Genetic behavior in selected tomatoes lines for yield and quality traits

Rashwan A.M.A and Abdel-Haleem A. H. El-Shaieny

Horticulture Depat. (Vegetable crops) Faculty, of Agriculture South Valley University, *Qena 83523, Egypt*
a.elshaieny@agr.svu.edu.eg, rashwan_univ@yahoo.com

Abstract: The goal of this research is to study the genetic behavior in selected tomato lines to yield and quality traits. Results, showed highly significant differences among genotypes (G) for all studied traits. The (G×Y) interaction was not significant for all studied traits except for TSS trait. Average lycopene content trait ranged from 19.27 for line SV_5 to 37.24 for line SV_2, Ascorbic acid ranged from 14.21 for Super Strain- B to 32.63 for line SV_6, total soluble solids ranged from 5.83 for Super Strain B to 6.71 for line SV_2, yield/ plant (g) ranged 1410 for line SV_8 to 2329.99 (g) for hybrid followed by SV_1, SV_2 and SV_4. The heritability estimated ranged from 27.78 for number of locus trait to 99.88 for lycopene content. The genotypic and phenotypic coefficients of variation were observed with slight differences between them for all studied traits except for TSS, reflecting to high genotypic variance and resulted in high estimates of broad-sense heritability. Genetic advance ranged from 2.94% for TSS to 43.48% for Lycopene trait. Results revealed tat fruit yield/ plant (g) was highly significant positive correlated with lycopene (0.519), ASC (0.337) and NL (0.411), While non significant with TSS (0.240).
[Rashwan A.M.A and Abdel-Haleem A. H. El-Shaieny. **Genetic behavior in selected tomatoes lines for yield and quality traits.** *J Am Sci* 2016;12(7):40-44]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). http://www.jofamericanscience.org. 5. doi:10.7537/marsjas120716.05.

Key words: Correlation, Genetic advance, Heritability, Lycopene, Tomato, yield per plant.

1. Introduction

Tomatoes are one of the most important vegetable crops from an economic stand point at most countries of the world (Hassan, 1991). The tomato belongs to the nightshade plants and a member of *Solanaceae* family. Tomatoes are considered one of the main sources of lycopene in vegetables crops. Lycopene is the red pigment in nature consisting fruits ripe tomatoes, and lycopene from powerful antioxidant and plays an important role in protecting tissue[1]s from oxidation free ions which consist with metabolic processes (Mohamed, 2010). Another study by Simon (1992) indicated that lycopene in tomato is very effective natural antioxidant and quencher of free radicals and Thompson *et al.* (2000), responsible for protecting cells against oxidative damage and thereby decreasing the risk of chronic diseases. The production of varieties of high lycopene has beneficial effects on human health (Lenucci *et al.,* 2007).

Evaluation of the genotype, environment and their interaction on carotenoid and ascorbic acid accumulation in tomato germplasm were studied by Salvador ***et al.*** (2010). They found that CDP 9822 cultivar is interesting high carotenoid and ascorbic accumulation. Generally, Cultivar high lycopene or ascorbic acid is becoming popular in the tomato processing industry. Saleem *et al.* (2013) pointed out that tomatoes are a good source and is rich vitamin C and A as well as minerals and lycopene and B – carotene. At present in Egypt and all over the world has become a fresh tomato consumption or manufactured indispensable they are poor and rich food. Tomatoes, becoming a successful industry are grown in different regions and seasons and exported to other places all over the world. So it was a concern in recent years to study the yield and quality traits of plant breeder. The objective of the current study was to evaluate some of new promising tomato lines for yield and quality traits and select the best lines for most important quality and yield/ plant trait, also, incorporated in breeding program.

2. Materials and Methods

Plant materials and field experiment.

Eight lines of tomatoes namely SV_1, SV_2, SV_3, SV_4, SV_5, SV_6, SV_7 and SV_8 (previously selected under Qena condition), and tow genotypes (Super Strain- B cv., and hybrid F_1 448), were used in the current investigation.

The ten tomato lines and genotypes were evaluated during the winter seasons of (2013/2014) and (2014/2015). Field experiments were established at Experimental Farm, Faculty of Agriculture, South Valley University, Qena. Seeds were sown in nursery on 1st August every season. Studied traits were as follows:

1- Yield / plant (g) (YP)
2- Ascorbic acid (ASC)
3- Lycopene content (LYC)
4- Total soluble solids: (TSS)
5- Number of Locus: (NL)
6- Fruit length (cm): (FL)

7- Fruit diameter (cm): (FD)

Chemical constituents of fruits:

Random samples of fruit were taken in the middle of harvested seasons (10 fruits from each plot). Ascorbic acid content was determined according to A.O.A.C. (1970). Lycopene content was estimated according to Ranganna (1978). Total soluble solids (TSS) by using hand-held refractometer.

Separate and combined analysis of variance for all studied traits, were done according to Gomez and Gomez (1984). Comparisons among means of lines tomato were tested using LSD values at 5% and 1% levels. Genotypic (GCV) and Phenotypic (PVC) coefficient of variability, Genetic advance (GA) and heritability (H^2) were estimated according to Johnson et al. (1955).

3. Results and discussion

As shown in Table (1 and 2), the combined and separate of variance for all studied traits showed significant differences among genotypes (G), indicating the presence of true differences between genotypes. The combined analysis revealed that the effect of genotypes by year interaction (G×Y) was not significant for all studied traits except for (TSS) trait, making it is possible to improve these traits through selection. Average (LYC) ranged 19.4 and 19.15 with an average of 19.27 for line SV_5 to 37.36 and 37.13 with an average 37.24 for line SV_2 in both seasons, from 14.2 and 14.23 with an average of 14.21 for Super Strain-B cv. to 32.43 and 32.83 with an average 32.63 for line SV_6 in (ASC) trait, from 6 and 5.66 with an average of 5.83 for Super Strain B cv. to 6.63 and 6.68 with an average 6.71 for line SV_2 in (TSS) trait, from 1400 and 1420 (g) with an average of 1410 (g) for line SV8 to 2333.33 and 2326.62 (g) with an average 2329.99 (g) for F_1 hybrid (448) in YP trait, from 33.3 and 3.66 with an average 3.49 for Super strain B cv. to 5. and 5.33 with an average 5.16 for line SV_5 in NL trait, from 4.76 and 4.66 with an average 4.71 for line SV8 to 6.46 and 6.33 with an average 6.39 for line SV5 in FL trait, from 5.1 and 5.2 with an average 5.15 for line SV4 to 6.23 and 6.26 with an average 6.24 for line SV3 in FD trait for both seasons Table 3.

Table 1: Separate analysis of variance for all studied traits.

Seasons	Item	D.F	Mean Squares						
			YP	ASC	LYC	TSS	NL	FL	FD
Year 1	Replication	2	1493.33	0.105	0.020	0.001	0.400	0.030	0.080
	Genotypes	9	263792.59**	75.74**	139.09**	0.117**	1.219*	0.748**	0.427**
	Error	18	1708.14	0.054	0.083	0.037	0.474	0.016	0.020
Year 2	Replication	2	1125.83	0.042	0.030	0.014	0.300	0.014	0.017
	Genotypes	9	268103.76**	77.07**	128.73**	0.329**	0.726**	0.731**	0.448**
	Error	18	722.13	0.146	0.050	0.010	0.337	0.012	0.014

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

Ahmed (2001) reported that Edkawy and Peto 86 cvs. were the superiorest cvs. in total yield of fruits/plant, ascorbic acid and TSS content at two seasons. Anther study by Falak *et al.* (2001), they found that 'Yaqui' cv. Out yielded other cultivars with 11.22 tons ha^{-1} in Pakistan, Maximum TSS was observed in cultivar "Avinash" 5.5 and Lyreka cv. Have the most obundant ascorbic acid of 16.03 mg/100gm. Wide range of variability among tomato cultivars/ lines was found (Hussin *et al.,* 1990, Chaughry *et al.* 1999, Hussain *et al.* 2001, El-Hamady *et al.* 2002, Nandan and Asati 2008, Initoye *et al.* 2009, and Jiregna *et al.* 2011, Sally 2012, Sunil *et al.*, 2013, and Rajasekhar *et al.* 2013).

Table 2: Combined analysis of variance for all studied traits.

Character / S.O.V	D.F	Mean squares						
		YP	ASC	LYC	TSS	NL	FL	FD
Year (Y)	1	20.417	0.486	1.473*	0.024	0.150	0.001	0.006
Error	4	1309.583	0.074	0.025	0.007	0.35	0.022	0.049
Genotype (G)	9	531238.935**	152.721**	267.097**	0.392**	1.794**	1.46**	0.845**
GXY	9	657.454	0.093	0.735	0.054	0.150	0.019	0.030
Error	36	1215.139	0.100	0.066	0.024	0.406	0.014	0.017

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

Broad sense heritability (h^2) ranged from 34.37 and 27.78 for NL trait to 99.82 and 99.88 for LYC trait in both seasons Table 4. These results revealed that most all traits studied were mostly controlled by

genetic factors and less affected by the environmental variation. These results were in line with those obtained by Rukhsar and Jag (2011) and Rashwan (2015).

The value of PCV and GCV were observed with slight differences between them for all studied traits except for TSS trait, reflecting to high genotypic variance and resulted in high estimates of broad- sense heritability which, suggesting that phenotypic selection for these traits could be efficient. These results were agreement with those obtained by Mohanty (2003). He stated that GCV and PCV ranged from 9.30 and 37.91 to 10.40., and 38.96 for all studied traits, respectively. Anther study by Hidaytullah *et al.* (2008), found that the value of GVC and PVC ranged from 3.84 and 3.85 to 80.41 and 84.88 for all studied traits.

Table 3: Means of yield per plant, ascorbic acid content, lycopene content and total soluble solids over two years for ten genotypes of tomato.

Character	1- YP			2- ASC			3- LYC			4- TSS		
Season	2013/2014	2014/2015	Average	2013/2014	2014/2015	Average	2013/2014	2014/2015	Average	2013/2014	2014/2015	Average
1- Super Strain- B	1560	1540	1550	14.2	14.23	14.21	22.46	22.46	22.46	6.0	5.66	5.83
2- F_1 (448)	2333.33	2326.66	2329.99	22	22.46	22.23	34.66	32.66	33.66	6.36	6.26	6.31
3- SV_1	2183.33	2240	2211.66	29.76	30	29.88	25.0	24.10	24.55	6.36	6.53	6.43
4- SV_2	2150.0	2161.66	2155.83	23.43	23.63	23.53	37.36	37.13	37.24	6.63	6.8	6.71
5- SV_3	1900	1883.33	1891.66	24.63	24.86	24.74	30.23	30.48	30.35	6.53	6.3	6.42
6- SV_4	2130	2153.33	2141.66	21.2	21.03	21.12	22.33	22.73	22.53	6.16	6.03	6.09
7- SV_5	1800	1766.66	1783.33	26.6	26.26	26.43	19.40	19.15	19.27	6.46	6.26	6.36
8- SV_6	2000	2020	2010	32.43	32.83	32.63	37.3	36.96	37.13	6.1	6.96	6.03
9- SV_7	1943.33	1966.66	1954.99	21.33	21.7	21.51	24.66	24.4	24.53	6.6	6.56	6.58
10- SV_8	1400	1420	1410	23.33	23.7	23.60	21.8	22.0	21.9	6.33	6.46	6.39
Average	1946.66	1947.83	1943.91	23.90	24.08	23.96	27.52	27.21	27.36	6.32	6.28	6.32
C.V	2.12	1.38		0.97	1.59		1.05	0.82		3.04	1.61	
L.S.D 0.05	100.20	65.16		0.56	0.92		0.69	0.54		0.46	0.24	
L.S.D 0.01	137.32	89.29		0.76	1.26		0.95	0.74		0.63	0.33	

Continue Table 3: Means of yield per plant, ascorbic acid content, lycopene content and total soluble solids over two years for ten genotypes of tomato.

Character	5- NL			6- FL			7- FD		
Season	2013/2014	2014/2015	Average	2013/2014	2014/2015	Average	2013/2014	2014/2015	Average
1- Super Strain- B	3.33	3.66	3.49	5.8	5.63	5.71	5.96	6.03	5.99
2- F_1 (448)	4.66	4.33	4.49	5.28	5.33	5.3	5.56	6.4	5.98
3- SV_1	5	4.66	4.83	5.5	5.53	5.52	5.73	6.6	6.16
4- SV_2	4.33	4.33	4.33	5.1	5.23	5.17	5.46	5.26	5.36
5- SV_3	4.66	4.66	4.66	5.4	5.4	5.4	6.23	6.26	6.24
6- SV_4	4.33	4.33	4.33	6.1	6.23	6.17	5.1	5.20	5.15
7- SV_5	5	5.33	5.16	6.46	6.33	6.39	5.3	5.46	5.38
8- SV_6	4.66	4.66	4.66	5.33	5.43	5.38	6.23	6	6.06
9- SV_7	4.33	4.33	4.33	5.23	5.13	5.18	6	6.16	6.08
10- SV_8	4.33	3.66	4.49	4.76	4.66	4.71	5.46	5.63	5.55
Average	4.30	4.4	4.43	5.50	5.49	5.49	5.69	5.71	5.79
C.V	16.01	13.19		2.32	1.97		2.50	2.10	
L.S.D 0.05	1.66	1.40		0.30	0.26		0.34	0.28	
L.S.D 0.01	2.28	1.92		0.41	0.36		0.46	0.39	

Table 4: The genetic parameters for all studied traits in two seasons.

seasons	Parameters character	$\overline{X}$	Range	PVC %	GVC %	H.B.S	GA
Year 1	**YP**	1946.667	1400-2333.33	15.331	15.183	98.082	26.465
	ASC	23.903	14.2-32.43	21.036	21.00	99.785	36.945
	LYC	27.527	19.40-37.36	24.95	24.720	99.820	43.484
	TSS	6.327	6.0-6.63	3.988	2.581	41.885	2.94
	NL	4.300	3.33-5.0	19.765	11.589	34.379	11.959
	FL	5.497	4.76-6.46	9.276	8.986	93.846	15.321
	FM	5.697	5.1-6.23	6.926	6.465	87.152	10.623
Year 2	**YP**	1947.833	1420.0-2326.6	15.389	15.301	99.196	26.867
	ASC	24.083	14.33-32.83	21.086	21.026	99.434	36.902
	LYC	27.213	19.15-37.13	24.18	24.00	99.884	42.334
	TSS	6.287	5.66-6.8	5.425	5.187	91.404	8.727
	NL	4.400	3.66-5.33	15.526	8.184	27.786	7.593
	FL	5.493	5.13-6.33	9.133	8.912	95.232	15.307
	FM	5.717	5.22-6.6	6.967	6.653	91.176	11.181

Genetic advance GA ranged from 2.94 and 7.59 for TSS trait to 43.48 and 42.33 for Lyc trait in both seasons. A large number of former and current studies studied the genetic importance of the crop in all countries of the world (Haydar *et al.,* 2007) in Bangladesh, Nandan and Asati (2008) in India, Jiregna *et al.* (2011) in Ethiopia and Rashwan (2015) in Egypt.

The results (Table 5) revealed that fruit yield/plant was high positive correlated with LYC (0.519^{**}), ASC (0.337^{**}) and NL (0.411^{**}) traits, while non significant with TSS (0.24). These results were in line with those obtained by Salvador *et al.* (2010) and Buckseth *et al.* (2012). Kashif *et al.* (2013) fond that fruit yield/ plant had strong positive correlation with lycopene content, while negative correlation with TSS.

Table 5: Simple correlation in all studied traits

	YP	ASC	LYC	TSS	NL	FL	FD
YP	×						
ASC	0.337^{**}	×					
LYC	0.519^{**}	0.347^{**}	×				
TSS	0.224	0.267^{*}	0.149	×			
NL	0.411^{**}	0.480^{**}	0.148	0.253^{*}	×		
FL	0.125	-0.055	-0.407^{**}	-0.329^{**}	0.305^{*}	×	
FM	-0.225	0.045	0.187	-0.161	-0.026	-0.313^{*}	×

Conclusion and Application

It could be concluded that the lines SV_1, SV_2 and SV_6 are considered promising for releasing as new cultivars because they are high productivity and quality fruit traits, under southern Egypt also, quality traits in tomato can be improved through the selection of yield/ plant trait. Contribute to these lines promising increase in productivity and quality in the tomato crop in southern Egypt in the future.

References:

1. A.O.A.C. (1970). (Association of Official Agricultural chemists). Methods of analysis, 11th Edition, Washington, D.C.
2. Ahmed, E.M.E. (2001). Response of some tomato cultivars to natural soil Salinity and use of some treatments to reduce salt injury. M. Sc. Thesis, Faculty of Agric., Mansoura University.
3. Buckseth, T., M. K. Sharma and Thakur, K.S. (2012). Genetic diversity and Path analysis in tomato (*Solanum Lycopersicon* L.). Vegetable Science, 39 (2): 221-223.
4. Chaudhry, M. F., Khokhar, K. M, Hussain, S.I, Mahmood T., and qbal, S.M.I. (1999). Comparative performance of some local and exotic tomato cultivars during spring and autumn season. Pakistan J. Arid. Agric. 2: 7-10.
5. El-Hamady, M.M, Hagag, A.A, Fayz, S.A, and El-Hamdi, Kh. H. (2002). Yield, Quality and chemical composition of tomato irrigation systems, salinity levels and soil types. J. Agric. Sci. Mansoura Univ., 27 (5): 3533-3543.
6. Falak, N., Ihsan, H., Syed, A., Abdus, S.S., and Abdur, R. (2011). Studies on growth, yield and nutritional composition of different tomato cultivars in Battal Valley of district Mansehir, Khyber Pakhtunkhwa, Pakistan. Sarhad J. Agric. Vol. 27, No. 4.
7. Gomez, K.A. and Gomez, A. A. (1984). Statistical procedures for the Agricultural Researches. John Wiley and Son, Inc. New York.
8. Hassan, A.A. (1991). The production of vegetable crops. Arabic House for publications, Cairo, A.R.E. (in Arabic).
9. Haydar, A., Mandal, M. A., Ahmed, M.B., Hannan, M.M., Karim, R., Razvy, V., Roy, U. K., and Salahin, M. (2007). Studies on genetic variability and interrelationship among the different traits in tomato (*Lycopersicon esculentum* Mill). Middle- East Journal of Scientific Research 2 (3-4): 139-142.
10. Hussain, S.I., Khokhar, K. M., Laghari, M.H., and Mahmud, M.M. (2001) yield potential of some exotic and one local tomato cultivars grown or summer production. Pakistan J. Biol. Sci. 4: 1215-1216.
11. Hussain, S.I., Khokar, K.M., Quereshi, K. M., Mahmood T.,and Niazi, Z.M. (1990). Studies on production of tomato cultivar sin summer season. Pakistan J. Agric. Res. 25: 65-69.
12. Ibitoye, D. O., Akin, P. E. Idowu and Ademoyegun, O. T. (2009). Agronomic and Lycopene evaluations in tomato (*Lycopersicon esculentum* Mill.) As A function of genotype, World Journal of agricultural Sciences 5: 892-895.
13. Jiregna,T., Derbew, B., Kassahum, B. and Wosene. (2011). variability, Heritability and genetic advance in tomato (*Lycopersicon*

esculentum Mill) Genotypes in west Shoa, Ethiopia. American Eurasian J. Agric. & Environ. Sci., 11 (1): 87-94.
14. Johnson, H. W., Robisnson H. F. and Comstock, R.E. (1955). Estimates of genetic and environmental variability in soybean. Agron. J. 47: 314-318.
15. Kashif, N., Muneeb, M. and Ahmed, S. C. (2013). Genetic Architecture and Association of fruit yield and Quality traits in tomato (*Solanum Lycopersicon* L.) Universal Journal of Agricultural research. 1(4): 155-159.
16. Jitendra, K. T. and Devendra, U. (2011). Correlation and path – coefficient studies in tomato (*Lycopersicon esculentum* Mill). Research Journal of Agricultural sciences 2(1): 63-68.
17. Lenucci, M. S, Caccioppola, A., Durante, M., Serrone, L., Piro, G. and Dalessandro, G. (2007). Carotenoids content in ripe raw and processed (Sauce) berries of high pigment tomato hybrids. Acta Hortic 758: 173-180.
18. Mohamed, A.A (2010). Tomatoes, Lycopene and human health. Technology center of communications and information – Mansoura University.
19. Mohanty, B. K. (2002). Studies on variability, heritability, interrelationship and Path analysis in tomato. Am. Agric. Res., 33: 65-69.
20. Nandan, M. and Asati, B.S. (2008). Genetic Relationship of growth and development traits with fruit yield in tomato (Lycopersicon esculentum Mill) Karnataka J. Agric. Sci., 21(1): 92-96.
21. Rajasekhar, B.R., Siddeswar, D. R. Roddaiah, K., and Sunil, N. (2013). Studies on genetic variability, heritability and genetic advance for yield quality traits in tomato (*Solanum Lycopersicon* L.) Int. J. curr-microbiol. App. Sci. 2(9): 238-244.
22. Rangona, S. (1978). Manual of analysis of fruits and vegetable products. Tata. Megraw- Hill publication company limited, New Delhi, PP: 109-110.
23. Rashwan, A. M. A. (2015). Improvement of weight fruit and yield in Super strain-B cultivar of tomato (*Lycopersicon esculentum* Mill) by Mass selection. Journal of American Science. 11(9) P 45-50.
24. Rashwan, A.M.A. ((2016)). Mass Selection in tomatoes under the conditions of southern Egypt. Life Science Journal. 13 (1) P 48-55.
25. Rukhsar, A. D. and Sharma, J. P. (2011). Genetic variability studies of yield and quality traits in tomato (*Solanum Lycopersicon* L.) international journal of plant breeding and genetics 5(2): 168-174.
26. Saleem, M.Y., Asghar, M., Iqbal, Q., Rahman, A., Akram, M. (2013). Diallel analysis of yield and some yield components in tomato (*Solanum Lycopersicon* L.). Pak. J. Bot. 45 (4): 1247-1250.
27. Sally, A. M. (2012). Response of some new tomato hybrids to foliar spray with some organic macro and micro nutrients. Zagazig Agric. Res., Vol. 39 (5): 817-836.
28. Salvador, R., Ana, M.A., and Jaime, C.C. (2010). Evaluation of the genotype, environment and their interaction on carotenoid and ascorbic acid accumulation in tomato germplasm. J Sci. Food Agric; 91: 1014-1021.
29. Simon, J. A. (1992). Vitamin C and Cardiovascular disease: A review. J. Am. Coll. Nutr., 11: 107-125.
30. Sunil, K. Y., Singh, B. K., Baranwal, D.K, and Solankey, S. S. (2013). Genetic study of heterosis for yield and quality components n tomato (*Solanum Lycopersicon*).
31. Thompson, K.A., Marshall, M.R., Sims, C.A., Wei, C.I., Sargent, S.A, and Scott, J. W. (2000). Cultivar, Maturity and heat treatment on lycopene content in tomatoes. Journal of food science, 65: 791-795.

5/27/2016