EFFECTS OF DIFFERENT LEVELS OF POTASSIUM AND IRON APPLICATIONS ON SEASONAL CHANGES OF POTASSIUM CONTENT OF TOMATO PLANT GROWN IN PERLITE MEDIUM

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INTRODUCTION

The world population is expanding rapidly and expected to be around 8 billion by the year 2025. This represents an addition of nearly 80 million people to the present population (6 billion) every year.

It is forecast that increases in world population will occur serious nutritional problems. Increases food production must be achieved that using both soil and non-agricultural lands. Non-agricultural lands bring in agriculture by the way soilless culture

In Turkey, vegetable production in soilless culture started since 1995 in Antalya region. For the last twenty years soilless culture has been increasing steadily in Turkey in an area of 327.5 ha, relatively Antalya having 57% of the total assets of soilless greenhouse in the country has been regarded as the centre of soilless production.

Soilless production system has been used by 59 companies with an area of 187.5 ha, mainly for vegetable (Tomato) and cut flower production.

Tomato is one of the most important horticultural crops grown in hydroponics, where the use of appropriate nutrient solution is a crucial factor for obtaining high fruit quality, antioxidant content in tomato.

These quality parameters will change depending on cationic proportions (K, Ca and Mg) in the nutrient solution and their interaction. Potassium is an important component in the nutrient solution.

Its function is mainly in osmoregulation in cells, regulation of enzyme activities and the translocation rate of photosynthate from leaves through phloem to storage tissue.

Plant potassium uptake depends on plant factors (including genetics and developmental stage) and environmental condition (soil properties and climate) (Rengel and Damon, 2008). At the same time, application of fertilizer affects on plant nutrition status.

Addition of potassium, iron plays an important role in tomato nutrition and fruit quality.

This microelement significantly affects the quantity and quality of tomato yield in greenhouses cultivation with a limited volume of the growing medium.

Different researchers reported that iron deficiency caused to decrease tomato (Chohura et al., 2009) and strawberry yield and fruit quality (Demiral, 2000).

As it is know, Different frequency fertigation, depending on plant growth status, radiation and drain ratio factors, applied in soilless culture by growers. In Turkey, growers using soilless growing system are usually used chelates form of Fe in fertilizing, but chelate forms of Fe have more cost than N, P, K in fertilizer.

Fe-chelate fertilizer cost comprises of 25 % in total expenses, in purpose of fertilization for soilless culture. Therefore, this situation leads to disadvantage in view of economical expenses of growers.

There is an interaction between macronutrients and micronutrients as reported by different researchers (Mengel and Kirky, 1987; Marschner, 2002). It can be assumed that nutrient interaction improves iron nutrition without directly iron fertilizing. Increasing Fe availability was associated with potassium in the Strategy I and Strategy II categories.

As it is well known plant elements selectivity is complex and it changes depending on growing status, environmental condition (temperature, light intensity etc.) and element concentrations in nutrient solution.

MATERIALS and METHODS

The experiment was carried out in a plastic greenhouse located in Antalya, Turkey. Tomato seedlings (Bandita) were planted in soilless culture (perlite) on 13 September 2006. Volume of each perlite bag was about 32 dm3 (1.2 m lenght and 25 cm width), with a density of 4 plants per m2. The experiment was designed according to the completely randomized factorial design with 4 replicates. Each plant was fed by a single dripper. Bumblebees (*Bombus* sp.) were introduced into the greenhouse for the beter pollination. The oldest leaves (i.e. those at the bottom of the stem) were periodically removed.


K2Fe3


4
K1Fe2

K

K_2SO_4 and KNO_3 as source; K conc. was arranged by K2SO4

K1:150 K2: 300 K3:450 mg/l

Fe

Fe-EDDHA as source

Fe_1:1 Fe_2: 2 Fe_3: 3 mg/l

N	**210 mg/l**	ammonium nitrate, potassium nitrate and calcium nitrate
P	**40**	mono potassium phosphate
Ca	**150**	calcium nitrate
Mg	**50**	magnesium sulfate
Mn	**0.75**	manganese sulfate
B	**0.4**	boric acid
Zn	**0.50**	zinc sulfate
Cu	**0.10**	copper sulfate
Mo	**0.05**	sodium molibdate


K_3Fe_3
K_1Fe_2
K_1Fe_1
K_3Fe_1
K_3Fe_1

Leaf samples (5th-6th fully expanded leaves) of tomato were collected as described by Geraldson et al (1973). The sampling were done two different period during growing season.

In 1st period, leaf samples were taken from at the fruit set **(**26 November 2006). In 2nd period, tomato leaf samples were taken at end of the harvest time (15 March 2007).

At the end of the six month experiment period, plants were harvested. Leaf samples were washed by distilled water and dried in a forced-air oven at 65 °C to constant weight. Samples were ground separately in a stainless mill to pass through a 20 mesh screen and kept in clean polyethlene bags for analysis.

Dried leaf samples of 0.5 g each were digested with 10 mL HNO3/HClO4 (4:1) acid mixture on a hot plate. The samples were then heated until a clear solution was obtained. The same procedure was repeated several times. The samples were filtered and diluted to 100 mL using distilled water. Concentrations of K were determined by ICP-OES (Kacar and Inal, 2008).

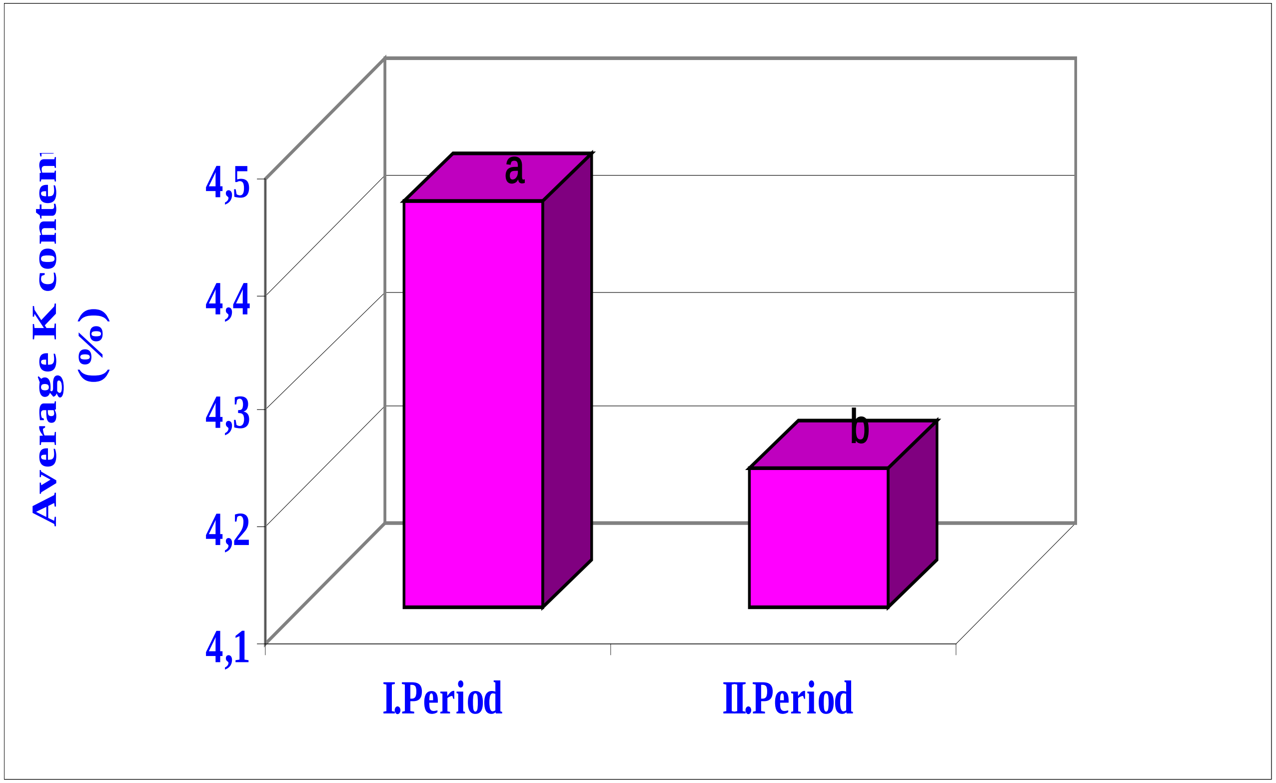
Statistical analysis was carried out using the MSTAT-C software. Means were compared by analysis of variance (ANOVA) and the LSD test at $P \leq 0.05$. A factorial analysis was used to determine interaction effects of potassium and iron levels on potassium content of tomato plants.

RESULTS AND DISCUSSION

Table 1. The Effects of Different Levels of Potassium and Iron Applications on Tomato K Content in Two Period.

Treatments	Leaf K content %	
	I. Period	II. Period
K_1Fe_1	**4.03 d**	**3.49 d**
K_1Fe_2	4.10 cd	3.74 cd
K_1Fe_3	4.48 abc	4.18 bc
K_2Fe_1	**4.85 a**	4.56 b
K_2Fe_2	4.26 bcd	4.02 bc
K_2Fe_3	4.57 ab	4.24 bc
K_3Fe_1	4.31 bcd	4.21 bc
K_3Fe_2	4.60 ab	**5.09 a**
K_3Fe_3	**4.85 a**	4.52 b
Significance of main effects and mean separation values for interactions		
K	***	**
Fe	*	ns
K X Fe	**	**
LSD	0.3609	0.4933

* Significant at the α= 0.05 probability level.
** Significant at the α= 0.01 probability level.
*** Significant at the α= 0.001 probability level.
ns = non-significant.
† For a significant (P ≤ 0.05) K X Fe interaction LSD values (0.05) are for comparing K applications means within or between Fe applications.



LSD0.05: 0.07545

Figure 1. Seasonal changes of average K contents of tomato leaf.

Seasonal changes in mean potassium contents of tomato plant were found to istatistically important (Figure 1). In the 1st period mean potassium content (4.45 %) was higher than in the 2nd period (4.22 %).

CONCLUSION

Different levels of potassium and iron applications were significantly effects on tomato leaf K contents.

Results indicated that interactive effects of these factors were important, under our investigation acts dependly.

Tomato leaf K contents changed depending on growing period. The mean potassium content of tomato leaves in fruit set were higher than harvest time.

Interrelationship between plant nutrient elements are complex and its may be changed by light intensity, temperature and plant variety.
Therefore, studies related to interaction effects of elements in different growing medium and plant variety are needed.