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Effects of Water and N Fertilizer on the Yield and Fruit Quality of Tomatoes under Drip (Tape) Irrigation System

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Introduction

Being vulnerable to food shortage, tomatoes are dependent on nitrogen fertilizer for their growth and crop yields (Zomorrodi, 2006). In effect, there is a close relationship between the amount of nitrogen fertilizer consumed and the accumulation of nitrate, which poses a threat to consumer health (Mousavi Fazl, 2005). The accumulation of nitrate in tomatoes has a considerable negative effect on its quality and increase the amount of toxic substances in tomatoes (Malakuti et al., 2005). The results of many studies show that the appropriate combination of nitrogen fertilizer treatments and the irrigation regime in such a way that the plant encounters a certain level of water stress during a particular period or throughout the growing season may lead to the maximum efficiency of water usage in the plant (Bagheri et al., 2016). Zomorrodi (2006) examined the effect of deficit irrigation on the quantitative and qualitative characteristics of tomatoes. The results showed that the effects of irrigation water on vitamin C, acidity and soluble solids were significant. Khorramian (2015) also studied different levels of drip irrigation with the supply of 40, 70 and 100% water requirement on the yield and water use efficiency in tomatos. The findings of this study showed that maximum yield was obtained from drip irrigation with 100% water level, while 40% water level treatment had the highest water use efficiency.

Materials and Methods

In order to investigate the effects of irrigation water and Nitrogen fertilizer on the quantity and quality characteristics of tomatoes under drip irrigation, a two-year field experiment was conducted in the Agricultural and Natural Resources Research Center of Semnan province (Shahrood). This experiment was based on the complete block randomized design with two factors and four replications. Treatments were irrigation water at four levels (40, 60, 80 and 100 percent) and N fertilizer at three levels (60, 80 and 100 percent). Irrigation water requirement was, then, determined by Penman Monteith method and a 3-day irrigation period.

Results and Discussion

The combined analysis of two years data showed the significance of the main and interaction effect of water and nitrogen fertilizer on the crop yield. The highest yield was obtained from the water level of 100% (83.6 t / ha), while the lowest yield was obtained from 40% water treatment

(33.8 t / ha). Regarding the interaction effects of the factors, the highest yield was obtained from the 80% water and 60% fertilizer treatment (89.4 ton / ha). Indeed, the highest water use efficiency was obtained from the 80% water and 60% fertilizer treatment (15.8 Kg per cubic meter water per hectare) and its lowest value from 60% water and 80% fertilizer treatment (9.8 Kg per cubic meter water per hectare). In turn, the factors of water and nitrogen fertilizer and their interaction on acidity were not effective. Besides, the results showed that brix in both of the experiment years was affected by the irrigation water treatments. In the combined analysis of the data, this parameter was significant at 1% level. Increasing the amount of water level in the treatments led to a decrease in the brix of the fruit. The results of combined analysis of data showed that the effect of irrigation water treatments on water-to-fruit flesh ratio was significant at 1% level and by decreasing water consumption, this ratio decreased. The results of the experiment showed that the effect of irrigation water treatments on the size and average weight of the fruits were significant at 1% level. In turn, water levels of 100% and 80% had bigger fruits than other irrigation treatments. The results of analysis of samples in different treatments and statistical studies indicated that the effects of irrigation water, nitrogen fertilizer and their interaction on the nitrogen accumulation of fruits were significant at 1% level. As the water increased, nitrate accumulation in the fruit decreased, while with regard to nitrogen fertilizer use, the amount of nitrogen accumulation increased with increasing nitrogen fertilization. The minimum amount of the fruit nitrate obtained in this study was 105.3 to 138.8 ppm. However, the nitrate limit for tomato in developed countries has been set at 120-10 ppm (Khoorgh, 2000). The results indicated that the factors of water and nitrogen fertilizer did not affect vitamin C, but their interaction on vitamin C was significant at 5% level.

Conclusion

According to the results of this study, the main and mutual effects of water and N fertilizer on the yields and quality characteristics of tomatoes, such as nitrogen accumulation, brix, pH, and vitamin C were significant. The maximum yield (89.4 ton/ha) and water efficiency (15.8 kg/m3.ha) was obtained from 80% water at 60% nitrogen treatment, which was selected as the best treatment. Due to the water scarcity and its value, 80% water level and 60% nitrogen fertilizer are recommended as a superior treatment for the sustainable production of healthy products. In this study, water stresses in the treatments (40, 60 and 80% water requirements) were continuously applied during the growing season, and its application in different stages of the plant growth can lead to different results.

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