hence, the present study was carried out to estimate the genetic variability; degree of association among various yield components and their direct and indirect effect on yield in 20 diverse genotypes in early planted tomato crop under eco-friendly management for genetic improvement of tomato.

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Materials and Methods

The experimental material comprised of 20 diverse tomato genotypes collected from different parts of the country (Table 1). The seeds were sown in nursery beds in the month of September and transplanting was done in October 2017-18 under open as an early planted crop using RBD with 3 replication at spacing of 90 cm x 60 cm using eco-friendly practices with preceding crop - marigold. The experiment was laid out at experimental farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, (India) (longitude 74º58' E and latitude 32º 40'N with altitude 332 m above MSL and mean annual rainfall between 1000-1200 mm). The experimental site experiences hot dry summer, hot and humid rainy season and cold winter months where maximum temperature goes up to 45°C or even more during summer (May to June) while minimum temperature falls to 1°C during winters (December to January).

For eco-friendly management, all the cultural practices were adopted as per Dar (2011) and modifications (including FYM @ 25 tonnes/ha, mustard cake @ 2 t/ha and vermicompost @ 5 t/ha; Neem oil @ 1.0%; Pheromone traps and low cost ecofriendly protected structures). Data was recorded for traits viz. days to 50% flowering, plant height (cm), number of primary branches per plant, number of flowers per cluster, number of fruits per truss, number of fruits per plant, average fruit weight (g), fruit shape index, fruit yield per plant (kg), pericarp thickness (mm), number of locules per fruit, total soluble solids (°B), ascorbic acid (mg/100 g), leaf curl incidence (%), wilt incidence (%) and fruit borer incidence (%).The phenotypic and genotypic coefficient of variance was estimated as per Burton and De Vane (1953). The estimates of heritability in broad sense and genetic advance were calculated as per Allard (1960).The genotypic and phenotypic correlation coefficients were calculated as per Al-Jibouri et al. (1958). Path coefficients analysis was carried out to determine relationship among yield components and for calculating direct and indirect contribution of characters towards yield (Dewey and Lu 1959).

Results and Discussion

Analysis of variance showed significant differences among genotypes for all the traits in early planted crop raised in open under ecofriendly management (Table 2). The comparison of mean performance of 20 genotypes for 16 traits using critical differences revealed existence of very high level of variability in the used genotypes. A wide ranges of variations in mean performance of genotypes were observed for all the traits such as days to 50% flowering (23.67 days in Arka Rakshak to 31.67 days in Palam Pride), plant height (65.60 cm in PKM-1 to 178.77 cm in BSS-488), number of primary branches per plant (4.78 in DVRT-2 to 8.41 in Arka Rakshak), number of flower per cluster (3.66 in Pusa Ruby to 8.66 in BSS-488), number of fruits per truss (1.66 in DVRT-2 to 4.08 in Arka Rakshak), number of fruits per plant (12.92 in PKM-1 to 42.25 in Hawaii-7998), average fruit weight (26.03 g in Hawaii-7998 to 85.52 g in DVRT-2), fruit shape index (0.67 in PKM-1 to 1.07 in Arka Rakshak), number of locules per fruit (3.11 in Hawaii-7998 and Arka Rakshak to 5.44 in DVRT-2), total soluble solids (3.93 ^{0}B in Selection-2 to 5.90 ^{0}B in Marglobe), ascorbic acid (23.32 mg in Marglobe to 33.91 mg in Arka Rakshak), pericarp thickness (3.62 mm in Marglobe to 6.05 mm in BSS-488), fruit yield per plant (0.59 kg in PKM-1 to 2.52 kg in Arka Rakshak), fruit borer incidence (1.44% in Arka Rakshak to 10.33% in Arka Abha), leaf curl incidence (0.00% in Arka Rakshak to 46.67% in PKM-1) and wilt incidence (3.33% in BWR-5 to 26.67% in Arka Abha).

Table 1: List of tomato genotypes used for present study along with their source

Sl. No.	Genotype	Source	Growth habit
1.	PKM-1	TNAU, Coimbatore	Determinate
2.	ArkaAbha	IIHR, Bengaluru	Semi-determinate
3.	ArkaAlok	IIHR, Bengaluru	Indeterminate
4.	ArkaSourabh	IIHR, Bengaluru	Semi-determinate
5.	ArkaVikas	IIHR, Bengaluru	Indeterminate
6.	Pusa Ruby	Durga seeds co.	Indeterminate
7.	Palam Pink	CSKHPKV	Indeterminate
8.	Hawaii-7998	CSKHPKV	Indeterminate
9.	BWR-5	CSKHPKV	Determinate
10.	CLN-2670- B1	CSKHPKV	Indeterminate
11.	Palam Pride	CSKHPKV	Indeterminate
12.	CLN-2123-A1 Red	CSKHPKV	Indeterminate
13.	DVRT-2	SKUAST-J, Chatha	Determinate
14.	KH-105	Khan hybrid seeds co.	Indeterminate
15.	Marglobe	IARI, New Delhi	Indeterminate
16.	BSS-48	AICRVIP	Indeterminate
17.	Bhagya	AICRVIP	Indeterminate
18.	ArkaRakshak	IIHR,Bengaluru	Indeterminate
19.	Selection-2	AICRVIP	Determinate
20.	S-22	Local selection	Determinate

The genotypic coefficients of variation (GCV) and phenotypic coefficients of variation (PCV) presented in Table 3 under that PCV were higher in magnitude than the corresponding GCV for all the characters studied. The differences between GCV and PCV were less in majority of the cases which shows that environmental factors had played less influence on the expression of these characters. Coefficients of variation varied in magnitude (low to high) which indicating that there was

Table 2: Analysis of variance for 16 horticultural traits in tomato

Traits	Replication	Treatments	Error	CV	CD
Degree of freedom	2	19	38	-	-
Days to 50% flowering	32.11	3892.54*	78.841	7.945	14.674
Plant height (cm)	0.45	13.911*	0.854	3.225	1.527
Number of primary branches/plant	0.24	2.752*	0.338	9.428	0.961
Number of flowers per cluster	0.52	5.55*	0.321	10.165	0.937
Number of fruits per truss	0.05	1.422*	0.121	12.891	0.574
Number of fruits per plant	1.19	164.17*	1.984	5.845	2.238
Average fruit weight (g)	27.96	647.265*	21.368	7.908	7.639
Fruit shape index	0.00	0.031*	0.001	3.412	0.048
Number of locules per fruit	0.07	1.189*	0.135	8.759	0.608
Total soluble solids (Bº)	0.20	0.951*	0.073	5.661	0.448
Ascorbic acid (mg/100g)	4.95	17.176*	2.824	6.485	2.777
Pericarp thickness (mm)	0.04	1.907*	0.066	5.606	0.425
Fruit borer incidence (%)	1.28	17.732*	1.699	11.544	2.646
Leaf curl incidence (%)	81.67	361.404*	65.877	18.847	9.279
Wilt incidence (%)	38.45	104.825*	19.590	19.935	6.585
Yield per plant (kg)	0.01	0.694*	0.017	10.417	0.215

* significant at 5% level of significance

a great diversity in the experimental materials (genotypes) used. High estimates of phenotypic as well as genotypic coefficient of variation were observed for wilt incidence (55.43% and 42.64%), leaf curl incidence (48.08 % and 37.22 %), fruit borer incidence (43.85% and 38.20%), fruit yield per plant (39.40 % and 38.00%), plant height (32.88% and 31.04%) and number of fruits per plant (31.06% and 30.51%). The high estimates of PCV and GCV for these characters were reported under natural sown condition by Rai et al. (2016), Sherpa et al. (2014) and Rath and Math (2001). Moderate GCV and PCV were observed for number of flowers per cluster, number of fruits per truss, average fruit weight and pericarp thickness. These results are in agreement with the earlier findings of Bhandari et al. (2017). Low GCV and PCV were observed for days to 50% flowering, total soluble solids, fruit shape index and ascorbic acid. These results are in accordance with the findings of Singh et al. (2017) and Prashanth et al. (2015). Low GCV and moderate PCV were observed for number of primary branches per plant and number of locules per fruit. These results are in conformity with earlier work of Bhandari et al. (2017) under normal sown conditions.

Heritability (H^2) estimates ranged from 59.19% to 96.46%. High heritability was recorded for number of fruits per plant, plant height, fruit yield per plant, fruit shape index, average fruit weight, pericarp thickness, number of flowers per cluster and days to 50%

Table 3: Mean, range and parameters of variability for selected characters of tomato genotypes

Observations/Traits	Mean	Range	Coefficients of variation		Heritability (%)	Genetic advance	Genetic gain
			PCV	GCV			
Days to 50% flowering	28.65 ± 0.75	23.67 - 31.67	7.96	7.28	83.61	3.93	13.72
Plant height (cm)	111.76 ± 7.25	65.60 - 178.77	32.88	31.90	94.16	71.27	63.77
No. of primary branches/plant	6.17 ± 0.47	4.78 - 8.41	17.34	14.55	70.42	1.55	25.15
Number of flowers per cluster	5.58 ± 0.46	3.66 - 8.66	25.76	23.67	84.43	2.50	44.81
Number of fruits per truss	2.70 ± 0.28	1.66 - 4.08	27.64	24.45	78.24	1.20	44.55
Number of fruits per plant	24.10 ± 1.15	12.92 -42.25	31.07	30.51	96.46	14.88	61.73
Average fruit weight (g)	58.46 ± 3.77	26.03 - 85.52	25.94	24.71	90.71	28.34	48.48
Fruit shape index	0.85 ± 0.02	0.67 - 1.07	12.42	11.94	92.45	0.20	23.65
Number of locules per fruit	4.20 ± 0.30	3.11 - 5.44	16.61	14.11	72.18	1.04	24.69
Total soluble solids (Bº)	4.79 ± 0.22	3.93 - 5.90	12.63	11.29	79.92	1.00	20.80
Ascorbic acid (mg/100g)	25.91 ± 1.37	23.32 - 33.91	10.65	8.44	62.88	3.57	13.79
Pericarp thickness (mm)	4.58 ± 0.21	3.62 - 6.05	17.99	17.09	90.28	1.53	33.45
Fruit borer incidence (%)	6.05 ± 1.06	1.44 - 10.33	43.85	38.20	75.88	4.15	68.55
Leaf curl incidence (%)	26.67 ± 6.63	0.00 - 46.67	48.08	37.22	59.93	15.83	59.35
Wilt incidence (%)	12.50 ± 3.61	3.33 - 26.67	55.43	42.64	59.19	8.45	67.58
Yield per plant (kg)	1.25 ± 0.11	0.59 - 2.52	39.40	38.00	93.01	0.94	75.49

Table 4: Genotypic (G) and phenotypic (P) correlation coefficients among various traits in tomato

Traits		B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
A	(G)	-0.078	-0.296*	-0.204	-0.369**	-0.228	-0.146	-0.056	0.395**	0.065	0.646**	0.316*	0.319*	0.420**	0.149	-0.494**
	(P)	-0.060	-0.234	-0.162	-0.300*	-0.189	-0.159	-0.055	0.312*	0.035	0.436**	0.281*	0.250	0.323*	0.153	-0.449**
B	(G)	-	0.913**	0.705**	0.746**	0.549**	-0.095	0.375**	-0.217	0.558**	-0.605**	-0.345**	-0.490**	-0.523**	-0.473**	0.462**
	(P)	-	0.738**	0.642**	0.656**	0.539**	-0.086	0.352**	-0.143	0.462**	-0.486**	-0.337**	-0.427**	-0.427**	-0.366**	0.447**
C	(G)		-	0.683**	0.700**	0.480**	0.013	0.409**	-0.380**	0.467**	-0.791**	-0.288*	-0.385**	-0.538**	-0.511**	0.512**
	(P)		-	0.559**	0.575**	0.403**	0.040	0.327*	-0.261*	0.370**	-0.462**	-0.273*	-0.355**	-0.345**	-0.409**	0.452**
D	(G)			-	0.560**	0.365**	0.113	0.390**	-0.387**	0.411**	-0.687**	-0.684**	-0.436**	-0.582**	-0.318*	0.443**
	(P)			-	0.600**	0.330*	0.188	0.331**	-0.276*	0.351**	-0.465**	-0.685**	-0.512**	-0.489**	-0.381**	0.457**
E	(G)				-	0.583**	-0.222	0.266*	-0.736**	0.552**	-0.620**	0.193	-0.316*	-0.373**	-0.341**	0.351**
	(P)				-	0.515**	-0.089	0.211	-0.533**	0.441**	-0.415**	0.270*	-0.443**	-0.405**	-0.386**	0.376**
F	(G)					-	-0.326*	0.224	-0.324*	0.367**	-0.602**	-0.317*	-0.688**	-0.598**	-0.144	0.590**
	(P)					-	-0.310*	0.215	-0.233	0.322*	-0.492**	-0.309*	-0.603**	-0.465**	-0.131	0.586**
G	(G)						-	0.404**	0.168	-0.101	0.228	-0.391**	-0.201	-0.513**	0.222	0.529**
	(P)						-	0.354**	0.147	-0.099	0.121	-0.426**	-0.288*	-0.444**	0.02	0.547**
H	(G)							-	-0.158	-0.216	-0.638**	-0.607**	-0.402**	-0.594**	-0.206	0.526**
	(P)							-	-0.081	-0.155	-0.485**	-0.548**	-0.310*	-0.394**	-0.138	0.478**
I	(G)								-	-0.193	0.587**	0.177	0.263*	0.250	0.423**	-0.099
	(P)								-	-0.131	0.328*	0.093	0.183	0.177	0.203	-0.033
J	(G)									-	-0.108	0.028	-0.309*	-0.194	-0.231	0.215
	(P)									-	-0.027	0.007	-0.244	-0.127	-0.117	0.175
K	(G)										-	0.725**	0.848**	0.954**	0.666**	-0.801**
	(P)										-	0.522**	0.525**	0.539**	0.364**	-0.594**
L	(G)											-	0.654**	0.811**	0.094	-0.629**
	(P)											-	0.663**	0.692**	0.199	-0.639**
M	(G)												-	0.898**	0.351**	-0.785**
	(P)												-	0.740**	0.457**	-0.755**
N	(G)													-	0.125	-0.979**
	(P)													-	0.167	-0.785**
O	(G)														-	-0.011
	(P)														-	-0.126
P	(G)															-
	(P)															-

A = Days to 50% flowering, B = Plant height (cm), C = Number of primary branches / plant, D = number of flowers / cluster, E = Number of fruits / truss, F = Number of fruits / plant, G = Average fruit weight (g), H = fruit shape index, I = Number of locules/ fruit, J = Total soluble solids (ºB), K = Ascorbic acid (mg/100gm), L = Pericarp thickness (mm), M = Fruit borer incidence (%), N = Leaf curl incidence (%), O = Wilt incidence (%) andP = Yield per plant (kg).

flowering. High genetic advance as per cent of mean was observed for plant height, number of fruits per plant and fruit yield per plant. The high estimates of heritability, genetic advance and genetic advance as per cent of mean for these characters were also reported earlier by several workers Singh et al. (2017). High GCV, heritability and genetic gain was observed for plant height, number of fruits per plant and fruit yield per plant, which shows that response to selection can be stable for crops raised under eco-friendly management.

The correlation coefficients among different characters worked out at genotypic and phenotypic levels is presented in Table 4. The values for genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients in most of the cases, this indicate strong genetic association among characters and less environment effect. Number of fruits/plant (0.590 and 0.586), average fruit weight (0.529 and 0.547), fruit shape index (0.526 and 0.478), number of primary branches /plant (0.512 and 0.452), number of flower/cluster (0.443 and 0.457), plant height (0.462 and 0.447) and number of fruits / truss (0.351 and 0.376) were had positive and significant association with fruit yield per plant both at genotypic and phenotypic levels respectively. These results indicate that the selection for these traits will directly improve the yield. Similar results were earlier reported by Meena et al. (2018) and Ambresh et al. (2017) under normal sown conditions. Significant negative correlation was observed with days to 50 % flowering, ascorbic acid, pericarp thickness, fruit borer incidence and leaf curl incidence. Number of locules per fruit and total soluble solids has no correlation with fruit yield per plant. These results are in accordance with that of Ambresh et al. (2017).

The genotypic correlation coefficient was partitioned into direct and indirect effects through path coefficient analysis (Table 5). Maximum positive direct effect towards fruit yield per plant was contributed by average fruit weight (0.851), followed by number of fruits per plant (0.847) and plant height (0.285). The other traits which showed positive direct effect with fruit yield per plant were fruit shape index (0.095), number of primary branches per plant (0.085), pericarp thickness (0.042), number of locules per fruit (0.0046) and flower per cluster (0.0042). Traits like days to 50% flowering (-0.379), fruit borer incidence (-0.237), number of fruits per truss (-0.207), ascorbic acid (-0.153) and total soluble solids (-0.023) had negative direct effect on fruit yield per plant. These results are in agreement with earlier work of Singh et al. (2018), Naveen et al. (2017) and Prajapati et al. (2015). Number of fruits /truss had maximum positive indirect effect on fruit yield per plant via number of fruits /plant (0.494) followed by fruit borer incidence via leaf curl incidence (0.3506) and fruit shape index via average fruit weight (0.3438). Whereas maximum negative indirect effect on fruit yield per plant via fruits per plant for fruit borer incidence (-0.5828), followed by average fruit weight for leaf curl incidence

Table 5: Estimates of direct and indirect effects of different traits on yield in tomato (Diagonal bold value is direct effect)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
A	**-0.3787**	-0.0222	-0.0252	-0.0009	0.0763	-0.1928	-0.1246	-0.0053	0.0018	-0.0015	0.0987	-0.0133	-0.0758	0.1641	0.0052	-0.4942
B	0.0297	**0.2825**	0.0777	0.0030	-0.1542	0.4650	-0.0809	0.0358	-0.0010	-0.0131	-0.0925	0.0146	0.1163	-0.2043	-0.0163	0.4623
C	0.1123	0.2581	**0.0851**	0.0029	-0.1447	0.4061	0.0110	0.0391	-0.0018	-0.0109	-0.1209	0.0122	0.0913	-0.2102	-0.0177	0.5119
D	0.0774	0.1992	0.0582	**0.0042**	-0.1159	0.3090	0.0961	0.0373	-0.0018	-0.0096	-0.1050	0.0289	0.1035	-0.2274	-0.0110	0.4430
E	0.1398	0.2107	0.0595	0.0024	**-0.2068**	0.4940	-0.1888	0.0254	-0.0034	-0.0129	-0.0947	0.0082	0.0749	-0.1455	-0.0118	0.3510
F	0.0862	0.1552	0.0408	0.0016	-0.1206	**0.8467**	-0.2773	0.0214	-0.0015	-0.0086	-0.0920	0.0134	0.1634	-0.2334	-0.0050	0.5904
G	0.0555	-0.0269	0.0011	0.0005	0.0459	-0.2760	**0.8507**	0.0386	0.0008	0.0024	-0.0349	0.0165	0.0478	-0.2004	0.0077	0.5293
H	0.0211	0.1058	0.0348	0.0017	-0.0551	0.1896	0.3438	**0.0955**	-0.0007	0.0051	-0.0974	0.0256	0.0954	-0.2321	-0.0071	0.5259
I	-0.1497	-0.0614	-0.0324	-0.0016	0.1521	-0.2748	0.1432	-0.0151	**0.0046**	0.0045	0.0897	-0.0075	-0.0625	0.0976	0.0146	-0.0987
J	-0.0247	0.1578	0.0398	0.0017	-0.1141	0.3109	-0.0858	-0.0207	-0.0009	**-0.0234**	-0.0165	0.0012	0.0733	-0.0758	-0.0080	0.2149
K	0.2446	0.1711	0.0673	0.0029	-0.1282	0.4098	0.1942	0.0609	-0.0027	-0.0025	**-0.1527**	0.0306	0.2013	-0.3725	-0.0230	-0.8010
L	0.1196	0.0976	0.0245	0.0029	-0.0400	0.2688	0.3326	0.0579	-0.0008	-0.0007	-0.1107	**0.0422**	0.1553	-0.3167	-0.0032	-0.6291
M	-0.1209	-0.1383	-0.0327	-0.0019	0.0653	-0.5828	-0.1714	-0.0384	0.0012	0.0072	0.1295	-0.0276	**-0.2375**	0.3506	0.0121	-0.7855
N	-0.1592	-0.1478	-0.0458	-0.0025	0.0770	-0.5060	-0.4365	-0.0567	0.0012	0.0045	0.1457	-0.0343	-0.2132	**0.3905**	0.0043	-0.9786
O	-0.0566	-0.1337	-0.0435	-0.0014	0.0705	-0.1215	0.1890	-0.0197	0.0020	0.0054	0.1017	-0.0040	-0.0833	0.0489	**0.0346**	-0.0115

Residual value: 0.00634

A = Days to 50% flowering, B = Plant height (cm), C = Number of primary branches / plant, D = number of flowers / cluster, E = Number of fruits / truss, F = Number of fruits / plant, G = Average fruit weight (g), H = fruit shape index, I = Number of locules / fruit, J = Total soluble solids (ºB), K = Ascorbic acid (mg/100gm), L = Pericarp thickness (mm), M = Fruit borer incidence (%), N = Leaf curl incidence (%), O = Wilt incidence (%) and P = Yield per plant (kg).

(-0.4365) and leaf curl incidence for ascorbic acid (-0.3725). The residual effect was recorded very low i.e., 0.00634. Various workers like Singh et al. (2018), Naveen et al. (2017) and Prajapati et al. (2015) earlier reported similar direct and indirect effects of various horticultural and quality traits on yield in tomato.

From above results, number of fruits per plant and average fruit weight, fruit shape index and number of primary branches /plant had highly significant positive correlation with fruit yield per plant. Hence these traits can be used as basic parameters of selection for improvement of yield in tomato for similar environment. Path analysis results indicates that direct selection for average fruit weight, number of fruits per plant and plant height in desired direction would be very effective for yield improvement. Among 20 genotypes 'Arka Rakshak, BSS-488, CLN-2123-A1 Red, DVRT-2 & BWR-5' are identified as superior genotypes for yield and other traits under eco-friendly management, which can be grown as early transplanted crop in Jammu region with protection against cold and frost under eco-friendly management.

lkjk'k

टमाटर के बीस प्रभेदों का मूल्यांकन पर्यावरण के अनुकूल प्रबंधन के हेतु उपज, गुणवत्ता और अन्य लक्षणों के लिए किया गया। विचरण के विश्लेषण से पता चला कि सभी लक्षणों के लिए प्रभेदों में अत्यधिक सार्थक अंतर है। बाह्य दृश्य प्रारूप भिन्नता (पीसीवी) के बाह्य दृश्य प्रारूप गुणांक और भिन्नता के आन्तरिक प्रभेद गुणांक (जीसीवी) के प्रति पौधे फल की उपज, पौधे फल की उपज, पौध की ऊँचाई और प्रति पौध फल की संख्या सहित लक्षणों के लिए उच्च परिमाण देखा गया था। उच्च आनुवांशिक अग्रिम अनुमानों के साथ युग्मित उच्च आनुवांशिकता को प्रति पौध, पौध की ऊँचाई और फल की प्रति पौध संख्या के लिए देखा गया। प्रति पौध उपज की संख्या के साथ सकारात्मक और अत्यधिक महत्वपूर्ण सहसम्बन्ध पाया गया। औसत फल भार, फल आकार सूचकांक और इन लक्षणों को निर्धारित करने वाले प्रति पौध प्राथमिक शाखाओं की संख्या अत्यन्त महत्वपूर्ण उपज घटक है जबकि 50 प्रतिशत फूल, पत्ती मरोड़ और फल बेधक एस्कार्बिक एसिड और फल भित्ती मोटाई के साथ नकारात्मक और महत्वपूर्ण सम्बन्ध पाया गया। प्रति पौध फलों की पैदावार के प्रति अधिकतम सकारात्मक और प्रत्यक्ष प्रभाव औसत फल वजन, प्रति पौध फलों की संख्या, पत्ती मरोड़ और पौध ऊँचाई से अधिक था। उच्च उपज और अन्य उपयोगी लक्षणों के साथ कुछ प्रभेदों को पर्यावरण के अनुकूल प्रबंधन हेतु भविष्य में उपयोग किया जा सकता है।

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