Nutrient Uptake Efficiency of Peach Cultivars in Kahramanmaraş, Turkey

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ABSTRACT: The knowledge soil fertility and plant cultivar interactions are crucial for selecting tolerant cultivars in adverse soil conditions. This study was performed to compare nutrient uptake efficiency of nine peach cultivars in Kahramanmaraş, Turkey. The studied cultivars were Red Heaven, Crest Heaven, Chasty, Fairlane, Washington, Independence, Hale Heaven, Summer Super Star, and Dixi Red. Significant differences were found among the cultivars for the nutrient acquisition with the exceptions of K and Cu. Calcium and Mg uptake of the cultivars followed similar trends, where Independence had the highest and Hale Heaven had the lowest Ca and Mg contents. Phosphorus uptake of Washington was significantly higher than the others, and Red Heaven and Dixi Red removed significantly higher levels of P compared to the others. Red Heaven was the most efficient cultivar for the uptake of Fe, Mn, and Zn. The cultivars Fairlane, Washington, Hale Heaven, and Dixi Red were not efficient for Fe uptake.
Key Words: Nutrient uptake, *Prunus persica* L. cultivar

Kahramanmaraş Koşullarında Yetiştirilen Şeftali Çeşitlerinin Besin Maddesi Alım Etkinlikleri

ÖZET: Toprak verimliliği ile bitki çeşitleri arasındaki etkileşimlerin bilinmesi olumsuz toprak koşullarında yetiştirilecek dayanıklı bitki çeşitlerinin seçilmesi açısından önemlidir. Bu çalışma Kahramanmaraş koşullarında yetiştirilen 9 şeftali çeşidinin besin maddeleri alım etkinliklerinin karşılaştırılması amacıyla yürütülmüştür. Çalışmada Red Heaven, Crest Heaven, Chasty, Fairlane, Washington, Independence, Hale Heaven, Summer Super Star ve Dixired çeşitleri kullanılmıştır. Analiz sonuçlarına göre, K ve Cu dışındaki besin maddelerinin topraktan kaldırılma etkinliği açısından çeşitler arasında önemli istatistiksel farklılıklar bulunmuştur. Kalsiyum ve Mg kaldırım etkinliği açısından Independence en etkin çeşit iken en düşük Ca ve Mg konsantrasyonlarına sahip çeşit Hale Heaven olmuştur. Fosfor alım etkinliği açısından Washington çeşidi ön planda iken onu Red Heaven ve Dixired takip etmiştir. Red Heaven Fe, Mn ve Zn alımı açısından en etkin çeşit iken Fe alımı açısından Fairlane, Washington, Hale Heaven ve Dixired en az etkin olan çeşitler olmuştur.
Anahtar Kelimeler: Besin maddesi alımı, *Prunus persica* L. çeşitleri

INTRODUCTION

Soil fertility and plant cultivar interactions are very important for making decisions since the adverse environmental conditions affect sustainable crop production. Soil fertility status of soils should not be a limiting factor for plant growth, since low-fertility soils can be corrected by adding appropriate fertilizers. Selecting Fe/Zn-efficient cultivars for alkaline or calcareous soils, however, was found to be the best management practice for controlling deficiency of these two micronutrients (Tsipouridis et al., 2005), because the factors lowering the availability of soil Fe and Zn also adversely affect the availability of fertilizer Fe and Zn. Tsipouridis et al. (2005) studied the tolerance of peach cultivars to iron chlorosis and concluded that the cultivars Loadel, May Crest, and Sun Crest are Fe-inefficient and should not be planted in calcareous soils. Majority of Turkey's soils has neutral (29.9%) and slightly alkaline (60.3%) pH, and 54.9% of Turkey's soils contain more than 5% $CaCO_3$ (Güçdemir, 2006) indicating a potential problem for availability of plant nutrients especially Fe and Zn. Indeed, Fe deficiencies in peach and apple orchards were reported in different regions of Turkey (Başar and Özgümüş, 1999; Sönmez and Kaplan, 2002). This study was performed to determine the nutrient uptake efficiency of 9 peach cultivars in an orchard in Kahramanmaraş, Turkey.

MATERIAL and METHODS

The orchard selected for the study is located at the Nuts Research and Application Center of the Sütçü Imam University, Kahramanmaraş City, Turkey. The orchard was established with 5m × 5 m spacing on south facing foot slopes of the Ahir Mount, and the area had no known history of previous agricultural production. Tree growth rate was less than expected in this area, and, therefore, fertility status of the soils was questioned in the area. Nine peach cultivars were compared in the study, and the selected cultivars were Red Heaven, Crest Heaven, Chasty, Fairlane, Washington, Independence, Hale Heaven, Summer Super Star, and Dixi Red. Leaf samples were collected in July of 2006 from near base of current year's growth (Jones and Case, 1990). The experimental area was approximately 2 da in size. A soil sample was taken using a hand probe

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to 20 cm depth and was composites of 10 cores within the orchard.

The soil sample was dried, and crushed to pass 2 mm sieve. The sample was analyzed for ammonium acetate extractable K, Ca, and Mg (Helmke and Sparks, 1996; Suarez, 1996), Olsen phosphorus (Kuo, 1996), DTPA-extractable Fe, Zn, Mn, and Cu (Lindsay and Norvell, 1978), pH (Thomas, 1996), and $CaCO_3$ (Loeppert and Suarez, 1996).

Leaf samples were digested with $HNO_3/HClO_4$ mixture for P, K, Ca, Mg, Na, Fe, Mn, Zn and Cu (Jones and Case, 1990). Vanadomolybdophosphoric acid method was used for total P (Kuo, 1996), and the total concentrations of K, Ca, Mg, Na, Fe, Mn, Zn and Cu were determined using an atomic absorption spectrophotometer (Perkin Elmer 3110).

Statistics

A single tree of the each cultivar was accepted as the smallest experimental unit, and three replications were used. The differences among the peach cultivars for the measured nutrients were compared using one-way ANOVA statistics and Duncan's multiple range test (SPSS, 1998).

RESULTS and DISCUSSION

The soils of the study area were slightly alkaline and had very low $CaCO_3$ and salt content (Table 1). Available concentrations of the measured macro- and micro-nutrients were adequate to support plant growth based on the critical values reported by Lindsay and Norvell (1978), and Rehm et al. (1995). Chemical fertilizers and manure had not been applied in the orchard, and, therefore, native soil fertility of the soil for the measured nutrients was probably due to the lack of previous agricultural production in the area.

Bergman (1988) reported optimum nutrient concentrations of peach leaves as 1.50-3.00% for K, 1.50-2.50% for Ca, 0.30-0.60% for Mg, 0.18-0.35% for P, 35-100 $mgkg^{-1}$ for Mn, 15-50 $mgkg^{-1}$ for Zn, and 7-15 $mgkg^{-1}$ for Cu. There are controversial reports regarding optimum Fe contents of peach leaves, but optimum values range between 50 and 300 $mgkg^{-1}$ (Anonymous, 2006). The results of leaf analysis indicated that the measured nutrient concentrations of the cultivars were in the optimum range. Therefore, a good agreement between soil and leaf analysis was found in this study. There were, however, significant differences among the cultivars for nutrient uptake with exceptions of K and Cu.

Potassium uptake of the peach cultivars was not significantly different (Table 2). Başar (2005) was also observed no significant differences for K uptake among the three peach cultivars he studied. There were significant differences for Ca acquisition among the cultivars, and leaves of the Independence cultivar had the highest Ca concentration whereas the lowest Ca contents were determined in the leaves of Red Heaven and Hale Heaven. Magnesium uptake of the cultivars showed similar trends with Ca, and again Independence had the highest and Hale Heaven had the lowest Mg content. The P uptake of the Washington cultivar was significantly higher than the others, and Red Heaven and Dixi Red absorbed higher levels of P compared to the others.

There were also significant differences among the cultivars for the uptake of metal micronutrients with the only exception of Cu. Red Heaven was the most efficient cultivar for the uptake of Fe, Mn, and Zn among the cultivars. This could be explained by the lower Ca uptake of Red Heaven, but the same scenario was not valid for micronutrient uptake of Hale Heaven. Similar to Red Heaven, Chasty removed significantly high amounts of Fe compared with to the other cultivars, and Fairlane, Washington, Hale Heaven, and Dixi Red were not efficient for Fe uptake. As it was mentioned, Mn content of the cultivar Red Heaven was significantly higher than the others, whose uptake was not significantly different. Zinc uptake of the cultivars was also significantly different. Red Heaven was the most efficient while Fairlane and Summer Super Star were the least efficient for the uptake. In contrast to our findings, Başar (2005) did not find Redhaven as the most efficient cultivar he studied for Fe and Mn acquisition. Therefore, rootstocks, and interactions between rootstocks and cultivars (Tsipouridis et al., 2002) along with soil pH may play a more crucial role for the uptake of Fe and Mn.

Soil and plant nutrient concentrations were found to be adequate in this study, yet there were significant differences among the cultivars for the uptake of the some measured nutrients. This findings show that there are significant differences among the cultivars to utilize plant available nutrients. The concentration of DTPA-extractable Fe, Mn, Zn, and Cu were high in the soil compared to the critical levels, and the two main factors affecting availability of these micronutrients, $CaCO_3$ content and soil pH, were near optimum levels. Therefore, accepting the cultivars with high Fe and Zn content as Fe/Zn efficient may be misleading, since how micronutrient uptake mechanisms of the cultivars will change in soils with higher pH and $CaCO_3$ contents is not known.

Soil fertility was not a problem for the measured nutrients, and the nutrient levels for the cultivars can be accepted as adequate levels of these plant nutrients. A deeper soil sampling with special emphasize on soil physical properties can be helpful to understand the reasons for the retarded growth of the cultivars. The existence of pebbles/stones in the orchard may also attribute impeded tree growth.

Table 1. Some chemical and physical properties of the soil samples taken from the orchard

pH	$CaCO_3$ %	Salt %	K mg kg^{-1}	Ca mg kg^{-1}	Mg mg kg^{-1}	P mg kg^{-1}	Fe mg kg^{-1}	Mn mg kg^{-1}	Zn mg kg^{-1}	Cu mg kg^{-1}
7.18	1.14	0.04	268.77	1603.48	119.73	21.69	25.53	43.18	2.12	3.70

Table 2. Macro and micro-nutrient concentrations of leaf samples of the cultivars and statistical comparisons

Peach Cultivars	K %	Ca %	Mg %	P %	Fe mg kg^{-1}	Mn mg kg^{-1}	Zn mg kg^{-1}	Cu mg kg^{-1}
Red Heaven	2.19ns*	1.68b[#]	0.42bcd	0.30b	218.34a	61.89a	43.62a	11.25ns
Crest Heaven	2.33	2.04ab	0.44ab	0.27bc	142.50bc	50.71ab	36.85b	8.33
Chasty	2.47	2.03ab	0.43abcd	0.27bc	229.49a	45.85b	31.33bc	12.08
Fairlane	2.19	2.22ab	0.43abcd	0.26c	110.44c	41.84b	30.14c	9.38
Washington	2.18	1.87ab	0.41cd	0.34a	133.02c	48.40b	36.31bc	9.38
Independence	2.41	2.43a	0.46a	0.26c	167.03b	47.31b	34.47bc	8.75
Hale Heaven	2.11	1.68b	0.40d	0.29bc	116.29c	44.15b	31.64bc	9.17
S. Super Star[&]	2.28	1.97ab	0.43abcd	0.27bc	166.47b	43.91b	29.86c	10.00
Dixi Red	2.32	1.93ab	0.44abc	0.30b	105.28c	44.15b	34.93bc	10.42

&=Summer Super Star, #=Numbers sharing the same letter are statistically not different ($p<0.05$),
*ns=Non significant

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