ADAPTABILITY OF TOMATO ADVANCE LINES IN TEMPERATE CLIMATE

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Abstract

An experiment “with objective to check the adaptability and yield of advance tomato lines” was conducted at Agriculture Research institute, Mingora Swat, Pakistan during 2015. Data was recorded on yield contributing parameters like fruit length, fruit width, single fruit weight, number of fruit cluster\textsuperscript{-1}, number of cluster plant\textsuperscript{-1}, number of fruits plant\textsuperscript{-1}, Yield (t/ha), plant height, moisture % and TSS. The highest fruit length (6.4cm) and number of fruit cluster\textsuperscript{-1} (4.2) was recorded in tomato genotype AVTO 9708. Highest fruit width (6.3cm), single fruit weight (131.7gm) and plant height (79.4cm) was recorded in tomato line AVTO 1429. Highest moisture content (96.5%), and TSS (5.1) was recorded in tomato AVTO 1288. Maximum number of fruit plant\textsuperscript{-1} (43) was obtained in tomato genotype AVTO 1424, highest yield was recorded in AVTO 1288, while the lowest yield was recorded in AVTO 1456 and maximum number of cluster plant\textsuperscript{-1} (20.6) was recorded in tomato genotype AVTO 1420. It can be concluded from the results that AVTO 1429 and AVTO 9708 tomato lines showed good performance. This is the 1\textsuperscript{st} year evaluation. It can be further evaluated for registration and approval of variety. These lines may also be used in future breeding program.

Key Words: Tomato, Advance line, Adaptability and Yield

INTRODUCTION

Tomato is one of the most important vegetable crop next to potato because of its wider adoptability, high yielding ability and multipurpose uses (Redday et al., 2013). Tomato is cultivated and consumed in most parts of the world, from home gardens and greenhouse to large commercial farms due to its wider adaptability to various agro climatic condition (Agyeman et al., 2014). The total area under tomato cultivation in Pakistan in 2011-2012 is 52.3 hectares while in Khyber Pakhtunkhwa province it is 12.6 hectares. The annual production of tomato in Pakistan is estimated to be around 530,000 tons’ hectares, while in Khyber Pakhtunkhwa, it is about 114.9 tons hectares. (Agriculture statistics of Pakistan 2011-2012). In Pakistan, tomato is consumed in diverse ways, including raw, as an ingredient in many dishes, sauces, salad and drinks. Tomatoes is a rich source of minerals, vitamins, essential amino acids, sugars and dietary fibers. It contains much vitamin B and C, iron Lycopene and phosphorus (Naika et al., 2000).

Tomato is annual plant which can reach to a height of over two meters. The first harvest is possible 45-55 days after flowering or 90-120 days after sowing (Iqbal et al., 2011). The best temperature
for higher yield and better adaptability of tomato is 20-27°C, when the temperature exceeds from 30°C or fall below 10°C, so fruit sitting is poor (Hanson et al., 2000). For better adoptability tomato crops prefers deep, well drained sandy loam soil with a pH range of 6.0-7.0. (Patel et al., 2015). In spite of the progress made in increasing tomato production at global level, approximately half of the population in the third world does not have an access to adequate tomato supplies. This could be due to the lack of high yielding varieties and poor management practices. There is not worth mention variety or hybrid in Pakistan and most of the seeds are imported. The imported seeds sometime cause huge losses to the grower because of poor adaptability.

Keeping in view the importance of tomato in our daily life. The present research was carried out to evaluate different tomato lines for adaptability and yield and to identify high yielding and better tomato line.

MATERIAL AND METHOD

The experiment was carried out at Agriculture Research Institute Mingora Swat during spring 2015. Using Randomize Block Design (RCBD) with 11 treatments replicated three times. Four week old nursery was transplanted keeping 40 cm distance between plants and rows. The soil was being analyzed for different chemical composition before transplantation (Table: 1)

<table>
<thead>
<tr>
<th>Sand</th>
<th>44.4%</th>
<th>OM</th>
<th>1.035%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt</td>
<td>52%</td>
<td>Lime</td>
<td>0.5%</td>
</tr>
<tr>
<td>Clay</td>
<td>3.6%</td>
<td>Total N</td>
<td>0.025%</td>
</tr>
<tr>
<td>Soil structure</td>
<td>silt loam</td>
<td>Mehlic-3 Ext P</td>
<td>12ppm</td>
</tr>
<tr>
<td>PH(1:5)</td>
<td>6.8</td>
<td>Mehlic-3 Ext K</td>
<td>72ppm</td>
</tr>
</tbody>
</table>

Each plot consisted of 4 rows of length 3 meter and width 1 meter and the number of plants per row was 10. Compound fertilizer DAP at rate of 10 kg was applied immediately after first weeding using side dressing method. The plots were manually weeded at two (2), four (4) and six (6) weeks after transplanting. Insecticides applied were Karate @ 2-3cc/L, Match @2-3cc/L. Staking was done after obtaining healthy vegetative growth for control of logging.

Data collection: The data collected on fruit length (cm), fruit width (cm), single fruit weight (gm), number of fruit cluster^-1, number of cluster plant^-1, plant height (cm) moisture content (%) and TSS (Brix^0). Ten plants at random were selected in each plot for recording the data. Total soluble solids were determined by hand refractometer.

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

Fruit length (cm): The statistical analysis regarding fruit length (Table 2) showed significant variation among the tomato genotypes. The highest fruit lengths (6.4 cm) was recorded in tomato genotypes AVTO 9708, which was statistically at par with fruit width (5.4, 5.1, 4.9, and 4.7 cm) observed in tomato genotype AVTO 1456. The highest fruit length of the mentioned genotypes could probably due to the better genetic structure and higher potential to transport photosynthetic materials for better fruit development. The results agree with Ali et al. (2012) who reported significant differences in fruit length among the studied tomato genotypes.

Fruit width (cm): The statistical analysis of the data (Table 2) revealed significant variations among the studied tomato genotypes. Among the studied tomato genotypes the highest fruit width (6.3 cm) was recorded in tomato AVTO 1429, which statistically at par with fruit width (5.4, 5.1, 4.9, and 4.7 cm) observed in tomato genotypes AVTO 1409, AVTO
9708, AVTO 1289 and AVTO 1424, respectively. While the lowest fruit width (4.5cm) was recorded in tomato genotype AVTO 1456. The highest fruit width recorded for AVTO 1429 is more closely associated with the leaf length and leaf width which were found greater for AVTO 1429 and AVTO 1405 which have provided maximum photosynthates for the developing fruits which resulted in highest fruit width and highest single fruit weight of AVTO 1429. Similar results are reported by El-Amin and Ali (2012) who evaluated six varieties of tomato for adoptability and yield in cold condition and found the significant difference in fruit width among all the studied tomato genotypes.

**Single fruit weight (g):** The highest single fruit weight (131.7g) (Table 2) was recorded in tomato genotypes AVTO 1429, which was statistically at par with single fruit weight (120.9, 96.9, 93.5, 79.1 and 78.1g) observed in tomato genotypes AVTO 1405, AVTO 1409, AVTO 9708, AVTO 1418 and AVTO 1288. While the lowest single fruit weight (53.8 g) was observed in tomato genotypes AVTO 1456. The highest single fruit weight obtained for AVTO 1429 is due to the greater leaf length and greater leaf width of AVTO 1429 which ultimately have absorb more sun light and have produced more photosynthates for AVTO 1429 resulted in highest single fruit weight. These result are in agreements with Chernet and Zibelo (2012) who evaluated nine varieties of tomato for fruit yield and yield components under the agro-climatic of western Tigray and found significant differences in single fruit weight among all the studied tomato varieties.

**Number of fruits cluster**: The highest number of fruits cluster (4.2) presented in Table 2 was recorded in tomato genotypes AVTO 9708, which was statistically at par with number of fruits cluster (3.9, 3.8, 3.2 and 3.1) observed in tomato genotypes AVTO 1456, AVTO 1424, AVTO 1420 and AVTO 1455 respectively. While the lowest number of fruits cluster (2.7) was observed in tomato genotypes AVTO 1405. The highest number of fruits cluster which is obtained in AVTO 9708 may be due to the difference in number of cluster plant and the percentage of flowers develop plant. The results are in accordance with El-Amin and Ali (2012) found significant differences in number of fruits cluster in different tomato lines under hot tropical condition.

**Number of cluster plant**: Data regarding number of cluster plant are shown in Table 2. The highest number of cluster plant (20.6) was recorded in tomato genotypes AVTO 1420, which statistically at par number of cluster plant (18.3, 17.8, 17.5, 16.6, 16.5 and 16.4) observed in tomato genotypes AVTO 1455, AVTO 1424, AVTO 1418, AVTO 1288, AVTO 1429 and AVTO 9708 respectively. Significant variation in number of cluster plant were reported by Regassa et al (2012) who evaluated nine tomato lines for yield and yield components. The number of cluster plant is related to the genetic variation between the tomato lines. As there was a greater genetic variation among the studied tomato lines therefore higher number of cluster plant was recorded in AVTO 1420.

**Number of fruits plant**: The highest number of fruits plant (43) (Table 2) was recorded in tomato genotypes AVTO 1424, which statistically at par with number fruits plant (36.3, 35.2, 33.9, 32.1 and 29.2) noted in tomato genotypes AVTO 1445, AVTO 1429, AVTO 9708, AVTO 1420 and AVTO 1418 respectively. The number of fruits plant is with the number of fruit cluster and fruit set percentage. This is in agreements with Regassa et al. (2015) who got the different number of fruits plant by evaluating different tomato lines. The results are also in agreement with Iqbal et al. (2011) as they evaluated the effect of nitrogen and phosphorus fertilizers on growth, yield and yield components tomato under the agro-climatic condition of Swat and they find significant difference in number of fruits plants among all the studied tomato genotypes.

**Plant height (cm):** The highest plant (74.9 cm) as shown in Table 2 was recorded in tomato genotypes AVTO 1429, which was statistically not different form plant height (70.603, 68.763, cm) observed in tomato genotypes AVTO 1455, AVTO 1424, respectively. El-Amin and Ali in 2012 found significant difference in plant height while evaluating different tomato lines. This parameter is known to be control genetically and the different line of tomato which were use in the experiment were differ from
one another in internode length and number of internode.

**Yield per ton per hectare:** Highly significant data show that maximum yield (27.000 ton⁻¹ hac⁻¹) was recorded in tomato line AVTO 1288, which statistically at par with yield (25.389, 24.33, 23.833, and 23.167 t ha⁻¹) recorded in tomato genotype AVTO 1418, AVTO 1429, AVTO 9708 and AVTO 1289, respectively. While the lowest yield (10.889 t ha⁻¹) was observed in tomato genotype AVTO 1456. Because of much better fertilizer and well environmental responsive genotype maximum yield was recorded in AVTO 1288. Similar result was obtained by Ali *et al.* (2012) by evaluating different tomato hybrids and found significant variation in yield among the studied tomato hybrids.

**Moisture content (%)**: The statistical analysis of the data (Table 2) shows that there was a significant variation in moisture content percentage. The highest moisture content (96.5%) was recorded in tomato genotypes AVTO 1288, which statistically at par moisture content (93.9, 92.6, 92.1, 92.0, 91.7 and 90.7%) observed in tomato genotypes AVTO 1405, AVTO 1455, AVTO 1456, AVTO 1429, AVTO 1409 and AVTO 1418 respectively. While the lowest moisture content (87.5%) was observed in tomato genotypes AVTO 1424. The highest moisture content obtained in AVTO 1288 is due more resistant to high temperature more tolerant to drought condition and thick skin of the fruit which have reduce the rate of transpiration in AVTO 1288. The results agree with said *et al.* (2014) who found significant differences in moisture content among 54 tomato lines.

**Total Soluble Solids (⁰Brix):** The highest TSS (5.1) as presented in Table 2 was recorded in tomato genotypes AVTO 1288, which statistically at per TSS (4.9, 3.7, 3.6, 3.5 and 3.4) was observed in tomato genotypes AVTO 1289, AVTO 1455, AVTO 1418, AVTO 1429 and AVTO 9708 respectively. While the lowest TSS (3.3) was observed in tomato genotypes AVTO 1456. The highest TSS value recorded in AVTO 1288 is closely associated with higher moisture content in the fruit. As the moisture content in AVTO 1288 is higher therefore its TSS value is also higher than the remaining tomato lines. This result is an accordance with *Said et al.* (2014) found substantial differences in TSS among 54 studied tomato genotype.

**CONCLUSION**

It is concluded that tomato genotype AVTO 1429 and AVTO 9708 exhibits good performance in term of highest fruit width, single fruit weight, plant height, fruit length and number of fruits cluster⁻¹. This should be further evaluated for registration and approval of variety. These tomato lines may be proved precious in future breeding strategy.

**ACKNOWLEDGMENT**

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Table 2. Fruit length, fruit width, single fruit weight, number of fruit cluster\(^1\), fruit Number of Cluster plant\(^1\), Number of fruit plant\(^1\), Plant Height, Moisture Content, Total Soluble Solid of advanced tomato lines under agro-ecological condition of Swat.

<table>
<thead>
<tr>
<th>Tomato genotype</th>
<th>FL (cm)</th>
<th>FW (cm)</th>
<th>SFW (gm)</th>
<th>NFC</th>
<th>NOCPP</th>
<th>NOFPP</th>
<th>PH(cm)</th>
<th>MC %</th>
<th>TSS</th>
<th>Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVTO 9708</td>
<td>6.4 a</td>
<td>5.1 bc</td>
<td>93.5 bc</td>
<td>4.2 a</td>
<td>16.4 ab</td>
<td>33.9 abc</td>
<td>58.327 bc</td>
<td>92.6 ab</td>
<td>3.4 f</td>
<td>23.833 ab</td>
</tr>
<tr>
<td>AVTO 1288</td>
<td>6.0 abc</td>
<td>4.7 cd</td>
<td>78.1 bcd</td>
<td>2.9 d</td>
<td>16.6 ab</td>
<td>25.0 abc</td>
<td>54.3478 bc</td>
<td>96.5 a</td>
<td>5.1 a</td>
<td>27.000 a</td>
</tr>
<tr>
<td>AVTO1289</td>
<td>5.9 abcd</td>
<td>4.9 cd</td>
<td>72.1 cde</td>
<td>2.8 d</td>
<td>15.8 b</td>
<td>22.7 bc</td>
<td>58.500 bc</td>
<td>90.1 bc</td>
<td>4.9 b</td>
<td>23.167 ab</td>
</tr>
<tr>
<td>AVTO 1405</td>
<td>5.4 abcd</td>
<td>6.0 a</td>
<td>120.9 a</td>
<td>2.7 d</td>
<td>9.6 c</td>
<td>15.9 c</td>
<td>58.663 b</td>
<td>93.9 ab</td>
<td>3.7 c</td>
<td>17.000 c</td>
</tr>
<tr>
<td>AVTO 1409</td>
<td>5.4 b</td>
<td>5.4 b</td>
<td>96.9 b</td>
<td>2.9 d</td>
<td>14.6 b</td>
<td>25.3 abc</td>
<td>57.477 bc</td>
<td>91.7 abc</td>
<td>3.7 cd</td>
<td>22.556 ab</td>
</tr>
<tr>
<td>AVTO 1418</td>
<td>5.9 abcd</td>
<td>4.86 cd</td>
<td>79.1 bcd</td>
<td>3.1 bcd</td>
<td>17.5 ab</td>
<td>29.2 abc</td>
<td>51.550 c</td>
<td>90.7 bc</td>
<td>3.6 de</td>
<td>25.389 a</td>
</tr>
<tr>
<td>AVTO 1420</td>
<td>4.9 d</td>
<td>4.9 cd</td>
<td>70.7 cde</td>
<td>3.2 bcd</td>
<td>20.6 a</td>
<td>32.1 abc</td>
<td>52.610 bc</td>
<td>89.9 bc</td>
<td>3.5 de</td>
<td>15.833 cd</td>
</tr>
<tr>
<td>AVTO 1424</td>
<td>5.2 cd</td>
<td>4.7 cd</td>
<td>68.4 de</td>
<td>3.8 abc</td>
<td>17.8 ab</td>
<td>43.0 a</td>
<td>68.763 a</td>
<td>87.5 c</td>
<td>3.4 ef</td>
<td>19.222 bc</td>
</tr>
<tr>
<td>AVTO 1429</td>
<td>5.4 bcd</td>
<td>6.3 a</td>
<td>131.7 a</td>
<td>3.0 d</td>
<td>16.5 ab</td>
<td>35.2 abc</td>
<td>74.917 a</td>
<td>92.0 abc</td>
<td>3.5 de</td>
<td>24.333 a</td>
</tr>
<tr>
<td>AVTO 1455</td>
<td>6.2 abc</td>
<td>4.6 d</td>
<td>71.6 cde</td>
<td>3.1 cd</td>
<td>18.3 ab</td>
<td>36.3 ab</td>
<td>70.603 a</td>
<td>92.6 ab</td>
<td>3.7 cd</td>
<td>17.167 c</td>
</tr>
<tr>
<td>AVTO 1456</td>
<td>4.9 d</td>
<td>4.5 d</td>
<td>53.8 e</td>
<td>3.9 ab</td>
<td>9.3 c</td>
<td>21.2 bc</td>
<td>54.487 bc</td>
<td>92.1 abc</td>
<td>3.3 f</td>
<td>10.889 d</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>1.01</td>
<td>0.45</td>
<td>23.24</td>
<td>0.81</td>
<td>8.64</td>
<td>19.95</td>
<td>7.03</td>
<td>4.98</td>
<td>0.16</td>
<td>5.068</td>
</tr>
</tbody>
</table>

FL: Fruit length, FW: Fruit Width, SFW: Single Fruit weight, NFC: Number of fruit cluster\(^1\), NOCPP: Number of Cluster plant\(^1\), NOFPP: Number of fruit plant\(^1\), PH: Plant Height, MC: Moisture Content, TSS: Total Soluble Solid, Yield (t/ha)
REFERENCES