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Research Paper

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 (a_1), Super Strain B (a_2) and King Stone (a_3)) and b: foliar fertilizer (distilled water (b_1), Ultrasol special for tomato 2% (b_2), humic acid 2% (b_3) and mixture of iron sulfate (2 per thousand), zinc sulfate (2 per thousand), manganese sulfate (2 per thousand) and boric acid (2 per thousand) (b_4)). 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 ($\alpha \leq 0.05$) 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 esculentom* Mill, foliar, variety, Ultrasol, micro-fertilizer

Introduction

Lycopersicon esculentom 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), B_1, B_2 and B_3 (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 ($\alpha \leq 0.05$) 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 esculentom*, 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.

Used factors

Two factors were evaluated. Factor A: 3 tomato varieties: Peto Early ch (a_1), Super Strain B (a_2) and King Stone (a_3).

Factor B: foliar fertilizer in 4 levels: distilled water (b_1), Ultrasol special for tomato 2% (b_2), humic acid 2% (b_3) and mixture of iron sulfate (2 per thousand), zinc sulfate (2 per thousand), manganese sulfate (2 per thousand) and boric acid (2 per thousand) (b_4). When plant height reached to 10cm, each fertilizer was sprayed five times during the growing season with distance of 10 days and concentration of 2 per thousand.

Seedling preparation and transfer

The seeds were cultivated in the greenhouse of Seed and Plant Institute, Karaj, Iran on 4, April, 2012. After 45 days, seedlings were transferred and cultivated in the main land of Seed and Plant Institute. Dimensions of plots were $3 \times 6m^2$. Sampling was performed from $5m^2$ in the middle of plots and calculation was done based on this $5m^2$. Spaces between ridges and plant spacing on a line were 1m and 0.5m, respectively. Irrigation was done once a week.

Measured traits

Some traits such as yield of different harvest, fruit number of different harvest, total yield of three harvests, fruit number of three harvests, fruit weight, fruit length and diameter were measured.

Statistical analysis

Obtained data were analyzed by SPSS 16 and Comparison of means was performed by the Duncan's multiple range tests.

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 ($\alpha \leq 0.05$) 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 ($\alpha \leq 0.05$), 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

		Mean Squares (MS)										
SOV	df	The first harvesting	Fruit number of the first harvesting	The second harvesting	Fruit number of the second harvesting	The third harvesting	Fruit number of the third harvesting	Total yield	Total fruit number	Average weight of one fruit	Fruit length	Fruit diameter
Variety (A)	2	0.39ns	81.08*	0.19*	181.02ns	1.21*	48.02ns	2.22*	856.86*	70.03*	67.15ns	51.27ns
Fertilizer (B)	3	4.93ns	422*	5.47*	189.06ns	40.03*	81.85*	40.03*	1763.435*	141.54*	79.49*	25.86ns
A × B	6	0.68ns	70.19ns	1.94ns	54.50ns	4.34ns	70.65ns	4.34ns	270.38ns	45.22	12.17ns	3.61ns
Block	2	1.48ns	79ns	1.77ns	105.44ns	2.74ns	78.77ns	2.74	188.77ns	80.34	33.38ns	34.95ns
error	22	1.71	123.57	1.37	113.83	9.27	85.62	9.27	585.23	65.73	34.22	39.20

ns, non significant; *, significant at $P \leq 0.05$; **, significant at $P \leq 0.01$.

Comparison of the first harvesting yield showed that more than 6kg of marketable tomato were harvested from each plot of $5m^2$. Fruit number of the first harvesting from each plot of $5m^2$ 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 $5m^2$) was obtained in King Stone variety and fruit number of each plot of $5m^2$ was 67 – 99n. The third harvesting yield showed that yield of different varieties were 5.7 – 7.6kg per plot of $5m^2$ and fruit number of different varieties were 77 – 81n. Total comparison indicated that the highest yield (30.5kg/plot of $5m^2$) and fruit number (287.7n/plot of $5m^2$) 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

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

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

Results indicated that range of the first harvesting yield was 6 – 11kg/plot of $5m^2$. The highest fruit number of the first harvesting (106.8n/plot of $5m^2$) was obtained in Ultrasol. The highest (7.5kg/plot of $5m^2$) and lowest (5.8kg/plot of $5m^2$) yield of the second harvesting was belonged to Ultrasol and control treatment, respectively. Fruits number of the second harvesting were 74 – 84n/plot of $5m^2$ in different treatments. Yield of the third harvesting was 6 – 7kg/plot of $5m^2$ 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 $5m^2$. During the period, fruit number range was 233 – 265n/plot of $5m^2$. 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 3. Effect of different fertilizers on measured traits

fertilizers	The first harvesting yield	Fruits number of the first harvesting	The second harvesting yield	Fruits number of the second harvesting	The third harvesting yield	Fruits number of the third harvesting	Total yield	Total fruit number	Average weight of one fruit	Fruit length	Fruit diameter
Control	6.89a	76.2b	5.8b	74.4a	6.1a	79.5b	17.8b	233a	77.5b	49.7b	50.1a
Ultrasol	9.4a	90.5a	7.5a	84.4a	7.3a	83.7a	22.44a	265.9a	86.6a	51.6b	50.4a
Humic acid	9.3a	77.5b	6.1ab	75.8a	6.08a	77.1b	18.3b	251.2a	82.6ab	49.7b	52.7a
Ultrasol + humic acid	8.2a	72.2b	6.2ab	78a	6.07a	77.4b	18.5b	240.8a	79.5b	56.04a	53.6a

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

Discussion

Changes in ripe fruit yield in different harvest and fruits number between different varieties indicated that there was different between ripping 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 ($\alpha \leq 0.05$) 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 imprives 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

Block G B (1992). Fruit vegetables and cancer prevention.: a review of the epidemiological evidence Journal Nutrition. Cancer.18: 1-29.

Elabdeen A Z, Metwally A M (1982). Effect of foliar spraying with Mn، Fe، Zn and Cu on the quality of tomato and pepper. Agr. Res. Rev. 60: 143-164.

El-Lebodi A, El-Gala A M, Sakr A A (1976). Growth and nutritional status of tomato subjected to foliar spray with certain nutrient solution. Agr. Res. Rev. 54: 109-127.

Farahmand A, Fardad H, Liyaghat A, Kashi A (2006). Investigation the effect of watering and nitrogen fertilizer on yield and water use efficiency of tomato. Iranian Journal of Agricultural Science. 37(2): 273-279.

Farzaneh N, Golchin A, Hashemi Majd K (2010). The effect of different supplement nitrogen and potassium levels and on yield, nitrogen and potassium concentration of tomato leaves. Science and Technology of Greenhouse Cultivation. 1(1): 27-33.

Fekri M (1999). The effect of nitrogen, potassium and boron on nutrient concentration of leaves, yield, quality and buds abscission of pistachio trees. PhD thesis, Tehran University.

Kalayic M, Torun B, Eker S, Aydin M, Ozturk L, Cakmak I (1999). Grain yield, zinc efficiency and zi.nc concentration of wheat cultivation grown in a zinc- deficient calcareous soil in field and greenhouse. Field Crops Res. 63:87-98.

Khoshkhouy M, Shibani B, Rouhani A, Tafzili A (1985). Horticulture Principles, 2rd ed., Shiraz University, Iran.

Malakouti M J, Tehrani M M (2005). The role of micronutrients in yield increasing and improving quality of agricultural products, 3rd ed., Tarbiyat Modarres University, Tehran. pp.273-279.
Marique L A (1993). Greenhouse crops: A review. Journal of Plant Nutrition. 16(12): 2411-2477.
Mokhtari I, Abrishamchi P, Ganjeali A (2008). The effects of Calcium on amelioration of injuries salt stress on seed germination of tomato (Lycopersicon esculentom L.). Iranian Journal of Sciences and Food Technology. 22(1): 89-100.
Rashid M A, Sing D P (2000). A manual on vegetable seed Production in Bangladesh. AVRDC-USAID-Bangladesh Project.
Soni J (2003). Separation of carotenoids from fruits and vegetables, US2003/0180435.
Tavassoli A, Ghanbari A, Ahmadiyan A (2010). The effect of manganese and zinc nutrition on fruit yield and nutrient concentration of hydroponic and greenhouse tomato. Science and Technology of Greenhouse Cultivation. 1(1): 57-63.
Taylor I B (1986). Biosystematics of the tomato, In: "The tomato crop: A scientific basis for improvement" (eds. Atherton، J.G.، and Rudich، J).
Turkmen O, Demir S, Sensoy S, Dursun A (2005). Effect of arbuscular mycorrhizal fungus and humic acid.USA, and SSSA book series: 1, 2005; pp: 873-911.