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Effect of transplanting dates on fruit yield and related quality traits of tomato genotypes (*Lycopersicun escutentum* Mill.)

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Fruit yield, transplanting date, tomato genotypes

A B S T R A C T

In order to determine the effects of transplanting dates on morpho physiological traits of tomato genotypes, an experiment conducted in Kahriz station during 2010-11 at two years. The experiment was split plot based on randomized complete blocks design with three replications. Five genotypes including Early Urbana-Y, Primo Early, Chef, Early Urbana-VF and L-144 arranged at main plots, three transplanting dates including 20 May, 5 June and 20 June were as subplots. Combined analysis of variance indicated that interactions between year, transplanting date and genotype on plant height, fruit yield, fruit weight, number of fruit at per plant, fruit diameter and total soluble solids were statistical significant differences. The most fruit yield with 91 and 78t/ha were achieved in L-144 and Early Urbana-Y at 20 May transplanting date, respectively. Simple correlation coefficient between traits showed that fruit yield was positive significant correlation with number of fruits at per plant ($r=0.66^{**}$). Expect of Chef cultivar, fruit yield reduced with delaying in transplanting dates. At 20 June Chef with 73t/ha fruit yield and 5.46% soluble solids had the highest values. It is conclude that Chef cultivar is recommended for second cropping systems in cold regions.

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important edible and nutritious vegetable crops in Iran. It belongs to the family of *Solanaceae* (Rani Das *et al*., 2011). Tomato originated from Latin America, more precisely from Peru, Bolivia and Ecuador. The origin species of varieties and cultivated forms nowadays is *Lycopersicon esculentum* var. cerasiforme, which was used, in Mexico, in 200 B.C., first as a medicinal plant and then as edible plant (Indrea *et al*., 2007). According to statistics issued by the World Processing Tomato Council (WPTC, 2010) the total world production of tomatoes in 2009 was 4.23 million tons, with the main production areas being the valley of California (Hanson and May, 2006).

Tomatoes need plenty of sun, water and heat, especially in short season areas. In order to generate enough energy to product fruit, the tomato plant needs at least seven hours of sunlight at per day (Bauer, 2009). Proper growth and development in tomato plants is possible at optimal atmospheric and soil conditions. The best temperature for growing tomato is 20-27^{0}C. When average temperature exceeds 30^{0}C or fall below 10^{0}C, fruit setting is poor (Hanson *et al.*, 2000).

Introduction of varieties with promising characters, have been important for vegetables industry, throughout the world. Tomato cultivars differ in fruit characteristics (e.g. size, color, shape, flavor, and intended use), earliness (early, mid, and late season), growth habit (determinate and indeterminate), and disease resistance (Wessel-Beaver, 1992). Ivakin, (1977) reported that tomato cultivars differed for heat and drought tolerance. Ermolova, (1982) observed that "Octyabr" a mid late variety of tomato attained the height of 65-70cm and produced 300-400g fruit weight.

Studies show that some cultivars have a greater adaptation, while others provide a valuable source for breeding material. Hussain *et al*., (2001) in a comparative study of local and exotic cultivars of tomatoes screened high yielding varieties that were suitable to their agro-climatic conditions.

Cremachi *et al*., (2010) evaluated the effects of three transplanting dates of 25 July, 17 August and 18 September on phonology and production of 4 greenhouse tomato hybrids. They reported that plants of third sowing date had the highest plant and fruit size; while, first planting date had early production with smaller fruits. Early production for higher prices is important in many areas of tomato production. Early planting dates often do not produce fruit much sooner than late planting when temperature is unfavorable (Dufault and Melton, 1990).

In west Azerbaijan province of Iran tomato varieties are transplanted from late May to mid-June in order to escape from the last killing frosts and spring precipitation. However, abiotic stresses during stand-establishment phase may delay plant development and obstruct any benefit to earliness. This experiment conducted to investigate the best transplanting date for planted tomato cultivars of this aria.

Material and methods

Experimental location: The experiment was carried out at Kahriz agricultural research station of west Azerbaijan province, Iran during two growing seasons of 2010-11. The station was located in latitude 45°, 10′ east, longitude 37°, 5' north and 1325m altitude. Soil texture was sandy loam with pH=8.2 and 0.81ds/m electrical conductivity (Table 1).

Experimental design: A split plot experiment was conducted based on randomized complete blocks design with three replications under field conditions. Five cultivars including Early Urbana-Y, Primo Early, Chef, Early Urbana-VF and L-144 arranged at main plots and three transplanting dates of 20 May, 5 June and 20 June were as subplots. Mean daily air temperature at 20 May transplanting date in first and second years was 16.2ºC and 17.2ºC, respectively. Also, 5 June mean daily air temperature was 26.3 and 20.6 ºC at two experimental years. Finally, at 20 June it was 23.4 and 24ºC. Other metrological parameters are in table 2.

Agronomical practices: Seeds prepared from seed and plant improvement institute of Iran and planted at single rows. When seedling had 4 to 5 true leaves and forty days old transferred into the field. Before planting, one-third of nitrogen fertilizer and total of potassium, phosphor and soleplate of iron and magnesium, zinc, cupper based on soil analysis (Table 1) was mixed with soil at late April. Then soil was ploughed and disked. Row distances were 120cm. Two-thirds of remaining nitrogen was added before flowering and fruit formation stages. Cultivars and dates were arranged based on design. Each subplot had 3 rows with 5m length.

Measurement of traits: During growth period quantitative traits including: plant height, fruit per plant, fruit weight, fruit diameter, leaf size and days to first fruit maturity were determined from randomly selected six plants at each plot according to Tanksley, (2004). Fruit yield was measured from each harvest and total plots by (Al-Aysh *et al*., (2012). Total soluble solid was recorded by Majidi *et al*., (2011), fruit pH was measured by Ajayi and Olasehinde, (2009) as related qualitative traits. Combined analysis of variance for traits of two years was done with MSTATC software. Means were compared with Duncan's multiple range tests. Simple correlation coefficients of traits were done with SPSS 18 software.

Results and Discussion

Combined analysis variance revealed that interaction between transplanting date and cultivar was significant for traits of fruit yield, fruit per plant, fruit weight, soluble solids and plant height (Table 3). Also it showed that three way interactions between year, cultivar and transplanting date had significant effects on fruit weight, plant height and fruit diameter. With recognizing precision transplanting date it can be used in cropping systems. Rani Das *et al*., (2011) in evaluating four sowing times in two cultivars showed that 9 November sowing time for sugar, organic acid, ascorbic acid and β-carotene contents of fruits at both cultivars had the highest values and Ratan was better than Roma cultivar. In Hussain *et al*., (2001) experiment fruit yield was varied in different tomato cultivars. Researchers revealed that to evaluation of varieties under field conditions must be conducted over the years to minimizing experimental errors (Goncalves *et al*., 2003).

Fruit yield and its components

Transplanting L-144 at 20 May with more than 91.t/ha had the highest value and Early Urbana-VF at 20 June with more than 50t/ha fruit yield had the lowest value (Table 4). Genotypes of L-144 and Chef at 20 may transplanting date were 48 and 29 fruit per plant, respectively.

Early Urbana-Y and Early Urbana-VF at transplanting dates of 5 and 20 June had 133 and 72g average fruit weight in 2011, respectively (Table 6). With increasing fruit number at per plant decreased fruit weight. At two years high fruit size with more than 5cm diameter obtained from Early Urbana-Y and Chef at transplanting date of 5 June. Genotype of L-144 at first year in transplanting dates of 20 June and 20 May and at the second year 20 June transplanting date with 3.7cm fruit diameter was the lowest fruit size. Also, Early Urbana-Y at 20 May at second season had the minimum value (Table 6). Fruit yield is the most important agronomical and complex trait in tomato. It is influenced by genetic and environmental effects, such as numerous abiotic (Foolad and Lin, 2001) and biotic stresses, applied agro-technical procedures (Kaskavalic, 2007) and growing location (Yoltas *et al.*, 2003). From three first fruit harvesting time, Primo Early at 20 May had the highest fruit yield with (18.66t/ha). Flowering initiation was delayed at L-144, but fruit setting synchronized with other genotypes. Fruit setting in 20 May transplanting date was delayed at Chef Genotype (Table 5).

Fruit quality

Early Urbana-VF at 20 June transplanting date with 5.8% and Early Urbana-Y at 5 June transplanting date with 5.1% had the most and lowest total soluble solids, respectively (Table 4). Soluble solid is one of the most important quality traits in processing tomato. 50% to 65% of soluble solids contents are sugars, glucose and fructose and their amount and proportion influences the organoleptic quality of tomatoes (Adedeji *et al*., 2006). Remaining soluble solids are mainly citric and malice acids, lipids and other components in low concentrations. Purkayastha and Mahanta, (2011) reported that soluble solids varied in genotypes from 4.1 to 5.9%. High total soluble solids are desirable to higher yield of processed products.

Cultivars were also differed in terms of fruit pH. Chef with 3.84 was the highest and Early Urbana-VF and L-144 with 3.78 and 3.75 were the lowest pH, respectively. Agong *et al*., (2001) introduced pH and soluble solids as the main criteria for assessing related quality traits in tomato. They emphasized botulism disease delayed in tomato products at lower pH than 4.5. In ripen fruits acid content was high enough to prevent botulism diseases.

Plant characters

Line L-144 at 20 June in 2011 season with 57cm length had the highest plant height and Primo Early with about 32cm was the lowest value (Table 6). Lerner, (2009) reported that short height cultivars take low spacing at field conditions, therefore with increasing plant density arise fruit yield. Also, these cultivars have determinate growth, similar maturities and selected for mechanized cultivation. Transplanting date at 20 June with producing 6cm leaflet length and 3.1cm leaflet wide had high leaf area (Table 7).

Correlation coefficient of traits

Fruit yield with fruit per plant ($r=0.66^{**}$) and fruit diameter ($r=0.20^{*}$) were positive and with soluble solid ($r=-0.22^{*}$) was negative significant differences (Table 8). Tomato fruit yield is obtained from multiplied plant density, number of fruit at per inflorescence and fruit weight (Zdravkovic *et al.*, 2011). With increasing one of them reduce other traits.

Number of fruits at per plant were positive correlated with fruit diameter ($r=0.26^{**}$). Golani *et al.*, (2007) showed that fruit yield with number of fruits at per plant was correlated positively significant but contrary related with fruit weight. Blay *et al.*, (1998) stated that number of fruits at per plant had the most important effect on fruit yield. At this experiment by increasing it decreased fruit weight ($r=-0.35^{**}$) and pH ($r=-0.19^{*}$). Therefore, genotypes with more fruits had low pH.

Soluble solid with fruit weight ($r=-0.23^{*}$) and fruit diameter ($r=-0.54^{**}$) and fruit yield ($r=-0.22^{*}$) were negatively significant differences. Thus, with increasing number of fruits at per plant increased fruit soluble solid and in heavy and large tomatoes decreased total soluble solid. Researchers also reported negative correlation between fruit weight and total soluble solid (Golani *et al.*, 2007).

Table.1 Soil characteristics of experimental location of Kahriz station

Phosphorus (%)		Potassium (%)	Organic carbon (%)		Electrical conductivity (ds/m)		Soil saturation (%)
8.3		195	0.77		0.81		27
Cupper (mg)	Zinc (mg)	Magnesium (mg)	Iron (mg)	Clay (%)	Loam (%)	Sand (%)	pH
1.18	0.68	5.54	3.94	11	39	50	8.2

Table.2 Meteorological parameters of agricultural research of Kahriz station

Month	Precipitation(mm)		Relative humidity (%)		Minimum absolute temperature (ºC)		Minimum temperature of soil surface (ºC)	
	2010	2011	2010	2011	2010	2011	2010	2011
April	32.5	69.1	56	48	4.7	5.6	0.9	1.5
May	131.3	73.1	65	57	9.1	9.2	0.6	6.1
Juan	21.4	41.5	45	56	15.3	14.0	11.5	10.4
July	0.0	14.6	42	48	18.9	18.7	15.0	15.0
August	0.0	15.7	39	47	17.9	19.6	14.0	15.9
September	5.3	1.7	47	51	16.1	14.5	12.3	10.6
October	3.7	21.1	49	59	11.4	9.4	7.3	5.4
November	4.4	61.5	53	68	1.0	1.5	-0.5	-1.0

Table.3 Combined mean square traits of tomato cultivars under field conditions at two 2010 and 2011 years

SOV	df	Mean squares								
		Fruit Yield	Fruit/plant	Fruit weight	pH	Soluble solid	Plant height	Leaf wide	Leaf length	fruit diameter
Year	1	1778.48**	114133.61^{ns}	852.54^{ns}	0.000^{ns}	12.10**	71.11^{ns}	0.08^{ns}	1.82^{ns}	47.67**
Rep(Year)	4	81.34	78093.14^{ns}	570.22^{ns}	0.009^{ns}	0.23^{ns}	138.21*	0.72	0.21	0.56
Genotype	4	570.49**	186927.40**	648.07^{ns}	0.022*	0.38**	636.37**	0.26^{ns}	1.81^{ns}	0.53^{ns}
Genotype x Year	4	1143.56**	327274.22**	432.60^{ns}	0.009^{ns}	0.18^{ns}	2.02^{ns}	0.01^{ns}	0.31^{ns}	0.99**
Error	16	133.24	28952.14	243.37^{ns}	0.007	0.08	36.72	0.26	1.04	0.23
Transplanting date	2	1656.4^{2**}	17281.11^{ns}	547.60*	0.001^{ns}	0.14^{ns}	164.31**	0.46^{ns}	3.83**	0.17^{ns}
Transplanting date x year	2	22.20^{ns}	4552.59^{ns}	517.64*	0.000^{ns}	0.05	14.44^{ns}	0.06^{ns}	0.32^{ns}	0.88**
Transplanting date x genotype	8	432.56**	101576.25**	474.77**	0.003^{ns}	0.25**	75.63*	0.22^{ns}	0.27^{ns}	0.34^{ns}
Transplanting date x year x genotype	8	98.64^{ns}	2473.10^{ns}	396.62*	0.007^{ns}	0.08^{ns}	5.98*	0.07^{ns}	0.09^{ns}	0.41*
Error	40	87.50	15917.99	162.71	0.007^{ns}	0.09	28.74	0.18	0.44	0.20
Coefficient of variation (%)		11.26	12.05	13.36	2.25	5.52	12.36	14.47	11.45	12.36

ns, * and **: were not significant and significant at 0.05 and 0.01 probability levels, respectively

Table.4 Mean comparison of interaction between transplanting date and tomato genotypes

genotype × transplanting date	Fruit yield (t/ha)	Fruit/plant	Soluble solid (%)
Early Urbana-Y×20 May	78.01b	36.90bc	5.30be
Early Urbana-Y×5 June	72.61bc	36.98bc	5.10e
Early Urbana-Y×20 June	62.98c	31.7ce	5.36be
Primo Early×20 May	69.55bc	30.49de	5.30be
Primo Early×5 June	64.62c	31.22ce	5.53be
Primo Early×20 June	65.86c	31.57ce	5.13de
Chef×20 May	69.00bc	29.30e	5.23ce
Chef×5 June	65.14c	35.02bd	5.23ce
Chef×20 June	73.67bc	38.72b	5.46ae
Early Urbana - VF×20 May	70.88bc	33.73be	5.20ce
Early Urbana- VF×5 June	66.63c	35.25bd	5.53ad
Early Urbana - VF×20 June	52.46c	31.79ce	5.85a
L144×20 May	91.78a	48.02a	5.66ab
L144×5 June	72.50bc	36.33bc	5.53ad
L144×20 June	62.95c	36.69bc	5.55ac

Means with the same letters in each column were not significant differences at 0.05 probability level

Table.5 Effect of transplanting date on initiation , fruit set and fruit yield of tomato genotypes in three first harvesting

Genotype × transplanting date	Start time		Fruit yield (t/ha)		
	Flowering	Fruiting	First time (20August)	Second time (1Sep)	Third time (11 Sep)
Early Urbana-Y×20 May	29 June	5 July	1.61	15.05	13.90
Early Urbana-Y×5 June	29 June	4 July	0.83	2.63	7.89
Early Urbana-Y×20 June	15 July	21 July	0.00	0.81	3.22
Primo Early×20 May	29 June	5 July	2.92	18.66	16.71
Primo Early×5 June	3 July	15 July	0.58	15.30	12.39
Primo Early×20 June	7July	19 July	0.00	0.69	9.83
Chef×20 May	29 June	5 July	3.90	15.77	8.25
Chef×5 June	29 June	16 July	0.42	3.86	19.39
Chef×20 June	20 July	24 July	0.00	025	19.41
Early Urbana- VF×20 May	29 June	5 July	2.61	7.11	12.83
Early Urbana- VF×5 June	29 June	12 July	1.86	2.06	7.75
Early Urbana- VF×20 June	15 July	19 July	0.00	1.14	3.50
L144×20 May	3 July	10 July	2.08	5.56	11.22
L144×5 June	3 July	10 July	0.25	1.03	4.08
L144×20 June	8 July	16 July	0.00	0.46	1.31

Table.6 Mean comparison of interaction between transplanting date× genotypes ×year

Genotype × transplanting date	Plant height (cm)		Fruit weight (g)		fruit diameter (cm)	
	2010	2011	2010	2011	2010	2011
Early Urbana-Y×20 May	42.10cd	43.66cd	105.7cf	89.8fi	4.07ei	4.06ei
Early Urbana-Y×5 June	42.35cd	41.66cd	97.0dh	133.1a	5.40ac	5.70a
Early Urbana-Y×20 June	44.24cd	41.83cd	105.0cf	77.6hi	3.80hi	3.70hi
Primo Early×20 May	38.40df	30.83f	103.7cf	98.9dh	4.66cg	4.73cf
Primo Early×5 June	38.63df	32.33ef	93.0di	112.1be	4.26ei	4.30ei
Primo Early×20 June	40.55ce	41.83cd	101.0dg	106.1cf	4.50eh	4.63dg
Cheff×20 May	42.51cd	43.66cd	122.7ac	114.4ad	4.63dg	4.70cg
Chef×5 June	42.74cd	40.83cd	84.3fi	126.5ab	5.30ad	5.46ab
Chef×20 June	44.66bd	45.16bd	89.3fi	102.8cf	4.83be	4.83be
Early Urbana- VF×20 May	44.20cd	45.50bd	100.3dg	91.8ei	4.23ei	4.40eh
Early Urbana- VF×5 June	44.43cd	44.00cd	103.7cf	86.0fi	4.03fi	3.96fi
Early Urbana- VF×20 June	46.35bd	44.33cd	92.0ei	72.2i	4.26ei	4.63dg
L144×20 May	46.33bd	45.33bd	93.6di	79.6gi	3.70i	3.90gi
L144×5 June	46.96bd	52.50ab	103.3cf	77.8hi	4.07ei	4.00fi
L144×20 June	48.88bc	57.16a	95.0bdh	89.2fi	3.76hi	3.76hi

Means with the same letters in each column were not significant differences at 0.05 probability level

Table.7 Mean comparison of transplanting date effect on tomato leaflet size

Transplanting date	Leaflet length (cm)	Leaflet wide (cm)
20 May	5.43b	2.92ab
5 June	6.09a	2.83b
20 June	5.99a	3.08a

Means with the same letters in each column were not significant differences at 0.05 probability level

Table.8 Simple correlation coefficient traits of tomato genotypes

Trait	Fruit yield (t/ha)	Soluble solid (%)	Fruit weight (g)	Fruit/plant	Plant height (cm)	Leaf length (cm)	Leaf wide (cm)	fruit diameter (cm)	fruit pH
Soluble solid (%)	-0.221*								
Fruit weight (g)	0.120	-0.233*							
Fruit/plant	0.667**	-0.028	-0.354**						
Plant height (cm)	0.039	0.169	-0.187	0.161					
Leaf length (cm)	0.077	-0.028	0.045	0.057	0.212*				
Leaf wide (cm)	0.099	0.064	0.079	0.068	0.235**	0.483**			
fruit diameter (cm)	0.202*	-0.545**	0.075	0.259**	-0.95	0.235**	0.270**		
Fruit pH	0.037	-0.163	0.197*	-0.198	-0.262**	-0.051	-0.016	-0.071	

* and **: were significant at 0.05 and 0.01 probability levels, respectively

Conclusion

Determination of suitable transplanting date of tomato is important to obtain early harvest and high yield of tomato. Also in second cropping system, after harvesting a major crop such as wheat, barley and canola, finding a proper variety with appropriate yield can be important in tomato production. Except of Primo-Early at first and second transplanting date, other genotypes had not significant effects on flowering initiation. Suitable fruit yield started from the second harvest.

The highest fruit yield (18.66t/ha) obtained from Primo-Early at the earliest transplanting date and it is recommended for early harvesting. Chef at second and third transplanting dates with more than 91t/ha at third harvest had the highest fruit yield and it was suitable for second cropping systems. In conclusion high total fruit yield obtained from L-144 at 20 May as first transplanting date. Early Urbana-VF at third transplanting date and L-144 at three transplanting dates had more total soluble solids than 5.5% and Chef at third transplanting date with 5.46% total soluble solids had the same value and suitable for processing tomato industry.

References

Adedeji, O., K. A. Taiwo, C. T. Akanbi and R. Ajani. 2006. Physicochemical properties of four tomato cultivars grown in Nigeria. Journal of Food Production Preceding. 30: 79-86.

Agong, S. G., S. Schittenhelm and W. Friedt. 2001. Genotypic variation of Kenyan tomato (*Lycopersicon esculentum* Mill) germplasm. Journal of Food and Technology. l: 13-17.

Ajayi, A. A. and I. G. Olasehinde. 2009. Studies on the pH and protein content of tomato (*Lycopersicon esculentum* Mill) fruits deteriorated by *Aspergillus niger*. Scientific Research and Essay. 4: 185-187.

Al-Aysh, F., H. Kutma, M. Serhan, A. Al-Zoubai and M. Abdelsalam Al-Naseer. 2012. Genetic analysis and correlation studies of yield and fruit quality traits in tomato (*Solanum lycopersicum* L.). New York Science Journal. 5: 142-145.

Bauer, M.,D. Barney and J. Robbins. 2009. Growing tomatoes in cool, short-season locations. The University of Idaho. Bulletin. 864: 1-7.

Blay, E. T., E Y. Danquah, S. KOffel and C. Kudadjie. 1998. Morphological and agronomic characterization of some tomato (*Lycopersicon esculenttom* Mill) in Ghana. Journal of Food Technology in Africa. 1: 13-17.

Cremaschi, G., R. Andreau, S. Martines, M. Garbi, G. Morelli and D. Bidondo. 2010. ISHS Acta Horticulturae 927: 1-2

Dufault, R. J and R. R. Melton. 1990. Cyclic cold stresses before transplanting influence tomato seedling growth, but not fruit earliness, fresh- market yield, or quality. Journal of American Society Horticultural Science. 115(4): 559-563.

Ermolova, E. V. and E. M. Kasymov. 1982. A new tomato variety. Horticultural Absteract. 55: 627.

Foolad, M. R and G. Y. Lin. 2001. Genetic analysis of cold tolerance during vegetative growth in tomato (*Lycopersicon esculentum* Mill). Euphytica. 122: 105- 111.

Golani, I. J., D. R. Mehta, V. L. Purohit, H. M. Pandya and M. V. Kanzariya. 2007. Genetic variability, correlation and pat coefficient studies in tomato. Indian Journal Agricultural Research. 41(2). 146-149.

Gonçalves, P. D. S., N. Bortoletto, A. L. M. Martins, R. B. D. Costa, P. B. Gallo. 2003. Genotype-environment interaction and phenotypic stability for girth growth and rubber yield of Hevea clones in São Paulo State, Brazil. Genetics and Molecular Biology. 26: 441-448.

Hanson, B. R. and D. M. May. 2006. Crop evapo-transpiration of processing tomato in the San Joaquin Valley of California, USA. Irrigation Science. 24: 211-221.

Hanson, P., J. T. Chen, C. G. Kuo, R. Morris and R. T. Opena. 2000. Suggested cultural practices for tomato. International Cooperators' Guide. www.avrdc.org.tw.

Hussain, S. I., K. M. Khokhar, M. H. Laghari and M. M. Mahmud. 2001. Yield potential of some exotic and one local tomato cultivars grown for summer production. Agricultural Research. 25: 65-6.

Indrea, D., S. Al. Aphidean, D. N. Maniutiu and R. Sima. 2007. Cultura legumelor Editura Ceres, Bucuresti.

Ivakin, A. P. 1977. A study of heat resistance in vegetables crops. Plant Breeding Abstract. 45: 4984.

Kaskavatci, G. 2007. Effect of soil polarization and organic amendment treatments for controlling Meloidogyne incognita in tomato cultivars in Western Anatolia. Turkish Jurnal Agricultural Foresty. 31: 159-167.

Lerner, B. R. 2009. Tomatoes. www.agcom.purdue.edu/AgCom/Pubs /menu.htm.

Majidi, H., S. Minaei, M. Almasi and Y. Mostofi. 2011. Total soluble solids, titrable acidity and repining index of tomato in various storage conditions. Australian Journal of Basic and Applied Sciences. 5: 1723-1726.

Purkayastha, M. D and Mahanta. C. L. 2011. Physicochemical properties of five different tomato cultivars of Meghalaya and their suitability in food processing. African Journal of food Science. 5: 657-667.

Rani Das, M., M. M. Tofazzal Hossain, M. M. Sultana, S. H. M. Golam Sarwar and M. H. R. Hafiz. 2011. Effect of different sowing time on the quality of tomato varieties. Bangladesh Research Publish Journal. 6(1): 46-51.

Tanksley, S. D. 2004. The genetic developmental and molecular bases of fruit size and shape variation in tomato. The Plant Cell. 16: 181-189.

Wessel-Beaver, L. 1992. Genetic variability of fruit set, fruit weight, and yield in a tomato population grown in Two high-temperature environments. Journal Amer Society. Horticultural Science. 117:867-870.

World Processing Tomato Council (WPTC). 2010. World production estimate as of 2 February 2010. http://www.wptc.to/releases/releases.

Yoltas. T, N. Bas, I. Vyral, O. Sedarouglu and A. C. Aydin. 2003. The determination of agronomical and technological produced to the production in Marmara region (Turkey) and reaction to infections by the agents of diseases. Acta Horticultural. 478: 361-366.

Zdravkovic. J., N. Pavlovic, Z. Girek, M. Brdar- JJokanovic, D. Savic and D. Cvikic. 2011. Generation mean analysis components and yield in tomato (*Lycopersicon esculentum* Mill). Pakistan Journal Botany. 43(3): 1575- 1580.