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MORPHOLOGICAL VARIATION AMONG TOMATO GERMPLASAMS

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Abstract

Eleven tomato genotypes AVTO-9708, AVTO-1288, AVTO-1289, AVTO-1405, AVTO-1409, AVTO-1418, AVTO-1420, AVTO-1424, AVTO-1429, AVTO-1455, and AVTO-1456 received from AVRDC (The World Vegetable Center) were evaluated at Agriculture Research Station, Mingora Swat, Pakistan during 2015. Germination percentage, days to first flowering, days to first fruiting, days to first fruit ripening, internode length, leaf length, leaf width, and stem diameter were studied during the experiment. Higher germination (91.3 %) war recorded in AVTO-1288. Early first flowering (51.7) and first fruit ripening (87.7) was observed in AVTO-1405 whereas early first fruiting (61.3) was recorded in AVTO-1409. The lengthy leaves (7.0 cm) and wider leaves (3.8 cm) were recorded for AVTO-1405, while bigger stem diameter (1.9) was recorded for AVTO-1456. These genotypes should be further studied for desired character and may be exploited in future breeding program.

Key words: Tomato, Germplasms, Morphology and Yield

INTRODUCTION

Tomato (*Lycopersicon esculentum L.)* is one of the most important edible and nutritious vegetable crops in the world. It belongs to family solanaceae and ranks next to potato because of high yielding, better adaptability and multipurpose uses. Tomato is cultivated and used all over the world (Khan et al., 2016). It is widely cultivated in tropical, sub-tropical and temperate climate and thus rank third in term of world vegetable production. The leading tomato producing countries are China, the United States of America, India, Egypt, Turkey, Iran, Mexico, Brazil and Indonesia (FAO, 2006). The total area under tomato cultivation in Pakistan during 2014-2015 is 60.7 ha while in Khyber Pakhtunkhwa province it is 13.3 hac. The annual production of tomato in Pakistan is estimated to be around 9.4 ton/hac, while in Khyber Pakhtunkhwa, it is about 9.9 tons/hac .(Agricultural statistics of Pakistan 2014-2015). Tomato is frequently used vegetables in many countries providing several plants nutrients and also provides nutritional value to human diet (Willcox et al., 2003). The crop requires warm weather and much sunshine for healthy growth and better performance. At lower temperature, the vegetative and reproductive growth is limited. Exposure of tomato to 30 C^0 or when the temperature fall below 10 ^{0}C so fruit sitting will be poor (Hanson *et al*., 2000). Plant grows well when supplied with adequate moisture and well-drained soil (Gould, 1992). In spite that progress has been made to increase the production of

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tomato crop at world level but access to adequate tomato crop is difficult this is because of poor cultural practices, poor storage facilities and lack of high yielding and better insects and pests resistant varieties. Organized study and screening of genotypes is important for current and future crop improvement (Reddy et al., 2013). Many parameters were used to identify variation among the genotypes such as morphological, biochemical, molecular primers. Morphological traits were used abundantly to identify variation among tomato genotypes (Mazzucato et al., 2008).

The aim of current study was to study tomato germplasms from different sources and to identify morphological diversity in order to obtain suitable genotypes for high yield and future breeding programs.

MATERIALS AND METHODS

The experiment was conducted at Agriculture Research Institute Mingora Swat during 2015. Randomized complete block design was use with 11 treatments replicated three times. Four week old nursery plants were transplanted by keeping 40 cm distance between rows and plants. Before transplantation the soil was analyzed for sand, silt, clay and for different organic constituents.

Tabe 1. Soil analysis of the experimental plots before transplantation of tomato seedlings.

Clay	3.6%	Nitrogen total	0.025%
Silt	53%	Lime	0.5%
Sand	43.2	Organic Matter	1.035%
Soil Structure	Silt loam	Mehlic-3 Exct K	74%
PH(1:5)	6.8	Mehlic-3 Exct p	10%

The Plot consisted of 4 rows of length 3 meter and width 1 meter and the number of plants per row was 10. Fertilizers such as DAP was applied at @ of 12 kg at the time of field preparation while urea at rate of 12 kg was applied immediately after first weeding using side dressing method. The plots were weeded manually at two, four and six weeks after transplantation. For insects control two types of insecticides were applied such as Match @ 2-3cc/L and Karate @ 2-3cc/L.

Data collection: Data were collected on yield contributing parameters such as Germination %, Days to first flowering, Days to first fruiting, Days to first fruit ripening, internode length, leaf length, leaf width and stem diameter.

Statistical analysis: The data recorded were subject to statistical analysis in randomized complete block design as per procedure outlined by Jan et al. (2009) by using software STATISTIX 8.1. Mean comparison was done using least significant test at 5 % level of significance.

RESULTS AND DISCUSSION

Germination %: Germination data was collected by counting the number of germinated seeds by comparing it with the number of seeds sown. The data related to germination percentage is given in Table 1. The analysis of the data shows that maximum seed germination (91.3 %) was recorded in AVTO 1288 which was statically par with germination percentage (88.3, 86.0, 84.0, 83.3) for tomato genotypes AVTO-14098, AVTO-1405 AVTO-9708 and AVTO-1409, respectively while the lowest germination (6.0%) was recoded in AVTO-1424. The lowest germination (6.0%) observed in AVTO-1424 could be because of high salinity as the high salinity facilitate the intake of toxic ions and decreasing the absorption of water which changes certain enzymatic and hormonal activities resulting in poor germination percentage. Similar results in variation of seed germination was recorded by (Kaveh et al., 2011) due to high salinity.

Days to first flowering: Days to first flowering data was taken by counting the number of days from transplantation till to first flower appearance and their related data is given in Table 1. The statistical analysis of data show that there was significant variation among the studied tomato genotypes. Among the studied tomato genotypes, more number of days to first flowering (61.0) was taken by tomato genotype AVTO-9708 which was statistically par with days to first flowering (60.7, 60.0 59.3, 58.0) observed in tomato genotypes AVTO-1288, AVTO-1455, AVTO-1456 and AVTO-1429 respectively, while minimum days to first flowering (51.7) was taken by tomato line AVTO-1420. The least days taken by AVTO-1420 was because of its better general growth, morphology and better standing ability. Our results are in agreement with Naz et al. (2011) as they reported the same results in relation to flowering in different tomato cultivars.

Days to first fruiting: Days to first fruiting data was taken by counting the number of days from flowering till to first fruiting. The statistical analysis of data (Table 1) revealed significant variations among the studied tomato genotypes. that the maximum days to first fruiting (75.0) was taken by tomato line AVTO-9708 which was statistically at par with tomato genotypes AVTO-1429, AVTO-1455, AVTO-1420 and AVTO-1288 (74.7, 73.3, 72.7, 71.0, respectively). The minimum days to first fruiting (51.7) was recorded by tomato genotype AVTO-1420. The minimum days to first fruiting taken by AVTO-1420 was because it has flowers early as compared to the rest of the tomato genotypes. Our results are in accordance with previous work done by Khokar et al. (2002) as they observed time variation in fruit sitting in various tomato cultivars.

Days to first fruit ripening: The data regarding days to first fruiting ripening was taken by counting the number of days from ripening till to first fruit ripening and their related data is given in Table 1. The statistical analysis of the data showed that fruit ripening was delayed (106.0) by tomato genotype AVTO-1420 which was statically at par with tomato genotypes AVTO-1418, AVTO-1455, AVTO-1409, and AVTO-1288 (103.3, 103.0, 100.7, 100.3, respectively). The early fruit ripening (87.7) was observed in tomato line AVTO-1405. There was significant difference in the traits of tomato genotypes at fruit ripening that is why line AVTO-1405 taken least days to fruit ripening as compared to the rest of tomato genotypes. Our results are agreement with Zahedi et al. (2012) who also reported substantial variations in days to first fruit ripening in different genotypes of tomato.

Table 1. Mean table for Germination %, Days to first flowering, Days to first fruiting, Days to first fruit ripening.

Tomato genotype	G %	DTFF	DTFF	DTFFR
AVTO 9708	91.333 a	61.000 a	75.00 a	106.0 a
AVTO 1288	88.333 ab	60.667 a	74.66 a	103.3 ab
AVTO1289	86.000 bc	60.000 a	73.33 ab	103.00 ab
AVTO 1405	84.000 c	59.333 a	72.66 ab	100.67 bc
AVTO 1409	83.333 c	58.00 ab	71.33 ab	100.33 bc
AVTO 1418	59.667 d	57.33 abc	71.00 ab	100.00 bc
AVTO 1420	55.000 e	56.66 abc	70.0 abc	97.67 cd
AVTO 1424	50.000 f	52.667 bc	70.0 abc	95.67 cde
AVTO 1429	50.000 f	52.667 bc	68.33 bc	93.00 de
AVTO 1455	40.000 g	51.667 c	65.33 cd	91.00 ef
AVTO 1456	6.000 h	51.667 c	61.33d	87.67 f
$LSD_{0.05}$	4.096	5.78	0.593	5.134

G %: germination percentage, DTFF: Days to first flowering, DTFF: Days to fruiting, DTFFR: Days to first fruit ripening.

Internode length: Internode length was taken with measuring tape and the its data is mentioned in Table.2 showed that highest internode length (7.6 cm) was recorded in tomato genotype AVTO-1424 which was statistically similar to tomato genotypes AVTO-1456, AVTO-1289, AVTO-1288 and AVTO-1405 with internode lengths (7.2, 7.1, 6.5, 6.4 cm, respectively). The least internode length (4.9 cm) was recorded in AVTO-1420. The highest internode length resulted in AVTO-1424 was because of well

watering which have increased the internode length as compared to moderate and severe stressed plants. Our results are supported by Sibomana et al. (2013) as they reported that when the water availability is limited so vegetative growth of the plant including stem diameter and internode length is reduce.

Leaf length: leaf length was taken with measuring tape and its data is mention in Table 2). The statistical analysis of the data showed that maximum leaf length (7.0 cm) was recorded in tomato line AVTO-1405 which statistically par with fruit length (6.8 6.6, 6.3, 6.1) recorded in tomato genotypes AVTO-1289, AVTO-1424, AVTO-1409 and AVTO-1288. While the lowest leaf length (4.9 cm) was observed in AVTO 1456. The lowest leaf length recorded in AVTO-1456 might be due to the less food assimilated by the mention tomato line which resulted in lowest leaf length. Our result are in accordance with (Ali et al., 2012) as they reported variation in leaf length by evaluating different tomato hybrids.

Leaf width: Measuring tape was used for taking leaf width and its data is given is (Table 2). The analysis of the data showed that maximum leaf width (7.0 cm) was recorded in AVTO-1405 which statically par with leaf width (6.8, 6.6, 6.3, 6.1cm) observed in tomato genotypes AVTO-1289, AVTO-1424, AVTO-1409 and AVTO-1288, respectively. The least leaf length (4.9 cm) was recorded in in genotype AVTO 1456. The lowest leaf width reported in tomato line AVTO-1456 could be due to the more sowing depth of the given tomato seedlings which result in absorption of more phosphorus from soil which interfere with absorption of Mn, Fe and Zn as they are necessary for leaf width, photosynthesis and other vegetative growth. Our results are in agreement with (Abebaw *et al*., 2016) as reported variation in leaf width due high sowing depth of different tomato genotypes.

Stem diameter: The data of stem diameter was taken with vernier caliper which is mention in Table 2. The statistical analysis of the data shows that maximum stem diameter (1.9 cm) was observed in AVTO-1456 which was statistically at par with stem diameter (1.6, 1.5, 1.4 1.3 cm) observed in tomato genotypes AVTO-9708, AVTO-1409, AVTO-1288 and AVTO-1289, while the lowest stem diameter (1.2 cm) was observed in tomato line AVTO-1424. The lowest stem diameter recorded in line AVTO-1424 could probably due to the water stress experienced by the given tomato line because water stress causes lower rate of stem thickness as compared to well-watered plants. Our results are in agreement with (Goldhamer and Fereres, 2001) as they observed the same variation in stem diameter in different tomato genotypes.

Table 2.Mean values for Internode length, Leaf length, Leaf width and Stem diameter of different tomato lines.

Tomato genotypes	IL (cm)	LL (cm)	LW (cm)	SD (cm)
AVTO 9708	7.6400 a	6.9667a	3.8600 a	1.8833 a
AVTO 1288	7.2367 ab	6.7800 ab	3.6333 ab	1.6867 ab
AVTO1289	7.0900 abc	6.6067 abc	3.4533 abc	1.6133 abc
AVTO 1405	6.9667 abcd	6.2633 abcd	3.4500 abc	1.5867 abcd
AVTO 1409	6.5167 bcd	6.1400 abcde	3.4000 abc	1.5333 abcd
AVTO 1418	6.4800 bcd	5.6133 bcdef	3.2967 abc	1.4533 bcd
AVTO 1420	6.3867 bcd	5.5200 cdef	3.0933 abc	1.4200 bcd
AVTO 1424	6.3600 bcd	5.5067 cdef	3.0667 abc	1.4067 bcd
AVTO 1429	6.1533 cd	5.3133 def	2.7633 bc	1.3600 bcd
AVTO 1455	5.9900 d	4.9000 ef	2.7367 c	1.2833 cd
AVTO 1456	4.9133 e	4.8667 f	2.7000 c	1.2400 d
$LSD_{0.05}$	1.034	1.248	0.875	0.360

IL: Internode length, LL: Leaf length, LW: Leaf Width, SD: Stem Diameter.

CONCLUSION

It is concluded that sufficient genetic diversity is available at phenotypic level which provide an opportunity for selecting desired traits. Based on the results it is concluded from the experiment that tomato line AVTO 1405 is found to be the best line

because of early flowering, early fruiting, early fruit ripening and lengthy and wider leaves.

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