Response of different tomato varieties to kinds of fertilizers foliar

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Abstract: Tomato is one of the most important produced vegetables in Iran and around the world. Although it is a warm season crop, but today is growing in greenhouse during the winter and also in North latitude. Using suitable varieties for each area and proper nutrition are key factors in cultivation and rearing of the plant. In order to investigate and compare response of different tomato varieties to some chemical fertilizers in climatic condition of Alborz, Iran, This project was conducted as a factorial experiment in the form of randomized complete block design with three replications. Evaluated factors were included a: tomato varieties (Peto Early ch (a1), Super Strain B (a2) and King Stone (a3)) and b: foliar fertilizer (distilled water (b1), Ultrasol special for tomato 2% (b2), humic acid 2% (b3) and mixture of iron sulfate (2 per thousand), zinc sulfate (2 per thousand), manganese sulfate (2 per thousand) and boric acid (2 per thousand) (b3)). Analysis of variance showed that varieties were not significantly affected yield traits, fruit number in the first, second and third harvest, total yield, total number of fruit per plant, fruit average weight, fruit length and width. Effect of fertilizer treatments were different for fruit number of the first harvest, yield of the second harvest and total yield (α=0.05) and not different for yield of the first harvest, fruit number of the second harvest, yield of the third harvest, fruit number of the third harvest, total of fruit number, fruit average weight, fruit length and width.

Keywords: Lycopersicon esculentum Mill, foliar, variety, Ultrasol, micro-fertilizer

Introduction

Lycopersicon esculentum Mill. belongs to solanaceae family and its chromosome number is 2n=2X=24 (Taylor, 1986; Rashid and Sing, 2000). Tomato is one of the most important agricultural plants in semi-arid and the Mediterranean areas. Tomato cultivation is very common as a major and productive crop in many parts of Iran (Mokhtari et al., 2008). It is rich in vitamins A, C (Block, 1992), B1, B2 and B3 (Khoshkhouy et al., 1985). Antioxidant and anticancer effects of tomato reflect the importance of its consumption (Block, 1992). Lycopene in addition to neutralizing ability to singlet oxygen (Soni, 2003) and antioxidant properties than beta-carotene (beta-carotene twice) and alpha-tocopherol (alpha-tocopherol twice), is able to prevent heart disease, cardiovascular disease and various cancers especially prostate, lung and stomach.

Although plants need to micronutrients is negligible in comparison with macronutrients but these elements are essential for plant growth and development as much as macronutrients. Nowadays, environmental pollution, degradation of soil structure, nutrient imbalance and many other cases have led to reducing the use of chemical fertilizers should be considered as a principle in agricultural programs (Kalayic et al., 1999).

Foliar application of iron and manganese was significantly increased dry matter and yield of tomato. The highest yield was observed in the plants which were fed twice with zinc, manganese, iron and copper (El-Lebodi et al., 1976). In another experiment the effect of iron and manganese micronutrients on yield and quality of tomato was studied and observed that iron and manganese foliar were increased earliness and fruit yield (Elabdeen and Metwally, 1982). Zinc and manganese nutrition was significantly affected fruit nitrogen (α=0.05) and the highest fruit nitrogen concentration was obtained in complete consumption of zinc and complete consumption of zinc with complete consumption of manganese. Fruit nitrogen concentration was reduced with zinc concentration decreasing of nutrient solution. The lowest fruit nitrogen concentration was obtained in control treatment (Tavassoli et al., 2010). According to Farahmand and his colleagues reported on the effect of nitrogen different levels on tomato, nitrogen treatment had significant effect on yield and the highest yield was obtained in nitrogen treatment of 120kg/ha and yield was decreased in higher levels of nitrogen (Farahmand et al., 2006). The independent and interaction effect of nitrogen (100, 200, 300 and 400mg/l) and boron (0.5, 1, 1.5 and 2mg/l) on shoot and root dry weight, nitrogen, iron, manganese and zinc concentration in tomato leaves of Rio Grande Ug variety was investigated. Results indicated that independent and interaction effect of nitrogen and boron was different for shoot and root dry weight. Simultaneous intake of 200mg/l of nitrogen and 1mg/l of boron were recommended to achieve the highest fruit yield in hydroponic environments (Farzaneh et al., 2010). Stimulatory effects of humic substances have correlated with increasing uptake of macro- (nitrogen, phosphorus and sulfur) and micronutrients (iron, zinc, copper and manganese) (Turkmen et al., 2005).

According to the nutritional and medicinal value of Lycopersicon esculentum, evaluation the effect of varieties and some chemical fertilizer for reaching the highest yield and quality was performed to find the best nutrition treatment and variety in climate condition of Alborz, Iran.

Material and Methods

This project was conducted to evaluate and compare response of different tomato varieties to some chemical fertilizers in climatic condition of Alborz, Iran. It was conducted as a factorial experiment in the form of randomized complete block design with three replications.
Results
Analysis of variance indicated that factor A (studied varieties) significantly affected fruit number of the first harvesting, the second harvesting yield, total yield, total fruit number and average weight of one fruit ($P \leq 0.05$) and not significantly affected the first harvesting yield, fruit number of the second harvesting, the third harvesting yield, fruit number of the third harvesting, fruit length and diameter (Table 1).

The effect of fertilizer treatments were different for fruit number of the first harvesting, the second harvesting yield, fruit number of the third harvesting, total yield, total fruit number, average weight of one fruit and fruit length ($P \leq 0.05$), and not different for other traits. The interaction effects of factors were not significant in any of the traits (Table 1).

Table 1. Analysis of variance of the effect of treatments on measured traits

<table>
<thead>
<tr>
<th>SOV</th>
<th>df</th>
<th>The first harvesting</th>
<th>Fruit number of the first harvesting</th>
<th>The second harvesting</th>
<th>Fruit number of the second harvesting</th>
<th>The third harvesting</th>
<th>Fruit number of the third harvesting</th>
<th>Total yield</th>
<th>Total fruit number</th>
<th>Average weight of one fruit</th>
<th>Fruit length</th>
<th>Fruit diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety (A)</td>
<td>2</td>
<td>0.39ns</td>
<td>81.08*</td>
<td>0.19*</td>
<td>181.02ns</td>
<td>1.21*</td>
<td>48.02ns</td>
<td>2.22*</td>
<td>856.86*</td>
<td>70.03*</td>
<td>67.15ns</td>
<td>51.27ns</td>
</tr>
<tr>
<td>Fertilizer (B)</td>
<td>3</td>
<td>4.93ns</td>
<td>422*</td>
<td>5.47*</td>
<td>189.06ns</td>
<td>40.03*</td>
<td>81.85*</td>
<td>40.03*</td>
<td>1763.435*</td>
<td>141.54*</td>
<td>79.49*</td>
<td>25.86ns</td>
</tr>
<tr>
<td>A x B Block error</td>
<td>22</td>
<td>1.71</td>
<td>123.57</td>
<td>1.37</td>
<td>113.83</td>
<td>9.27</td>
<td>85.62</td>
<td>9.27</td>
<td>287.7a</td>
<td>105.9a</td>
<td>52.2a</td>
<td>50.9a</td>
</tr>
</tbody>
</table>

Comparison of the first harvesting yield showed that more than 6kg of marketable tomato were harvested from each plot of 5m². Fruit number of the first harvesting from each plot of 5m² was 73 – 106n that King Stone and Peto Early variety had the highest and lowest amount, respectively. The second harvesting yield indicated that the highest yield (11.1kg/plot of 5m²) was obtained in King Stone variety and fruit number of each plot of 5m² was 67 – 99n. The third harvesting yield showed that yield of different varieties were 5.7 – 7.6kg per plot of 5m² and fruit number of different varieties were 77 – 81n. Total comparison indicated that the highest yield (30.5kg/plot of 5m²) and fruit number (287.7a/plot of 5m²) was belonged to King Stone variety. King Stone variety had the biggest fruit with 105.9g. Comparison of fruit length showed that there was no significant difference between varieties. Fruit length was 49 – 55mm in different varieties. Peto Early and Super Strain had the most elongated and round fruits, respectively. There was no significant difference between varieties in the fruit diameter. Fruit diameter range was 50 – 54mm (Table 2).

Table 2. Effect of tomato varieties on measured traits

<table>
<thead>
<tr>
<th>Varieties</th>
<th>The first harvesting yield</th>
<th>Fruit number of the first harvesting</th>
<th>The second harvesting yield</th>
<th>Fruit number of the second harvesting</th>
<th>The third harvesting yield</th>
<th>Fruit number of the third harvesting</th>
<th>Total yield</th>
<th>Total fruit number</th>
<th>Average weight of one fruit</th>
<th>Fruit length</th>
<th>Fruit diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peto Early</td>
<td>7.2a</td>
<td>73.4b</td>
<td>4.3b</td>
<td>67.83a</td>
<td>5.7a</td>
<td>77.2a</td>
<td>19.2b</td>
<td>218.4b</td>
<td>88.4b</td>
<td>55.9a</td>
<td>50.08a</td>
</tr>
<tr>
<td>Super Strain</td>
<td>6.5a</td>
<td>81ab</td>
<td>6ab</td>
<td>75.75a</td>
<td>5.94a</td>
<td>80.25a</td>
<td>18.4b</td>
<td>237.25b</td>
<td>78b</td>
<td>49.2a</td>
<td>54.03a</td>
</tr>
<tr>
<td>King Stone</td>
<td>11.8a</td>
<td>106.8a</td>
<td>11.1a</td>
<td>99.9a</td>
<td>7.65a</td>
<td>80.9a</td>
<td>30.5a</td>
<td>287.7a</td>
<td>105.9a</td>
<td>52.2a</td>
<td>50.9a</td>
</tr>
</tbody>
</table>

Means in a column followed by the same letter are not significantly different at $P \leq 0.01$.
the second harvesting was belonged to Ultrasol and control treatment, respectively. Fruits number of the second harvesting were 74 – 84/plot of 5m² in different treatments. Yield of the third harvesting was 6 – 7kg/plot of 5m² and the highest fruit number of the third harvesting was observed in Ultrasol treatment (Table 3).

Ultrasol fertilizer had the highest total yield with 22.44kg/plot of 5m². During the period, fruit number range was 233 – 265/plot of 5m². The highest average weight of one fruit was belonged to Ultrasol (86.6g) and humic acid (82.6g) treatment. Ultrasol + humic acid treatment had the highest fruit length with 56mm. There was no significant difference between treatments on fruit diameter (Table 3).

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>The first harvesting yield</th>
<th>Fruits number of the first harvesting</th>
<th>The second harvesting yield</th>
<th>Fruits number of the second harvesting</th>
<th>The third harvesting yield</th>
<th>Fruits number of the third harvesting</th>
<th>Total yield</th>
<th>Total fruit number</th>
<th>Average weight of one fruit</th>
<th>Fruit length</th>
<th>Fruit diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>6.89a</td>
<td>76.2b</td>
<td>5.8b</td>
<td>74.4a</td>
<td>6.1a</td>
<td>79.5b</td>
<td>17.8b</td>
<td>22.44</td>
<td>77.5b</td>
<td>49.7b</td>
<td>50.1a</td>
</tr>
<tr>
<td>Ultrasol</td>
<td>9.4a</td>
<td>90.5a</td>
<td>7.5a</td>
<td>84.4a</td>
<td>7.3a</td>
<td>83.7a</td>
<td>24.2a</td>
<td>53.6</td>
<td>75.6</td>
<td>52.7a</td>
<td>53.6</td>
</tr>
<tr>
<td>Humic acid</td>
<td>9.3a</td>
<td>77.5b</td>
<td>6.1ab</td>
<td>75.8a</td>
<td>6.08a</td>
<td>77.1b</td>
<td>18.3b</td>
<td>251.2</td>
<td>82.6ab</td>
<td>49.7b</td>
<td>52.7a</td>
</tr>
<tr>
<td>Ultrasol + humic acid</td>
<td>8.2a</td>
<td>72.2b</td>
<td>6.2ab</td>
<td>78a</td>
<td>6.07a</td>
<td>77.4b</td>
<td>18.5b</td>
<td>240.8</td>
<td>79.5b</td>
<td>56.04a</td>
<td>53.6</td>
</tr>
</tbody>
</table>

Means in a column followed by the same letter are not significantly different at P<0.01.

Discussion
Changes in ripe fruit yield in different harvests and fruits number between different varieties indicated that there was different between ripening time of varieties, yield and marketability of used varieties in the project. Harvesting 3.8 – 6 kg of fruit per square meter in field condition shows that 38 – 60 tons of fruit per hectare could be harvested. Considering that this yield belongs to the experimental plots, so on a broader level, yield could be properly lower than that amount.

Yield comparing of different fertilizers showed that fertilizer treatment of Ultrasol had the highest yield in final harvesting with 22.44kg/plot. This difference showed that tomato was showed better policy response to this fertilizer. Also another reason for lack of yield increasing in mixture of micro-fertilizers and humic acid could be related to these fertilizers quality. Micronutrient fertilizers and low intake of humic acid more affect qualitative traits.

In the experiment was shown that foliar application of iron and manganese was significantly increased dry matter and yield of tomato. The highest yield was observed in the plants which were fed twice with zinc, manganese, iron and copper (El-Lebodi et al., 1976). In another experiment the effect of iron and manganese micronutrients on yield and quality of tomato was studied and observed that iron and manganese foliar were increased earliness and fruit yield (Elabdeen and Metwally, 1982). Zinc and manganese nutrition was significantly affected fruit nitrogen (εc<0.05) and the highest fruit nitrogen concentration was obtained in complete consumption of zinc and complete consumption of zinc with complete consumption of manganese (Tavassoli et al., 2010). Nitrogen optimum nutrition is very important in the growth of tomato plants. High nitrogen application improves vegetative growth and will be delayed flowering (Marique, 1993). Nitrogen is one of the most important nutrients and limiting factors for plant growth and plays an important role in plant nutrition (Malakouti and Tehrani, 2005). With increasing nitrogen levels, plant growth will be increase and nutrient will be diluted, and therefore potassium concentration decreases (Fekri, 1999). The independent and interaction effect of nitrogen (100, 200, 300 and 400mg/l) and boron (0.5, 1, 1.5 and 2mg/l) on shoot and root dry weight, nitrogen, iron, manganese and zinc concentration in tomato leaves of Rio Grande Ug variety was investigated. Results indicated that independent and interaction effect of nitrogen and boron was different for shoot and root dry weight. The highest shoot dry weight was belonged to 300mg/l of nitrogen + 1mg/l of boron. The highest fruit yield and root dry weight was observed in 200mg/l of nitrogen + 1mg/l of boron. With increasing nitrogen levels in the nutrient solution, nitrogen and manganese concentration of leaves was increased and iron, boron and zinc concentration of leaves was decreased. While at high boron level in nutrient solution, nitrogen, boron and zinc was increased. Iron and manganese concentration of leaves was significantly decreased. Simultaneous intake of 200mg/l of nitrogen and 1mg/l of boron were recommended to achieve the highest fruit yield in hydroponic environments (Farzaneh et al., 2010).

References


