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Selection strategies to choose better parents in tomato using genetic parameters

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Abstract

This experiment comprising a total of 21 genotypes of tomato was evaluated in RCBD to show variation, heritability, genetic advance and genetic advance in percentage of mean of different yield contributing traits. All the genotypes varied significantly with each other for all the studied characters indicated the presence of inherent genetic variations among the genotypes. The phenotypic coefficient of variation (PCV) were slightly higher than the respective genotypic coefficient of variation (GCV) for all the characters under study indicating that the characters were less influenced by the environment. Plant height and number of fruits per plant showed high heritability along with high genetic advance were normally more helpful in predicting the genetic gain under selection. Moderate heritability for primary branches per plant indicated favorable influence of environment rather than genotypes. Considering this idea and other agronomic performances, the genotypes BD-7748, Local Jessore -3 and Local Kustia- 1, BD-7762, BD-7285 and BARI hybrid-4, BD-7290, BD-9011 and BARI Tomato-3 might be considered better parents for efficient hybridization programme in Bangladesh.

Keywords: Genetic advance; germplasms; heritability; morphological; variability.
Abbreviations: AFW_average fruit weight; D50%F_days to 50% flowering; DFF_days to first flowering; df_degrees of freedom; DM_days to maturity; ER_error; FD_fruit diameter; FL_fruit length; FPC_fruit per cluster; FPP_fruits per plant; FYP_fruit yield per plant; GA_genetic advance; GA%_genetic advance percentage of mean; GEN_genotype; NFC_ umber of flower per cluster; PBP_ primary branches per plant; PH_plant height; REP_replication; SBP _secondary branches per plant.

Introduction

Tomato (*Solanum lycopersicum* L. Syn. *Lycopersicon esculentum* Mill., 2n=2x=24) is one of the most important and popular vegetables in the world because of its wider adaptability, high yielding potential and suitability for variety of uses in fresh as well as processed food industries (Meena and Bahadur, 2015). It is being produced in most of the countries of the world with an estimated global production of over 162 million metric tons from an area of 4.83 million hectares (Dagade et al., 2015).Tomato is an herbaceous, usually sprawling plant in the order solanales and nightshade family, Solanaceae. It is one of the most important vegetable crops of both tropics and subtropics of the world. As a cash crop, it has great demand in the International market (Hannan et al., 2007; Solieman et al., 2013). Tomatoes are an excellent source of minerals and vitamins (Sainju et al., 2003; Naika et al., 2005; Akinfasoy et al., 2011). Its vitamin C content is particularly high (Kanyomeka and Shivute, 2005) and is an excellent source of lycopene, a powerful antioxidant and reduces the risk of prostate cancer (Hossain et al., 2004).

Tomato has an excellent nutritional profile owing largely to its balanced mixture of minerals (potassium, calcium, phosphorus, iron and zinc), vitamins (A, B1, B2, B6, biotine, folic acid, nicotinic acid, pantothenic acid, C, E and K), antioxidants such as carotenoids and polyphenolic compounds and carbohydrates. No doubt, because of its exceptional nutritive value, tomato is the world's major vegetable crop. Fresh ripe tomatoes are prevalently consumed raw in salad as well as curried in combination with variety of vegetables. Tomato can also be processed and canned into a wide range of value added products like soups, juices, pastes, sauces, ketchups and purees. Tomato is also having medicinal value. The pulp and juice are digestible and blood purifier (Frasher et al., 1991).

Now Bangladesh is producing a good amount of tomatoes. In Bangladesh tomato has great demand throughout the year but is available and cheaper during in the winter season. Tomato was cultivated in 61213 acre of land and its record production was 232459 metric tons during 2010-2011(BBS, 2011). Nowadays, tomatoes are grown round the year. Due to increasing consumption of tomato products, the crop is becoming promising.

Diverse breeding lines including specific genetic stocks are the most precious basic materials for crop breeders to meet the current and future needs. Characterization of genetic stocks and varieties by morphological is obligatory for the purpose of selection of new varieties for direct production or for use in hybridization program. Crops as manifested in morphological or molecular diversity are essential for crop improvement, leading to the production of preferred crop types.

Plant breeders are continuously endeavoring to improve the genetic potential of yield and quality traits of tomato crop so as to meet the demands of an ever-increasing population of the world. The approaches to make significant improvement in tomato production require information regarding nature and magnitude of genetic variation in quantitative traits and their interrelationships in the available germplasm, which are important pre-requisites for a systematic breeding program (Firas et al., 2012). Researchers have emphasized on estimation of genetic components such as coefficient of variation, heritability and expected genetic advance in the prediction of response quantitative traits to selection (Mohamed et al., 2012; Dar and Sharma, 2011; Saeed et al., 2007; Mohanty et al., 2003; Mohanty et al., 2002).

According to Burton (1952), for the improvement of any character through breeding, it is essential to know the extent of variability present in that species. The efficiency of a plant breeding program depends on the amount of genetic variability exist in nature or how much a plant breeder can create variability in the population so as to perform effective selection. We evaluated the significant variation among the economically yield contributing traits of tomato genotypes and that genotypes may serve as a potential parents for the future improvement scheme of tomato.

Result and Discussion

Analysis of variance

The analysis of variance indicated that there were highly significant differences among the tested genotypes for all the studied characters (table 1). The results suggested the presence of inherent genetic differences with respect of various traits among the genotypes which can be exploited through selection. Similar results were noticed by Meena and Bahadur, 2015; Jilani et al., 2013; Monamodi et al., 2013; Kumar et al., 2013.

For the development of potential plant material of tomato through selection and breeding, availability of variation in the desired characters is imperative for vegetable breeder. In present investigation, simple analysis of variance for different morphological characters of tomato revealed significant variability. These results indicated that variation in these morphological characters may due to the effect of additive genetic component as described by Hayman (1954) and the variation would be helpful for the development of desired plant architecture in tomato. However, a detailed study for the genetic components of variation is essential to confirm the output of analysis of variance.

Analysis of genetic parameters

Plant height

The grand mean of plant height was recorded 100.05 cm. The analysis of variance revealed highly significant differences among the genotypes with respect to plant height. The maximum plant height (160.78 cm) was recorded by the "BD-7279" and the lowest (61.00cm) was in "BD-7748". The PCV and GCV were 31.23% and 30.40% respectively (Table 4). There was little difference between the phenotypic and genotypic coefficient of variation indicating little environmental influence in the expression of this character. In the present study, the genotypic and phenotypic coefficient of variation was moderate for plant height. Similar observations were made by Marine et al. (2003). Singh et al. (2002) showed that the phenotypic coefficient of variation was greatest for this character. The estimate of heritability was high at 94.78% with an expected genetic advance 61.00% for plant height (Table 4).

Number of primary branches per plant

The grand mean number of primary branches per plant was registered 9.61. "BD-7279" produced the maximum number of primary branches (12.55) and the minimum (5.80) was in "BARI Tomato-9". The PCV and GCV were 20.98 and 15.61 percent respectively. The PCV value was slightly higher than the respective GCV denoting little influence of environment for the expression of the character. Singh et al. (2002) also showed that phenotypic coefficient of variation was greatest for primary branches per plant. This indicated that it may be attributed to non-additive gene effects controlling its expression and selection would not be rewarding. The estimate of heritability was moderate at 55.37 % with low genetic advance 2.30%.

Number of secondary branches per plant

The grand mean number of secondary branches per plant was recorded 7.18. The maximum (14.00) and minimum (3.33) number of secondary branches was recorded in genotype "BD-7285" and "BARI Tomato-8" respectively. The PCV and GCV were 42.10 and 36.19 percent respectively. Coefficient of variation studies indicated that the estimates PCV were slightly higher than GCV indicated that the characters were less influenced by the environment. Therefore, selection as the basis of phenotype alone can be effective for the improvement of the trait. The estimates of heritability were high at 73.87% with low genetic advance (4.60%).

Number of flowers per cluster

The grand mean number of flower per cluster recorded was 8.52. The maximum number of flower per cluster (15.93) was recorded in the genotype "BARI Tomato-11" and the minimum number (6.37) was in the genotype "BD-7285". The PCV and GCV were 29.66 and 26.55 percent respectively. The GCV was less than the corresponding PCV indicating the role of environment in the expression of the trait under observation. The estimates of heritability were high at 80.12% with low genetic advance (4.17%).

Number of fruits per cluster

The grand mean number of fruit per cluster was 4.47. The maximum number of fruit per cluster (10.78) was recorded in "BARI Tomato-11" and the minimum number (3.07) was in "BD-7748" (Table 2). The PCV and GCV were 40.51 and 35.73 percent respectively (Table 4). A narrow difference between GCV and PCV indicated less influence of environment. The estimate of heritability was high at 77.83 % with low genetic advance 2.91% (Table 4). This indicated the predominance of additive gene action in expression of this trait is expected to be effective.

Days to first flowering

The grand mean number of days to first flowering recorded was 52.00. The maximum number of days to first flowering (61.67) was recorded by the "BARI Tomato-3" and the minimum number (46.00) was recorded in "BD-7748" (Table 2). The PCV and GCV were 9.07 and 7.91% respectively (Table 4). There was little difference between the phenotypic and genotypic coefficient of variation indicating little environmental influence in the expression of this character.

Table 1. Analysis of variance of twelve yield and yield related characters of tomato.

S.V.	df	Mean sum of square											
		PH	PBP	SBP	NFC	FPC	DFF	D50%F	DM	FPP	AFW	FL	FD	FYP
REP	2	113.05	0.15	0.44	1.85	0.77	8.14	0.68	9.68	2408.44	77.81	23.24	0.60	0.32
GEN	20	2,826.5**	8.55**	22.64**	16.63**	8.39**	56.1**	80.66**	364.17**	23105.76**	1,013.50**	213.74**	23.50**	1.18**
ER	40	50.96	1.81	2.38	1.27	0.72	5.34	5.01	7.62	374.01	44.13	14.77	1.33	0.07

**= Significant at 1% level of probability

Table 2. Mean effects of tomato genotypes on the yield and yield contributing characters.

Sl No.	Genotype	PH	PBP	SBP	NFC	FPC	DFF	D50%F	DM	FPP	AFW	FL	FD	FYP
1	Local Jessore 2	74.67fg	9.9a-c	5.78c-e	7.21e-g	3.34e	48.33a-d	53.33d-g	115c-e	71.89e-g	35.67d-g	34.4d-f	40.74b-f	1.46c-d
2	Local Jessore 3	81.33ef	10.11a-c	5.89c-e	6.93e-g	3.23e	45.67cd	52fg	115c-e	75.56e-g	46.10c-e	38.77c-e	44.83b-d	2.06bc
3	BARI Tomato-7	124.8b	10.33a-c	6c-e	7.45e-g	3.38e	52 a-d	58.33c-f	121ab	52.44fg	51.53b-d	38.83c-e	48.47a-c	1.45c-g
4	BARI Tomato-9	71.33fg	5 e	3.23e	8.04e-g	5.71bc	54.67a-c	65 ab	121.1ab	58fg	39.71d-f	44.52bc	37.58c-g	1.07fg
5	BD- 7281	61.11g	9.23a-d	9.89bc	9.08de	3.52de	50a-d	56.33c-g	113e	143.3c-e	20.8g-i	24.73gh	27.93gh	1.73c-g
6	Local Kustia-1	61.00g	8.12b-e	53.34e	7.82e-g	3.79de	47.67b-d	54d-g	115.1c-e	101.2d-g	32.67e-h	49.69 ab	31.84f-h	1.37c-g
7	BARI Tomato-15	97de	7.56c-e	5.12de	8.93d-f	5.08b-d	57.33ab	65 ab	124.1 a	60.55fg	66.63 ab	52.76 a	45.9a-d	1.93b-d
8	BD- 9960	82.44ef	10.33a-c	6c-e	12.59b	5.64bc	58.67a	62a-c	115.8b-e	155.2cd	20.67g-i	31.52 d-g	31.07f-h	1.61c-g
9	BD-7289	148.1a	10.67a-c	7.79b-d	7.45e-g	4.12c-e	49a-d	53.33d-g	117.4b-e	123.8d-f	15.5 hi	26.71f-h	32.34f-h	1.38c-g
10	BD-7279	160.8a	12.55a	8.78b-d	7.56e-g	3.89de	57.33ab	62a-c	124.4 a	96.33d-g	16.47 hi	27.44f-h	32.78e-h	1.03g
11	BD-7290	118.7bc	10.78a-c	8.56b-d	7.89e-g	4.19c-e	52.67a-d	58.67c-e	114.1 ab	115d-f	24.23f-i	29.64f-h	34.87d-h	1.84b-d
12	BARI Tomato-8	86.44ef	5.89de	3.33e	6.89e-g	3.41de	50.33a-d	66 ab	121.1 ab	31g	58.27c-d	38.32c-e	55.77 a	1.09e-g
13	BARI Tomato-3	113b-d	8.67bcd	3.56e	7.56e-g	3.56b-e	57.67ab	67.33 a	120 a-c	69.33fg	45.27c-e	39.4 cd	46.97a-c	1.79c-e
14	BD-10321	152.1a	10.33a-c	6.45c-e	10.37cd	3.93de	53.33a-d	58.33c-f	119.6a-d	59.33e-g	32.3e-h	31.4 e-g	40.83b-f	1.31d-g
15	BD-7762	96.22de	11.11a-c	8.56b-d	7.89e-g	4.34c-e	54a-d	59.67b-d	114.7c-e	153.4cd	24.3f-i	33.2 d-f	30.1f-h	1.74c-f
16	BD-7276	106.2cd	9.56a-c	6.23c-d	11.98bc	6.11b	55.33a-c	65.33 ab	113.3 e	198.8bc	17.33hi	24.67 gh	26.05hi	1.36c-g
17	BD-7748	61g	7.67b-e	10bc	6.89e-g	3.08e	44d	50.33 g	113.8de	68fg	70.4 a	47.48 ab	50.45ab	2.47 b
18	BARI Hybrid-4	77.67fg	10.22a-c	10.67ab	7.45e-g	4.31c-e	48.67a-d	53 e-g	92.67f	154.2cd	43.1 c-e	38.18 c-e	43.49b-e	3.18 a
19	BD-7285	110 bcd	11.33ab	14a	6.38g	3.97de	51.67a-d	56.67c-g	93.11f	226.9b	13.2 i	27.92f-h	31.32f-h	3.46 a
20	BARI Tomato-11	75fg	9.12a-d	8b-d	15.93a	10.78a	47.33b-d	54d-g	82.33g	415 a	6.94 i	23.32 h	17.3 i	1.76 c-f
21	BD-9011	127.7b	8.78b-d	8.67bcd	6.82fg	3.71de	48b-d	52.67e-g	121 ab	113.7d-f	33.33e-h	39.45 cd	44.82a-d	2.05bc
LSD value		16.02	3.076	3.586	1.860	1.408	8.615	5.602	5.124	63.71	15.57	6.853	9.579	0.595
Level of significance		**	**	**	**	**	*	**	**	**	**	**	**	**

In a column, the figures with similar letter (s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly. **,* = Significant at 1% and 5% level of probability.

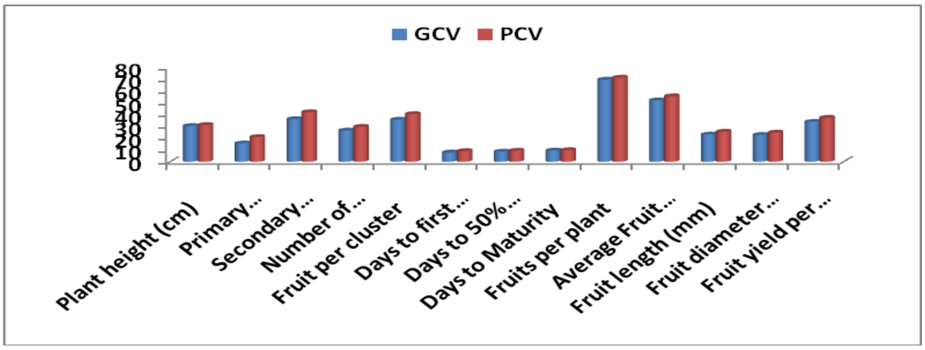

Fig 1. Genotypic and phenotypic variability in tomato.

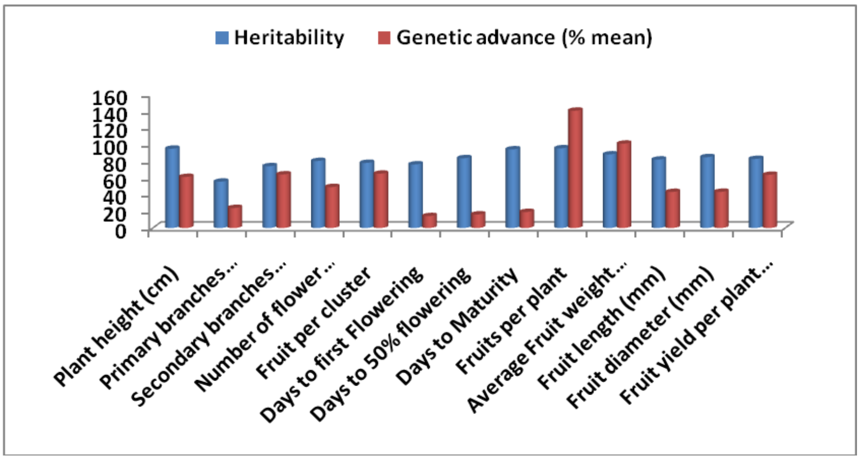

Fig 2. Heritability and genetic advance over different yield contributing characters in tomato.

Such value of GCV with least difference was observed by Singh *et al.* (1973) and Korla *et al*. (1998). The estimate of heritability was high at 76% with low genetic advance 7.39% (Table 4).

Days to 50% flowering

The grand mean number of days to 50% flowering recorded was 58.41. The maximum number of days to 50% flowering (67.33) was recorded by the "BARI Tomato-3" and the minimum number (52.00) was in "Local Jessore 3" (Table 2). The PCV and GCV were 9.41 and 8.60 percent respectively (Table 4). The PCV were slightly higher than the respective GCV denoting environmental factors influencing the expression to some degree or other. The estimate of heritability was high at 83.41% with low genetic advance 9.45% (Table 4). High heritability coupled with low genetic advance was observed for days to 50 % flowering by Singh *et al.* (1973) and Kumar *et al.* (1980).

Days to maturity

The grand mean number of days to maturity was registered 113.74. The maximum number of days to maturity (124.45) was recorded by the "BD-7279" and the minimum number (82.33) was in "BARI Tomato-11" (Table 2). The PCV and GCV were 9.89 and 9.59 percent respectively (Table 4). Narrow difference between values of PCV and GCV indicating that they were less influenced by environment and can be convinced by looking of low values of ECV. The works of Hayder et al. (2007) supports the present findings. The estimate of heritability was high at 93.97% with moderate genetic advance 21.77% (Table 4). This indicates the influence of non-additive gene action and considerable influence of environment in the expression of this trait. This trait could be exploited through manifestation of dominance and epistatic components through heterosis.

Number of fruits per plant

The grand mean number of fruit per plant recorded was 124.83. The maximum number of fruit per cluster (415.00) was recorded by the "BARI Tomato-11" and the minimum number (28.55) was recorded in "BARI Tomato-8" (Table 2). The PCV and GCV were 71.43 and 69.73 percent respectively (Table 4). The difference between GCV and PCV were relatively low which indicated that the character was comparatively stable and highly heritable.

The estimate of heritability was high at 95.30% with high genetic advance 175.05% (Table 4). This indicates that the character controlled by polygenes might be useful to the plant breeder for making effective selection and the findings are in

Table 3. Estimation of genetic parameters in thirteen characters of 21 genotypes in Tomato.

Parameters	Range	Grand Mean	CV (%)	SD	SE	F-value
PH	169.67-50.67	99.34	9.77	30.70	6.70	29.85
PBP	14.33-3.00	9.39	19.85	1.69	0.37	2.81
SBP	16.00-0.67	7.13	30.47	2.75	0.60	4.89
NFC	16.67-5.67	8.52	13.23	2.36	0.51	13.09
FPC	11.78-2.11	4.48	19.07	1.67	0.37	11.53
DFF	64.00-37.00	51.60	10.12	4.32	0.94	1.96
D50%F	69.00-46.00	58.25	5.83	5.19	1.13	7.36
DM	127.67-80.67	113.70	2.73	11.02	2.40	37.18
FPP	465.00-22.33	121.10	31.88	87.76	19.15	14.37
AFW	87.90-5.90	34.02	27.74	18.38	4.01	10.64
FL	56.26-17.32	35.35	11.75	8.44	1.84	12.58
FD	78.17-14.83	37.88	15.33	9.74	2.12	8.00
FYP	3.84-0.68	1.76	20.43	0.63	0.14	9.22

Table 4. Estimation of genetic parameters in thirteen characters of 21 genotypes in Tomato.

Trait	σ^2 p	σ^2g	σ^2 e	PCV	GCV	ECV	h^2b	GA	GA%
PH	976.14	925.18	50.96	31.23	30.40	7.13	94.78	61.00	60.97
PBP	4.06	2.25	1.81	20.98	15.61	14.01	55.37	2.30	23.93
SBP	9.14	6.75	2.39	42.10	36.19	21.52	73.87	4.60	64.07
NFC	6.39	5.12	1.27	29.66	26.55	13.23	80.12	4.17	48.96
FPC	3.29	2.56	0.73	40.51	35.73	19.07	77.83	2.91	64.94
DFF	22.26	16.92	5.34	9.07	7.91	4.45	76.00	7.39	14.21
D50%F	30.23	25.22	5.02	9.41	8.60	3.83	83.41	9.45	16.17
DM	126.47	118.85	7.62	9.89	9.59	2.43	93.97	21.77	19.14
FPP	7951.26	7577.25	374.01	71.43	69.73	15.49	95.30	175.05	140.23
AFW	367.26	323.12	44.14	55.63	52.18	19.28	87.98	34.73	100.82
FL	81.10	66.32	14.78	25.57	23.13	10.92	81.78	15.17	43.08
FD	8.73	7.39	1.34	24.78	22.80	9.70	84.66	5.15	43.22
FYP	0.45	0.37	0.08	37.36	33.95	15.59	82.58	1.14	63.55

agreement with the observations of Ara et al. (2009) and Singh et al. (2001).

Average fruit weight

The grand mean of average fruit weight was recorded 34.45 g. The maximum average fruit weight (73.97 g) was recorded in the genotype "BARI Tomato-15" and the minimum average fruit weight (6.93 g) was recorded in the genotype "BARI Tomato-11" (Table 2). The PCV and GCV were 55.63% and 52.18% respectively (Table 4). There was little difference between the phenotypic and genotypic coefficient of variation indicating little environmental influence in the expression of this character. The estimate of heritability was high at 87.98% with moderate genetic advance 34.73% (Table 4). High estimates of heritability coupled with moderate genetic advance observed for this character is in accordance with earlier findings of Mohanty et al. (2003).

Fruit length (mm)

The grand mean of fruit length was 35.22 mm. The maximum fruit length (52.76 mm) was recorded by the "BARI Tomato-15" and the minimum (23.32 mm) was recorded by the "BARI Tomato-11" (Table 2). The PCV and GCV were 25.57 and 23.13 percent respectively (Table 4). Smallest differences observed between PCV and GCV values of fruit length suggest lesser influence of environmental factors on the expression of the trait. The estimates of heritability was high at 81.78 percent with low genetic advance (15.17%) (Table 4). Very high heritability estimates for fruit length indicate possibility of improvement through selection. Similar results have been reported by Tasisa et al. (2011) and Ullah et al. (2012).

Fruit diameter (mm)

The grand mean fruit diameter recorded was 11.92 mm. The maximum fruit diameter (16.06 mm) was recorded by the "BD-7748" and the minimum fruit diameter (5.51 mm) was recorded by the "BARI Tomato-11" (Table 2). The PCV and GCV were 24.78 and 22.80 percent respectively (Table 4). There was little difference between the phenotypic and genotypic coefficient of variation indicating little environmental influence in the expression of this character. The estimates of heritability was high at 84.66 percent with low genetic advance (5.15%) (Table 4).

Fruit yield per plant (kg)

The grand mean fruit yield per plant recorded was 1.79 kg. The maximum fruit yield per plant (3.46 kg) was recorded by the "BD-7285" and the minimum (1.02 kg) was recorded by the "BD-7279" (Table 2). The PCV and GCV were 37.36 and 33.95 percent respectively (Table 4). The estimates of heritability was high at 82.58% with low genetic advance (1.14%) (Table 4).

Materials and Methods

Experimental Site

The present research work was carried out in the experimental farm, Sher-e-Bangla Agricultural University

(SAU), Dhaka during September 2013- May 2014. The location of the site is 23° 74' N latitude and 90° 35' E longitude with an elevation of 8.2 meter above sea level. The experimental site was situated in the subtropical zone. The soil of the experimental site lies in Agroecological region of "Madhupur Tract" (AEZ No. 28). Its top soil is clay loam in texture and olive gray with common fine to medium distinct dark yellowish brown mottles. The pH is 6.1 and organic carbon content is 0.82%.

Plant Materials

Twenty one genotypes of tomato were used for the present research work. Among these genotypes three land races, seven popular varieties, eleven advanced lines were undertaken. The genetically pure and physically healthy seeds of these genotypes were collected from Plant Genetic Resources Centre of Bangladesh Agricultural Research Institute and land races were collected from farmer's field.

Field Experiment

The experimental plot was prepared by ploughing with proper tiller. The weeds and other unwanted plant materials were removed from the field during the land preparation. Proper laddering was done to bring the soil at proper tilth condition. A Randomized Complete Block Design was used in the experiment with three replications. The field was divided into three blocks; the blocks were subdivided into 21 plots. Genotypes were randomly assigned into 21 plots in each block. The plot size was 195 m^2 (13m x 15m). Block to block and plot to plot distance were 1 m and 0.5 m, respectively.

The seed sowing was carried out on 13 November 2013 in the seedbed. After 25 days seedlings were transplanted into the main field. Intra and inter row distance were maintained @ 0.6 m and 0.5 m, respectively.

The Urea, Triple Super Phosphate, Muriate of Potash @ 550, 450, 250 kg/ha and Cowdung 10 ton/ha were used in the experiment. Total TSP and Cowdung were applied in final land preparation. Half of Urea and half muriate of potash were applied after three weeks and remaining were applied in the plot after five weeks of transplanting.

When the seedlings were well established, 1^{st} mulching and weeding were done uniformly in all the plots. 2^{nd} weeding was done after 20 days of the first one. Mechanical support was provided to the growing plants by bamboo sticks to keep them erect. During early stages of growth, pruning was done by removing some leaves to allow the plants to get more sunlight and to reduce the self-shading and incidence of increased insect infestation. Several weeding mulching were done as per requirement. After transplanting the seedlings were properly irrigated for 3 consecutive days. Then flood irrigation was given to the plants after each top dressing of urea. Final irrigation was given during active fruiting stage.

Ripcord 10EC (Cypermethrin) was used for 6 times at an interval of 7 days from 06 January to 11 February 2014 to prevent pest infestation. There were different types of weeds which were controlled effectively by hand weeding. Harvesting continued from 04 March to 20 April, 2014 because fruits of different lines matured progressively at different dates. Fruits were picked on the basis of maturity, size, color and age.

Data were recorded on individual plant basis from 10 randomly selected plants. Observations were recorded on various plant traits i.e. plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of flowers per cluster, number of fruits per cluster, days to first flowering, days to 50 percent flowering, days to maturity, number of fruits per plant, average fruit weight (g), fruit length (mm), fruit diameter (mm) and fruit yield per plant (kg).

Statistical analysis

The data were analyzed for different components. Mean, range, co-efficient of variation (CV), DMRT was estimated using MSTAT computer programme. Phenotypic and genotypic variance was estimated by the formula used by Johnson et al. (1955). Genotypic and phenotypic coefficient of variation were estimated according to Burton (1952) and Singh and Chaudhary (1985). Heritability and genetic advance were measured using the formula by Johnson et al. (1955), Hanson et al. (1956) and Allard (1960). Genetic advance in percent of mean was calculated by Comstock and Robinson (1952).

Conclusion

The genotypes varied significantly for all the studied characters indicated the presence of considerably variations among the genotypes. The PCV values were slightly higher than the respective GCV values for all the characters under study indicating that the characters were less influenced by the environment. Therefore, selection on the basis of phenotype alone can be effective for the improvement of the traits. Plant height and number of fruits per plant showed high heritability along with high genetic advance were normally more helpful in predicting the genetic gain under selection. Therefore, these characters were most likely to be influenced by additive gene effects and selection for the improvement of these traits would be effective in early generations (F_2-F_3) for the development of superior genotypes. Moderate heritability for primary branches per plant indicated favorable influence of environment rather than genotypes consequently, selection of superior genotypes to develop branching habit genotypes would not be rewarding in early genotypes. The phenomenon can be explained in a way that total fluctuations in yield are governed principally by changes in one or more component; though all fluctuations in components as in or case were not expressed in yield due to indecisive ratings of desirable and undesirable associations among yield and yield related traits. Considering this idea and other agronomic performances, the genotypes BD-7748, Local Jessore -3 and Local Kustia- 1, BD-7762, BD-7285 and BARI hybrid-4, BD-7290, BD-9011 and BARI Tomato-3 might be considered better parents for efficient hybridization programme.

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