Mass Selection in Tomatoes under the conditions of southern Egypt

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Abstract: This investigating was carried out during the period from 2008/2009 to 2012/2013 in successive winter seasons at the experimental farm at the Faculty of Agriculture, South Valley University Qena, Egypt. Presented study aimed to selected superior populations from germplasm tomatoes (collected from different governorates in Upper Egypt) through selection programs by mass selection. It was conducted three cycles (M_1, M_2 and M_3) of the mass selection of eight populations of tomatoes. Analysis of variance revealed significant differences between populations in three cycles for all studied traits compared with base (unselected) populations (M_0) and tow cheeks (Castel Rock and GS-12). The populations exhibited a wide range variability in three cycles for all the traits. The study indicated that yield/plant kg was higher for populations Sv_7, Sv_2, Sv_1 and Sv_4, Number of Fruits/plant for Sv_1 and Sv_7, wF (g) for Sv_1 and Sv_4, NB/plant for Sv_2, Sv_5, respectively. The results revealed high values of heritability in broad sense (h^2b) and genotypic coefficient of variance (GCV%) in all studied traits for all populations in three cycles. The values of heritability ranged from 61.50% for Nb trait in Sv_7 to 99.79% for yield/plant kg in Sv_4, and (PCV%) ranged 3.46% for DF trait in Sv_8 to 22.24% for yield/plant kg for Sv_1, indicating that all traits were highly heritable and small environmental effects. High genetic advance was observed for yield/plant in populations Sv_1 and Sv_4 (34.11 and 33.19), NF for Sv_1 (30.52), PH for Sv_3 (29.26), NF for Sv_1 (22.32) and DF for Sv_8 (5.8), high H^2b coupled with high genetic advance were noticed for YP, WF, NB and PH traits in all populations in three cycles. The M_1, M_2 and M_3 of mass selections relative to (M_0%) base populations were 122.48%, 141.83%, 165.19% and 119.22%, 131.84, 151.19% for yield/plant kg in populations Sv_4 and Sv_1. It could be concluded that the population Sv_1, Sv_2, Sv_4, Sv_7 and Sv_3 are considered promising as lines because they are high yield/plant traits and its components. Results of the study confirm that the mass selection was effective in creating new lines of high productivity. And it can take advantage of these lines grown under conditions of Southern Egypt.
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Key words: tomatoes, yield/plant, mass selection, relative to (M_0%), GCV% and PCV%, genetic advance.

1. Introduction

Production of tomato crop in Egypt will face many problems in the future for the following reasons:

1- The absence of a national strategic program for the production of cultivares of hybrid tomato seeds, which give good yield and high quality.

2- Dependence on the import of hybrid tomato seeds from foreign companies (Dutch – US – French – German – Australian), Egypt becoming a great store for the marketing of the seeds of these companies.

Egypt imports 10 tons of tomato seeds every year to be grown for month's year. (Alborsa news, 2013).

3- Import of seeds and the absence of a program for the production of seeds has led to a lack of local varieties spread as well as, hybird seeds in Egypt, despit the great economic and nutritional importance of the tomato crop in Egypt.

In Egypt, various genotypes of tomato (imported – local) show a lot of variability in many important economic traits (Ahmed et al., 2009 and Rashwan 2015). There are large variations in yield, earliness and quality traits in tomato plants grown in upper Egypt (Aswan – Luxor – Qena – Sohag) Governorate. For this reason, they are considered as a good source of variation as well as can be used as a major selection material in breading programs to improve the traits of tomato.

Generally, breeding by selection is the basis of all the great improvement operations performed on the tomato plants in the past and the present time, it provides the opportunity for the production of local varieties (or desirable families) and adopted to environmental condations and also produce high yield hybrids and quality, as well as the creation of the basis material on which it work the plant breeder in breeding programs. In this respect, genetic variability, heritability and genetic advance in germplasm of tomato were studied by Pujari et al. (1995), Frageria and kokli (1997), Das et al,(1998), Prasad and Rai (1999), Bharti et al. (2002), Singh et al. (2002), Mariame et al. (2003), Haydra et al. (2007), Arai et al. (2009), Ghosh et al. (2010), El-Sayed et al. (2010), Kashif et al. (2013) and Rajasekhar et al. (2013). They found that the improvement of traits in tomato was effective during the selection and used in the breeding program to produce new varieties in the long term and strategic importance. The present study aimed to select superior populations from germplasm tomatoes (collected from different governorates in Upper Egypt) through selection programs by mass selection.

2. Materials and Methods

Seed material

The collection of 25populations of tomatoes from several different areas of southern Egypt (Aswan – Luxor – Qena – sohag), during the winter season 2007/2008, as well as the selection of the top 5 fruits from the plant of each populations in all areas, toyield (Fruit weight – number of fruits/plat).

Selection procedure:

1- In 2008/2009 winter season, the seeds of 25 tomatoes populations were planted at the Experimental Farm of South Valley University. Each population represented by single ridge and was repeated three twice, so as to choose the best eight populations for yield (fruit weight – number of fruits), as well as increase the number seeds of each population. Seeds were sown in nursery on 15 August. Transplants were set on one sid of the ridge imeter width and 5m long, with 30 cm between transplants. Serial number and sources of eight tomatoes populations are given in Table (1).

Table (1): Serial number and sources of tomatoes (eight populations and two cheeks)

Genotypes (Population No)	Population name	Source (governorate)
1 2 3	Sv_1 Sv_2 Sv_3	Luxor
4 5	Sv_4 Sv_5	Qena
6 7	Sv_6 Sv_7	Sohage
8	Sv8	Aswan
- Cheeks Castal Rock G15-12	 Cultivar Hybird	 AGR** AGR**

Sv* : South Valley
AGR ** : Agricultural Research center (ARC), Egypt.

2- Three cycles of mass selection procedure practiced in the recommended planting date during 2009/2010, 2010/2011 and 2011/2012 winter seasons under condition South Valley.

3- Mass selection populations (M_1, M_2 and M_3) and the unselected base population (M_0) as a control were evaluated during 2012/2013 winter season at the experimental farm of South Valley University. The populations were arranged in a randomized complete block design (RCBD) with six replications Seeds were sown in nursery on 15 August transplants were set on one side of the ridge 1 meter width and 5 m long, width 30 cm between transplants. Experimental unit consisted of 4 ridges as the plot area was 20 m^2 (1/180) Feddan. The normal practices of cultivars, irrigation, fertilization and pest control tomato population were followed.

Data recorded:

1- Days to flowering (DF)
2- Plant length (cm) (PH)
3- Number of branches/plat (Nb)
4- Weight of fruit (g) (WF)
5- Number of fruits/plat (NF)
6- Yield/ plat (YP)

Statistical analysis

Data of each population in each cycle were statistically analyzed, according to Gomes and Gomes (1984).

Comparisons among means of populations were tested using LSD values at 5% and 1% levels.

The components of variance were estimated according to the following method suggested by Johnson et al. (1955).

$$PCV = \frac{\sqrt{\sigma^2 P}}{\bar{X}} \times 100$$

$$GCV = \frac{\sqrt{\sigma^2 g}}{\bar{X}} \times 100$$

Where
PCV = Phenotypic coefficient of variation
GCV = Genotypic coefficient of variation
σ^2P = Phenotypic variance
σ^2g = Genotypic variance
$\bar{X}$ = Population mean

These were calculated as follows using the values from the analysis of variance:

Environmental variance (σ^2e)= Error mean square

$$\sigma^2 e = \frac{Msg - MSe}{r}$$

Where,
σ^2g = Genotypic variance
MSg = Mean square of genotypes
MSe = error mean square
R = number of replications
$\sigma^2p = \sigma^2g + \sigma^2e$
where,
σ^2g = Genotypic variance
σ^2p = Phenotypic variance
σ^2e = Environmental variance

Broad sense heritability h^2 (b) of the traits was estimated according to the formula suggested by Johnson et al. (1955) as follows:

$$h^2(b) = \frac{\sigma^2 g}{\sigma^2 p} \times 100$$

Where:
H^2(b) = heritability in broad sense
σ^2g = Genotypic variance
σ^2p = Phenotypic variance

The genetic advance (in broad sense) expected under selection, assuming the selection intensity of 5%, was caculated by the formula described by Johnson et al. (1955).

GA = K σ p, (h^2b)

Where , GA = Genetic advance

σ^2p = the phenotypic standard deviation of the character

H^2(b) = heritability estimate in broad sense and

K = the selection differential (K = 2.06 at 5% selection intensity).

3. Results and Discussion

Mean Performance

Mean squares of analysis of variance for all populations selected and three cycles for all studied traits are given in Table 2 and 3.

Results illustrated that differences between all populations selected are highly significant, as well as, between in three cycles. Similar results have been reported by Shravan et al., (2004) on 14 traits in tomato. Premalakshme et al., (2006), Singh et al., (2008) and Ankur et al. (2014), also had similar findings that the genotypes showed significant differences for all the traits. Mean performance for the six studied traits of all populations selected as an average of three cycles is presented in Table 4.

Mean days from transplanting to flowering ranged from 77.41 day for the population (Sv_5) to 81.28 day for population (Sv_8) with a mean 77.44 day after three cycles. In this respect, all populations significantly flowering earlier than the two cheek except two population (Sv_8 and Sv_4).

On the other hand, the earliness of flowering days was recorded in the populations (Sv_5 and Sv_7).

This results coincided with those of Singh et al., (2000), Rajasekhar et al., (2013) and Rashwan (2015). Data in Table 4 showed that, plant height of the studied populations ranged from 84.12 cm for population (Sv_8) to 61.37 cm for (Sv_6) with a mean of 75.26 cm after three cycles. The results indicated that population (Sv_8) gave the highest value and was significantly taller than other populations and two cheeks.

Data for Nb traits showed that the highest value of this trait was obtained from population Sv_2 (11.78) followed by Sv_5 (10.65).

On the other hand, the lowest value was Obtained from population Sv_8 (8.33). Obtained results are in accordance with those of Jitendra and Devendra (2011). Average FW g ranged from 116.03 g for population (Sv_1) to 74.70 g for population (Sv_7) with a mean of 108 g in three cycles. Three populations Sv_1, Sv_4 and Sv_2 showed maximum fruit weight (116.03, 114.62 and 112.82 g), respectively, and significantly exceeded GS-12 (the highest cheek fruit weight g) by 26.03%, 24.62% and 22.82%, respectively. The present results are in confirmation with that of Nandan and Asati (2008), Meseret et al., (2012) and Ankur et al., (2014), where they reported significant genotypic variations in fruit weight of tomato.

NF plant ranged from 38.16 for population (Sv_1) to 31.74 for population (Sv_8) with a mean 37. the three populations Sv_1, Sv_7 and Sv_6 produced the highest NF (38.16, 37.99 and 37.45) respectively, and significantly exceeded the highest cheek by 4.16%, 3.99% and 3.45% respectively. This difference is probably due to the difference in the number of fruits/cluster and fruit set percentage for all populations in three cycles. Several other outhors (Eshteshabul et al. 2010; Agong et al., 2011 and Maseret et al. 2012) reported that the mean number of fruit/ plant Lay between 4.46 and 62. significant differences between the evaluated breeding populations were observed in yield/ plant kg Table 4, Since their yields ranged from 1802.9 kg/ plant for population (Sv_7) to 1038.16 kg/ plant for population (Sv_8) with a mean 1737 kg/ plant. The highest yield/ plant was produced by population Sv_7 followed by population Sv_2 and Sv_1 after three cycles. All breeding lines (populations selected significantly outyielding the base population (M_0) and two cheeks, except for population (Sv_8).

Similar results were recorded by Christakis and Fasoules (2002), Zakher (2005) and Rajeskhar et al. (2013). Who found that some tomato lines were highest yield than the cheek cv. It could be concluded that all these populations are superior comparatively to the base population (M_0) and two cheek, and could be recommended as new lines.

These results apparently, confirmed these reported by Salib (2006), Bhnan (2008), Zakher (2010) and Rashwan (2015).

Table (2): Analysis of variance for eight populations in all studied traits in tomato.

Populations d.f M. S scharacters	Sv_1		Sv_2		Sv_3		Sv_4		Sv_5		Sv_6		Sv_7		Sv_8	
	35	7	35	7	35	7	35	7	35	7	35	7	35	7	35	7
	M_1E	M_2T	M_1E	M_2T	M_1E	M_2T	M_1E	M_2T	M_1E	M_2T	M_1E	M_2T	M_1E	M_2T	M_1E	M_2T
1- DF	0.600	153.500**	0.464	51.600**	0.531	87.260**	1.508	113.000**	0.931	59.600**	0.997	74.260**	0.789	141.400**	0.731	47.930**
2- PH	3.389	275.600**	0.644	107.110**	1.819	213.200**	1.167	109.700**	2.519	252.100**	1.978	245.800**	2.419	413.800**	1.064	324.300**
3- Nb	0.664	24.600**	0.342	11.380**	0.478	19.280**	0.222	23.560**	0.386	4.819**	0.486	8.819**	1.075	11.3800**	0.600	7.00**
4- WF	7.086	1346.800**	1.544	210.108**	6.311	630.8**	1.186	191.200**	2.253	509.200**	3.367	182.300**	1.586	195.500**	1.864	180.600**
5-NF	1.044	265.400**	0.475	144.700**	0.644	174.3**	1.300	161.300**	1.044	23.300**	0.597	73.260**	0.586	83.490**	0.878	120.900**
6- YP	634.200	929737.5**	1042.2	521088.90**	387.800	358244.400**	286.00	818534.400**	380.830	129237.500**	307.500	348437.500**	221.100	321627.800**	1043.800	189012.100**

*, ** significant and highly significant at 5% and 1% levels of probability, respectively.

1- DF = Days to flowering, 2- PH = plant high, 3- NP = number pf branches/plant, 4-WF= weight of fruit, 5- NF = Number of fruits/ plant, 6- yield/ plant kg.

Table (3): Analysis of variance for three cycles from mass selection in all studied traits in tomato

Cycles d.f M.S characters	M_0		M_1		M_2		M_3	
	15	3	15	3	15	3	15	3
	M_1E	M_2T	M_1E	M_2T	M_1E	M_2T	M_1E	M_2T
1- DF	0.643	8.714**	0.976	9.854**	1.047	14.930**	0.750	22.180**
2- PH	1.321	519.50**	2.299	521.60**	1.888	442.60**	1.805	440.70**
3- Nb	0.614	5.286**	0.731	8.988**	0.543	8.000**	0.448	7.619**
4- WF	1.804	911.60**	2.178	1076.10**	3.271	1214.50**	2.917	1295.00**
5-NF	1.057	32.040**	0.738	38.690**	0.876	33.620**	0.862	41.910**
6- YP	373.100	249380.9**	533.9	361689.2**	590.700	499459.2**	619.3	604431.5**

*, ** significant and highly significant at 5% and 1% levels of probability, respectively.

(M_0)= base population, (M_1)= cycle one, (M_2)=cycle two, (M_3)= cycle three.

*** Estimates of genotypic (GCV%) and Phenotypic (PCV%) coefficient of variation.**

Data in Table 5, showed that the value of genotypic coefficient of variation (Gcv) ranged from 3.46% for days to flowering trait in the population (Sv_8) to 22.24% for yield/ plant (kg) in population (Sv_1). Similarly, values for phenotypic coefficient of variation (PCV) ranged from 3.60% to 22.29% for yield/ plant (kg). The smallest differences observed between PCV and GCV values for all studied traits in all populations, indicating the importance of the genetic effects in controlling the inheritance of all studied traits. This results were in agreement with those obtained by Kamruzzahan et al., (2000), Mohanty (2000); Nandan and Asati (2008), Ghosh et al. (2010) and Jiregna et al., (2011).

Table (4): Mean yield/ plant and its components traits at the population after three cycles in tomato

Character Enters	Mean cheek	1- Days to flowering (DF) Sv_1	Sv_2	Sv_3	Sv_4	Sv_5	Sv_6	Sv_7	Sv_8	Average	Mean of cheek	2-plant hight (PH) Sv_1	Sv_2	Sv_3	Sv_4	Sv_5	Sv_6	Sv_7	Sv_8	Average
Cheek Cv.	83.16										70.66									
Cheek F1	80.00										67.00									
M_0		83.83	82.49	83.49	84.99	81.49	82.5	82.83	84.66	83.29		65.16	76.16	56.16	76.66	53.99	59.99	63.16	76.00	65.91
M_1		80.83	80.16	80.16	81.99	77.83	79.66	80.33	82.16	80.39		72.50	79.83	60.66	80.83	58.83	63.66	66.33	80.83	70.43
M_2		75.33	78.49	77.66	79.16	76.16	77.16	76.50	80.16	77.57		76.5	82.49	65.33	83.33	63.5	69.99	72.66	86.49	75.03
M_3		72.33	75.49	74.49	74.66	74.16	73.99	71.83	78.16	74.38		80.99	86.16	69.83	86.99	69.16	74.33	81.99	93.16	8032
Average		78.08	79.15	78.95	80.20	77.41	78.32	77.87	81.28			73.78	81.16	62.99	81.95	61.37	66.99	71.03	84.12	
L.S.D. 05		1.92	1.70	1.83	3.09	2.43	2.51	2.24	2.15			4.63	20.1	3.36	2.70	4.00	3.54	3.92	2.60	
L.S.D. 01		1.39	1.23	1.32	2.2	1.73	1.80	1.61	1.54			3.34	1.45	2.43	1.95	2.87	2.55	2.81	1.86	
		3- Number of branches (Nb)										4- weight of fruit (WF)								
Cheek Cv.	8.83										83.49									
Cheek F1	9.0										90.00									
M_0		7.49	9.99	8.16	7.83	9.49	7.83	8.16	7.16	8.26		98.83	105.99	94.5	107.16	92.99	102.99	104.83	69.5	97.09
M_1		8.00	11.49	9.16	9.49	10.16	8.16	8.99	7.83	9.16		110.66	110.16	104.5	114.16	99.16	105.66	107.49	71.99	102.97
M_2		10.33	12.49	10.49	10.66	11.16	9.49	10.66	8.66	10.49		120.49	115.83	113.33	116.50	107.83	110.49	112.00	75.16	108.95
M_3		11.99	13.16	12.16	12.46	11.66	10.49	11.16	9.66	11.59		134.16	119.33	117.66	120.66	113.83	115.49	116.66	82.16	114.95
Average		9.45	11.78	9.99	10.11	10.61	8.99	9.74	8.33	9.875		116.03	112.82	107.49	114.62	103.45	108.65	110.24	74.70	
L.S.D. 05		2.05	1.44	1.74	1.18	1.56	1.75	2.61	1.95			6.68	3.10	6.33	2.74	3.78	3.44	3.17	3.44	
L.S.D. 01		1.53	1.04	1.26	0.85	1.10	1.26	1.86	1.41			4.83	2.24	4.58	1.95	2.71	2.46	2.27	2.49	
		5- Number of fruits (NF)										6- yield / plant kg (YP)								
Cheek Cv.	33.66										1172.00									
Cheek F1	34.00										1400.00									
M_0		30.33	32.16	28.33	31.33	30.16	33.00	33.33	26.83	30.68		1311.66	1429.99	1269.99	1326.66	1393.33	1414.99	1495.00	838.33	1287.49
M_1		36.16	34.33	31.83	34.99	34.33	36.66	36.83	29.5	34.32		1649.99	1673.33	1468.66	1625.00	1596.66	1695.00	1769.99	987.49	1558.26
M_2		39.99	38.49	34.66	40.00	37.16	39.00	39.66	33.66	37.82		1861.66	1904.99	1683.66	1881.66	1653.33	1874.83	1911.66	1061.66	1729.18
M_3		46.16	43.49	40.99	42.99	40.66	41.16	42.16	36.99	41.82		2251.66	2109.99	1846.66	2194.16	1739.99	196.0	2035.00	1265.00	1925.30
Average		38.16	37.11	33.95	37.32	35.57	37.45	37.99	31.74			1768.74	1779.57	1567.24	1756.78	1595.82	1736.20	1802.91	1038.12	
L.S.D. 05		2.57	1.70	2.01	2.87	2.57	2.36	1.93	2.36			63.49	81.41	49.64	42.67	49.23	81.51	37.51	81.50	
L.S.D. 01		1.86	1.23	1.45	2.05	1.83	1.70	1.39	1.70			45.91	58.92	35.89	30.84	35.58	58.93	27.11	58.93	

*** Estimates of broad sense heritability (h^2b) and Expected genetic advance (GA).**

Heritability estimates consider one of the essential parameters to selection response in generations and express the type of gene action. In this study estimated broad sense heritability values were almost ranged from 61.50% for the Nb trait in population (Sv_7) to 99.79% for the yield/ plant kg in population (Sv_4) Table 5. such high values of h^2b for all traits clarified that they were least affected by environmental modification and selection based on phenotypic performance would be reliable. Estimates of genetic advance ranged from 5.80 (days to flowering) in population (Sv_8) to 39.07 (yield/ plant kg) in population (Sv_1). Highest genetic gain was observed for YP trait in populations Sv_1 and Sv_4 (39.07 and 36.19), Nb trait for Sv_1 and Sv_4 (34.11 and 33.19), NF trait for Sv_1 (30.52), PH trait Sv_3 (29.26), NF trait Sv_1 (22.32) and DF trait for Sv_8 (5.8), respectively. High heritability with high GCV and genetic gain were noticed for yield/ plant (kg) weight of fruit (g), NF plant, PH (cm), NB plant and days to flowering for all populations which might be assigned to additive gene effect governing their inheritance and phenotypic selection for their improvement could be achieved by simple method like pure line or mass selection or bulk method following hybridization and selection in early generation. These results were in line with those obtained by Mayavel et al., (2005), Kumar and Thakur (2007), Aria et al., (2009), Singh (2009), Prerma et al.; (2011) and Rajaskhar et al., (2013).

Table (5): Genetic parameters for all studied traits in eight population in tomato

Populations parameters	Sv_1				Sv_2			
Characters	PCV	GCV	H.B.S	GA	PCV	GCV	H.B.S	GA
1- DF	6.527	6.451	97.700	11.223	3.785	3.686	94.837	6.318
2- PH	9.458	9.123	93.049	15.489	5.283	5.190	96.498	8.972
3- Nb	22.067	20.932	85.731	34.111	12.528	11.504	84.324	18.593
4- WF	13.084	12.882	96.924	22.320	5.340	5.225	95.747	8.999
5-NF	17.595	17.390	97.685	30.250	13.306	13.176	98.062	22.964
6- YP	22.293	22.247	99.592	39.075	16.623	16.524	98.812	28.909
	Sv_3				Sv_4			
1- DF	3.903	4.815	96.457	8.323	5.588	5.374	92.494	9.097
2- PH	9.655	9.415	95.090	16.159	5.351	5.187	93.939	8.848
3- Nb	19.163	17.850	86.765	29.264	19.938	19.393	94.601	33.197
4- WF	9.774	9.490	94.283	16.218	4.993	3.902	96.390	8.470
5-NF	15.961	15.786	97.823	27.479	14.166	13.833	95.352	23.774
6- YP	15.623	15.572	99.354	27.318	21.041	21.019	99.791	36.955
	Sv_5				Sv_6			
1- DF	4.225	4.037	91.307	6.789	4.632	4.454	92.451	7.537
2- PH	10.821	10.508	94.290	17.958	9.743	9.515	95.358	16.352
3- Nb	9.977	8.086	65.684	11.534	15.285	13.156	74.078	19.928
4- WF	8.990	8.872	97.403	15.411	5.300	5.024	89.855	8.382
5-NF	6.128	5.413	78.036	8.416	9.516	9.290	95.302	15.962
6- YP	9.267	9.186	98.258	16.025	13.910	13.873	99.473	24.352
	Sv_5				Sv_6			
1- DF	6.316	6.213	96.743	10.755	3.603	3.446	91.498	5.802
2- PH	11.860	11.656	96.592	20.162	8.802	8.716	98.063	15.191
3- Nb	17.066	13.384	61.504	18.473	15.493	12.394	64.000	17.451
4- WF	5.260	5.135	95.322	8.825	7.531	7.306	94.111	12.473
5-NF	9.977	9.772	95.931	16.845	14.393	14.087	95.795	24.266
6- YP	12.867	12.840	99.589	22.553	17.332	17.050	96.776	29.520

Estimates of Relative to M_0%:

Results in Table 6, indicated that, there are significant increased After the first, second and third cycles (M_1, M_2 and M_3) of mass selection compared with base population (M_0) and two cheek in all studied traits for all populations. The M_1, M_2 and M_3 of mass selection relative to base populations were 122.48%, 141.83%, 165.19% and 119.22%, 131.84, 152.19% for the yield/ plant kg trait in populations Sv_4 and Sv_1, 119.00%, 141.19%, 171.66% and 112.35%, 122.34%, 144.68% for the NF plant trait in populations Sv_1 and Sv_3, 111.97%, 121.92%, 135.74% and 110.58%, 119.92%, 124.51% for WF (g) trait in populations Sv_1 and Sv_3, 106.73%, 137.82, 160.0% and 112.24%, 128.58%, 148.98% in the Nb plant trait in populations Sv_4 and Sv_1, 111.26%, 117.40%, 124.3% and 108.95%, 117.6%, 128.09% in the PH cm trait in populations Sv_5 and Sv_1 respectively. These results were in agreement with those reported by various researchers in tomato Mohanty (2002); Haydar et al., (2007); Nandan and Asati, (2008); Ghosh et al. (2010); Jiregna et al. (2011); Meseret et al. (2012) and Kashif (2013). Also, improvement of weight fruit and yield in super strain – B cultivar of tomato by mass selection was studied by Rashwan (2015), who reported that breeding in tomato by mass selection were effective after three cycles.

Table (6): Relative to M_0% and two cheek after three cycles in eight population in tomato

Character Entry	1- Days to flowering (DF)											
	Sv_1 relative to			Sv_2 relative to			Sv_3 relative to			Sv_4 relative to		
	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%
M_1	0.96	0.96	101.03	0.97	0.96	100.2	0.96	0.96	100.2	0.96	0.98	101.0
M_2	0.90	0.91	0.94	0.95	0.94	0.98	0.93	0.93	0.97	0.93	0.95	104.1
M_3	0.86	0.87	0.90	0.91	0.90	0.94	0.89	0.89	0.93	0.87	0.89	108.7
	Sv_5			Sv_6			Sv_7			Sv_8		
M_1	0.95	0.93	0.97	0.96	0.95	0.99	0.97	0.96	100.4	0.97	0.98	102.7
M_2	0.93	0.91	0.95	0.93	0.92	0.96	0.92	0.91	0.95	0.93	0.96	100.2
M_3	0.91	0.89	0.92	0.89	0.88	0.92	0.86	0.86	0.89	0.92	0.93	0.97
2- Plant high cm (PH)												
M_1	111.26	104.80	108.2	104.81	112.97	119.14	108.00	0.85	0.90	105.43	114.39	120.64
M_2	117.40	108.26	114.17	108.31	116.74	123.12	116.31	0.92	0.97	108.69	117.93	124.37
M_3	124.30	114.61	120.88	113.12	121.94	128.60	124.33	0.98	104.22	113.47	123.11	129.84
M_1	108.95	0.83	0.87	106.11	0.90	0.95	105.01	0.93	0.99	106.35	114.3	120.6
M_2	117.60	0.89	0.94	116.66	0.99	104.0	115.03	102.8	108.45	113.80	122.4	129.0
M_3	128.09	0.97	103.0	123.89	105.1	110.9	129.47	116	122.37	122.58	131.8	139.0

Character Entry	3- Number of branches/ plant (Nb)											
	Sv_1 relative to			Sv_2 relative to			Sv_3 relative to			Sv_4 relative to		
	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%
M_1	106.73	0.90	0.88	115.00	130.1	127.0	112.24	103.7	101.8	121.26	107.5	105.5
M_2	137.82	116.9	114.7	125.01	141.5	138.8	128.53	118.8	116.6	136.20	120.7	118.5
M_3	160.00	135.8	133.2	131.71	149.0	146.2	148.98	137.7	135.1	159.57	141.5	138.8
	Sv_5			Sv_6			Sv_7			Sv_8		
M_1	107.05	115.1	112.9	104.27	0.92	0.90	110.16	101.8	0.99	109.28	0.88	0.87
M_2	117.58	126.4	124.0	121.26	107.5	105.5	130.61	120.7	118.5	120.93	0.98	0.96
M_3	122.40	132.0	129.55	134.03	118.8	116.6	136.74	126.4	124.0	134.89	109.4	107.3
4- Weigh of fruit (g) (WF)												
M_1	111.97	132.5	122.9	103.93	131.9	122.4	110.58	125.16	116.1	106.53	136.7	126.85
M_2	121.92	144.3	133.8	109.27	138.7	128.7	119.92	135.7	125.9	108.71	139.5	129.4
M_3	135.74	160.6	154.6	112.58	142.9	132.5	124.51	140.92	130.7	112.59	144.5	134.0
M_1	106.63	118.7	110.1	102.59	126.5	117.27	102.54	128.7	119.4	103.58	0.86	0.79
M_2	115.95	129.1	119.8	107.47	132.3	122.7	106.83	134.1	124.0	108.15	0.90	0.83
M_3	122.40	136.3	126.4	112.13	138.3	128.32	111.28	139.7	129.6	118.22	0.98	0.91

Character Entry	5- Number of fruits / plant (NF)											
	Sv_1 relative to			Sv_2 relative to			Sv_3 relative to			Sv_4 relative to		
	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%	M_0%	Cv%	F_1%
M_1	119.00	107.4	106.3	106.74	101.9	100.9	112.35	0.94	0.93	111.68	103.9	102.9
M_2	141.19	118.8	117.6	119.69	114.3	113.2	122.34	102.9	101.9	127.67	118.8	117.6
M_3	171.66	137.1	135.7	135.23	127.9	127.9	144.68	121.7	120.5	136.16	127.7	126.4
	Sv_5			Sv_6			Sv_7			Sv_8		
M_1	113.80	101.9	100.9	111.10	108.9	107.8	110.50	109.40	108.3	109.95	0.87	0.86
M_2	123.20	110.4	109.3	118.18	115.8	114.7	119.06	117.8	116.6	125.47	100.01	0.99
M_3	134.80	120.8	119.6	124.74	121.0	121.0	126.50	125.2	124.00	137.88	109.9	108.8
6- Yield / plant kg (YP)												
M_1	119.22	140.7	117.85	117.01	142.7	119.5	115.64	125.3	104.9	122.48	138.6	116.0
M_2	131.84	158.84	132.9	133.21	162.54	136.0	132.54	143.62	120.23	141.83	160.5	134.4
M_3	152.19	192.12	160.8	147.55	180.00	150.7	144.35	156.4	130.95	165.38	187.2	156.7
M_1	14.59	136.2	136.23	119.78	144.6	121.0	118.39	151.02	126.4	117.79	0.84	0.70
M_2	118.66	141.06	118.09	132.49	159.9	133.9	127.07	163.11	136.54	123.65	0.90	0.76
M_3	124.87	148.4	124.2	138.51	167.2	140.0	136.12	173.6	145.3	150.8	107.9	0.90

Conclusion:

Results of the study showed that populations Sv_1, Sv_2, Sv_4, Sv_7 and Sv_3 are considered promising as lines because they are high productivity.

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