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Studies on Genetic Variability and Interrelationship among the Different Traits in Tomato (*Lycopersicon esculentum* Mill.)

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Abstract: The genetic parameters, character association and path coefficient analysis between yield and yield contributing characters of different tomato genotypes were studied. The genotypes exhibited a wide range of variability for all the traits studied. The traits were also found to be highly heritable. High genetic advance as percentage of mean was exhibited for fruit weight/plant followed by number of fruits in three cluster/plant and number of flowers in three clusters/plant. Fruit yield had high positive r_p and r_g with total number of fruits at harvesting period and number of fruits in three clusters/plant. Plant height at flowering, number of flowers in three clusters/plant, days to flowering and total number of fruits at harvesting period also contributed yield directly. The results indicate that for increasing yield, selection should be based on plants bearing more fruits of larger size and weight.

Key words: Genetic variability · Tomato · *Lycopersicon esculentum* Mill

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular and important vegetables in Bangladesh. It is cultivated in all parts of the country. In Bangladesh the average yield of tomato is very low (7.51 t ha^{-1}) compared to other tropical countries [1]. To increase the genetic yield potential, maximum utilization of the desirable characters for synthesizing of any ideal genotypes is essential. Fruit yield is a quantitative character, which is influenced by a number of yield contributing characters. Selection for higher yield, the complex interrelationship between the yield contributing characters usually shows a complex chain of interacting relationship. In tomato, yield is the cumulative effect of many component characters individually contributing towards yield. In Bangladesh, tomato is grown during the winter season. It is one of the most important vegetable crop of Bangladesh. However, the yield of tomato in Bangladesh is not satisfactory enough in comparison with other tomato growing countries [2]. The crop being off-spring for the plains, give high economic returns to the farmers. Diversity in tomato is expected to be immense as the fruits vary greatly in shape and size [3] studies on genetic parameters and character associations provide information about the expected response of various traits to selection and help in developing optimum breeding procedure. Many researchers [3-6] have reported about different genetic parameters in tomato based on few traits. As yield is the main object of a breeder, so it is important to know the relationship between various characters that have direct and indirect effect on yield. The degree of relationship or association of these characters with yield can be ascertained by correlation studies. This would aid in formulating an efficient breeding program for improving the yield potential via its components [4]. A study was, therefore, conducted on the variabilities, genetic parameters, character associations and path coefficient analysis between yield and yield contributing characters of tomato.

MATERIALS AND METHODS

Twelve tomato genotypes received from Rantic Ltd, Namo Bhadra, Rajshahi, were grown at Botanical Research Garden, Rajshahi University, Rajshahi, Bangladesh during September 1998 to February 1999. Each genotype was grown in a single 10 m long row. The experiment was laid

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out in the Randomized Block Design with three replications. The experimental plot was divided into three unit plots, each of 4.5×13.9 square meter size, with 75 cm spacing between the replications and 30 cm between the rows. Appropriate agronomic practices were followed to raise a good crop. Five randomly selected plants were used for recorded observations on Days to Flowering (DF), obtobyw (PHF), Number of Leaves at Flowering (NLF), Number of Flowers in Three Cluster/plant (NF1), number of fruits in three cluster/plant (NF2), Total Number of Fruits at Harvesting Period (TFHP) and fruit weight/plant (FW/P). Genotypic Coefficient of Variation (GCV), Phenotypic Coefficient of Variation (PCV), heritability in broad sense (h2b), genetic advance in percentage of mean (GA%), genotypic (rg) and phenotypic correlation coefficient (rp) and path coefficient analysis were done following the formula used by Singh and Choudhury [11].

RESULTS AND DISCUSSION

Estimates of different statistical and genetic parameters like mean, genotypic and phenotypic variation, genotypic and phenotypic coefficient of variability, heritability and genetic advance as percentage of mean for different characters have been presented in Table 1.

Analysis of variance showed significant variation among the genotypes for all the characters except total weight of ears/plant (Table 1). Maximum genotypic variation was found for fruit weight followed by number of flowers in three clusters/plant and number of fruits in three clusters/plant while the same was minimum for number of leaves at flowering. Phenotypic variation was also maximum for fruit weight and minimum for number of leaves at flowering. GCV and PCV were maximum for fruit weight while it was minimum for number of leaves at flowering. The highest GCV and PCV for fruit weight/plant was obtained by some researchers [5, 6]. Heritability was high for most of the characters and minimum for number of leaves at flowering. Genetic advance as percentage of mean was maximum for fruit weight followed number of flowers in three cluster/plant and number of fruits in three cluster/plant indicating the presence of additive gene effects [9]. The character with high values of GCV and h2b accompanied by high GA% suggests that improvement of these would be effective through phenotypic selection. High h2b associated with moderate to low GA% for days to flowering, plant height at flowering and number of leaves at flowering may be attributed to non-additive gene action and may be further improved through hybridization, which are in consistance with some researchers [4, 5].

Genotypic and phenotypic correlation coefficients between different pairs of characters are presented in Table 2. Fruit weight showed significant positive correlations with number of leaves at flowering, number of flowers, number of fruits and total number of fruits at harvesting period at both the level except number of leaves at flowering at phenotypic. Islam and Khan [10] reported that fruit yield was significantly correlated with days to maturity, average fruit weight and fruit length. Correlation and path analysis was also studied in tomato [11]. Number of branches and fruit/plant showed significant positive correlations with yield/plant at both the levels. Genetically fruit weight showed a high significant correlated with number of flowers in three cluster/plant,number of fruits in three cluster/plant and total number of at harvesting period was also studied [5]. The correlation study suggested that the important characters like number of leaves at flowering, number of fruits at harvesting showed positive association with fruit weight i.e. increase of leaves at flowering, number of flowering and total number of fruits at harvesting reflects yield increase. On the other hand, positive associations with these characters indicate that vegetatively tall and

Table 1: Estimates of genetic parameters for seven characters in tomato

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Characters	mean	CV	Error	F-value	∂2p	∂2g	PCV	GCV	h2b	GA%
DF	47.58	77.75	5.45	14.27	29.55	24.10	62.10	50.65	81.56	19.19
PHF	51.77	202.01	7.84	25.77	72.56	64.72	140.16	125.02	89.20	30.23
NLF	11.62	5.57	1.65	3.37	2.96	1.31	25.45	11.24	44.15	13.46
NFi	21.15	656.03	2.56	256.66	220.38	217.83	1041.99	1029.91	98.84	142.92
NF2	19.04	1028.69	2.58	398.10	344.62	342.00	1810.15	1796.58	99.25	199.36
TFHP	19.65	194.15	3.69	52.64	67.17	63.49	341.89	323.12	94.51	81.21
FW	1.21	2092.71	16.51	126.75	708.58	692.07	58560.33	57195.87	97.67	4421.86

Table 2: Phenotypic (P) and Genotypic (G) correlation of coefficient for different pairs of characters in tomato

Characters		DF	PHF	NLF	NF1	NF2	TFHP	FW
DF	P	1.000	0.613	-0.221	0.457	0.541	0.535	0.239
	G	1.000	0.654	0.351	0.231	0.356	0.548	0.229
PHF			1.000	0.548	-0.451	-0.513	0.271	0.227
				0.617	0.414	-0.445	0.513	0.232
NLF					0.216	-0.641	-0.451	0.214
					-0.561	-0.174	0.231	-0.471
NF1						0.454	0.117	0.541
						0.613	0.701	0.421
NF2							0.424	0.454
							0.642	0.238
TFHP								0.682
								0.526

Table 3: Path coefficient analysis for fruit weight of tomato

Characters	DF	PHF	NLF	NF1	NF2	TFHP	rg with FW
DF	0.330	0.215	0.115	0.113	0.117	0.180	0.225
PHF	0.444	0.680	0.419	0.281	-0.302	-0.348	0.232
NLF	-0.109	-0.192	-0.312	0.175	0.054	-0.072	-0.471
NF1	0.113	0.203	-0.275	0.491	0.300	0.354	0.421
NF2	-0.189	0.236	0.092	-0.326	-0.532	0.074	0.238
TFHP	0.063	-0.059	0.026	0.061	0.074	0.116	0.526

Residual effect = 0.692, DF=Days to flowering, PHF=Plant height at flowering, NLF=Number of leaves at flowering, NF1=Number of flowers in 3 cluster/plant NF2=Number of fruits in 3 cluster/plant, TFHP=Total number of fruits at harvesting period, FW=Weight of fruits/plant (Wt. of 10 fruits/plant)

vigorous plant stature with more flowers produce more fruits. Thus, these characters are important yield attributes to be reckoned in the selection criteria for improvement. The path coefficient analysis involves a method of partitioning correlation coefficient into direct and indirect effects through alternate pathways, rg were used to compute the path analysis (Table 3). Highest direct contribution towards yield was evident through plant height at flowering followed by number of flowers in three cluster/plant and days to flowering. Number of fruits in three cluster/plant had shown high negative direct effect followed by number of leaves at flowering. Path analysis revealed that number of brances/plant was the first component of yield [11]. On the other han the indirect effect of plant height at flowering via days to flowering is high. High direct effects by fruits per plant and average fruit weight towards yield were reported [3, 4] that obtained highest positive direct effect was found for fruit shape index followed by size of stem end scar on yield/plant. Residual effect was 0.692 indicating that about 30% of the variability in the yield in tomato was contributed by the characters studied in path analysis. Similar result of residual path value was also noted [3]. The conclusion that can be reached from the variability, correlation and path coefficient was that plant height at flowering and number of flowers was the most important yield contributing characters and maximum emphasis should be given on these characters.

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