Plant Nutrient Characterization of Akça Pear (*pyrus communis l.*) Cultivars Grown in Aegean Region of Turkey

Bülent TOPCUOĞLU and M. KUBİLAY ÖNAL

Abstract— **The study was conducted on early-ripening Akça pear cultivars (*Pyrus communis* L.) collected from Aegean region of Turkey for assessing the plant nutrient contents. Total quantities of nutrients accumulated within the deciduous organs were used to make provisional estimates of the uptake of macro and micro nutrients by the Akça pear cultivars used in this study. The concentrations of macro and micro nutrients within the leaves of 13 pear cultivars were recorded over two growing seasons. Potassium was clearly the major nutrient in the samples in the investigated cultivars, and this nutrient is likely to be a major component of maintanence fertiliser programmes. In general, most of the nutrient concentrations of the 2036, 2051 and 2103 cultivars were slightly higher than the nutrient concentrations of the other varieties. Application of these data in future studies has potential utility within the fields of agro-biodiversity conservation and nutrition of Akça pears**.

***Keywords*— Pear cultivars, Nutrients, Genotypic variability**

I. Introduction

The pear is one of the distinguished members of fruits belonging to *Pyrus communis,* and is extensively produced in Turkey. There is great diversity among cultivars of *Pyrus communis* in terms of physical and chemical characteristics, and Akça pear is one of the most important varieties and the earliest ripening cultivar grown in Aegean region of Turkey, and has several different types [1].

Differences among species and genotypes in plant response to mineral nutrient deficiency have been reported by many authors. Nutrient concentration and uptake by different plant genotypes are the most important criteria for identifying the existing genetic specificity of plant nutrition [2]. The tolerance in a given plant species or genotype to nutrient stress is closely related to its nutrient use efficiency. For a given genotype, nutrient use efficiency is reflected by the ability to produce a high yield in a soil that is limiting in one or more mineral nutrients for a standard genotype [3]. The exploration of genotypic variability in the responses of Akça pear to mineral nutrient deficiency may allow identification of physiological or biochemical tools to screen tolerant varieties and to improve the productivity of this plant. Variability among cultivars in potential for uptake of mineral nutrients is caused by factors which are at least partly under genetic control. However, balanced nutrition is required for maximum tree performance and foliage is the tissue most generally used in diagnosis.

Although there is extensive research on the pear, literature does not report any data on the nutritional properties of pear based on this variety. In the current study, influence of different Akça pear cultivars on leaf mineral composition was studied.

Bülent Topcuoğlu, is with Vocational School of Technical Sciences, Akdeniz University; Antalya, Turkey;
Kubilay Önal, is with Vocational School of Technical Sciences, Akdeniz University; Antalya, Turkey;

II. Material And Methods

A two-year study was conducted in an experimental orchard of Aegean Agricultural Research Institute located near Menemen country of Izmir province for assessing the leaf nutrient contents of early-ripening Akça pear cultivars (*Pyrus communis* L.). These cultivars had selected from İzmir, Aydın and Manisa provinces of Aegean region of Turkey, and had taken into an adaptation trial in this orchard. Leaf samples were collected from 13 Akça pear cultivars namely Akça (control, accepted as standart cultivar), 2036, 2039, 2042, 2043, 2045, 2051, 2099, 2100, 2101, 2102, 2103 and 2104. Soil characteristics of experimental soil can be summarized as; sandy loam texture, slightly alkaline reaction, low $CaCO_3$, high exchangeable K and Ca contents, normal levels of N and plant available P, K, Ca, Mg, Fe, Zn, Mn and Cu.

Leaf samples were taken on mid may, with five replications. Leaf samples were dried at 65 ºC for 48 h and ground for determination of plant analysis. In dried leaf samples, total N were determined by Kjeldahl method. Plant tissues were digested in aqua regia (1:3 HNO_3/HCl) for mineral analysis. In wet ashed leaf samples total P were determined by molibdophosphoric yellow colour method, total K, Ca, Mg, Fe, Zn, Mn and Cu were determined by atomic absorption spectrophotometry (FAAS) under optimised measurement conditions.

Variance analysis was carried out on thirteen pear varieties, and the difference between the mean values was investigated by using the standart Least Significant Difference (LCD) test.

III. Results And Discussion

In this study, total quantities of plant nutrients accumulated within the deciduous organs were used to make provisional

estimates of uptake of macro and micro nutrients by Akça pear trees used in this study.

Table 1 shows that the statistical effects of year and cultivar differences on the leaf nutrient concentrations of Akça pear cultivars. No changes except N concentration were recorded in investigated nutrients with the year. However, all investigated nutrients except Cu were recorded significantly different within the cultivars.

TABLE I. EFFECT OF YEAR AND CULTIVARS ON LEAF NUTRIENT CONTENTS OF AKÇA PEAR CULTIVARS.

	Leaf Nutrients of Akça pear cultivars								
	N	P	K	Ca	Mg	Fe	Zn	Mn	Cu
Year	*	ns	ns	ns	ns	ns	ns	ns	ns
Cultivar	**	**	**	**	**	**	**	**	ns

*, ** : significant levels at 5 % and 1 % respectively, ns: not significant

Table 2 and Table 3 show that leaf mineral contents of Akça pear cultivars sampled in two years. Table II also shows that critical nutrient concentrations of all varieties of pear proposed by Pennsilvania State University Agricultural Analytical Services Laboratory, to make comparative estimates for Akça pear nutrition.

Leaf nitrogen contents of Akça pear cultivars significantly varied with respect to year. Nitrogen contents were slightly lower in the second year. Leaf nitrogen content of Akça pear cultivars were generally ranged in normal levels. High nitrogen contents were determined in 2036, 2051 and 2103 cultivars. In this subject, It is indicated that year effect was predominant only for leaf nitrogen and phosphorus [4].

Leaf phosphorus contents of Akça pear cultivars were ranged between low and normal levels. Although phosphorus content of all cultivars except 2036, 2051 and 2103 was near to the low level, no deficient symptoms were observed on the cultivars at the time of sampling. Potassium concentration was found in high levels and was the major element present in the investigated Akça pear cultivars with a range of 1.88-3.47 %. Possibly, this may be caused by high exchangeable soil potassium content. Similar results were found in Japanese pear [5]. Thus this nutrient is likely to be major component of maintanence fertilizer programmes. As for calcium, magnesium, iron, zinc, manganese and copper concentrations were ranged between normal and high levels. Mineral element content of Akça cultivar that represents standart cultivar of Akça pear genotypes was determined in intermediate levels among the investigated cultivars.

IV. CONCLUSION

In breeding programs priorities are generally given to traits as adaptability to environmental conditions, high yield and fruit quality or disease resistance. However, mineral nutrition may create marked effects on above mentioned characteristics. In this regard, significant differences were found among the cultivars. Among the Akça pear cultivars, the concentration of plant nutrients in 2036, 2051 and 2103 cultivars were higher than the other investigated cultivars. A parallel study to this research conducted by authors also showed that these cultivars were taken the first place according to weighed-ranked method with regard to some characteristics such as yield, fruit size and earliness. These results could be helpful in development of reliable screening parameters for selection of high nutrient containing and high nutrient-use efficient genotypes in breeding programs.

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TABLE II. LEAF MINERAL CONTENTS OF AKÇA PEAR CULTIVARS (*PYRUS COMMUNIS* L.) SAMPLED IN THE FIRST YEAR.

Cultivars	N	P	K	Ca	Mg	Fe	Zn	Mn	Cu
	%, dw					mg kg^{-1}, dw			
Akça,	1.93[1] cde[2]	0.15 abc	2.72 d	1.68 c	0.58 b	148 c	38 c	114 d	9
2036	**2.75 a**	**0.15 abc**	**3.33 b**	**1.89 b**	**0.56 c**	**145 c**	**58 a**	**133 c**	**7**

2039	2.10 bcd	0.11 de	2.32 f	1.41 ef	0.60 b	107 fg	16 g	77 ef	10
2042	2.15 bcd	0.14 bc	2.82 d	1.37 fg	0.61 ab	125 d	23 f	130 c	13
2043	1.97 cde	0.11 de	2.27 f	1.72 c	0.36 f	120 d	30 e	90 e	14
2045	2.05 bcd	0.15 abc	2.39 ef	2.15 a	0.59 b	112 e	31 de	132 c	11
2051	**2.27 bc**	**0.17 a**	**3.47 a**	**1.57 d**	**0.64 a**	**164 ab**	**48 b**	**155 b**	**11**
2099	1.90 cde	0.14 bc	2.45 e	1.37 fg	0.39 e	121 d	18 g	70 f	8
2100	1.88 def	0.13 cd	2.82 d	1.55 d	0.41 e	158 b	17 g	88 ef	7
2101	1.76 ef	0.11 de	2.78 d	1.45 e	0.56 c	94 h	34 cd	180 a	13
2102	1.62 f	0.10 e	1.96 g	1.32 g	0.48 d	100 gh	37 c	83 ef	12
2103	**2.40 ab**	**0.16 ab**	**3.14 c**	**1.82 b**	**0.64 a**	**167 a**	**60 a**	**165 ab**	**10**
2104	1.78 def	0.14 bc	2.31 f	1.44 ef	0.49 d	81 ı	35 c	109 d	8
CC[3]	1.35-1.60-2.41	0.15-0.18-0.26	0.16-0.20-2.01	0.10-1.30-9.01	0.05-0.30-0.61	40-50-400	5-20-200	5-20-199	2-6-25

[1] : All data represent the mean of three determinations; [2]: Means followed by the same letter are not significantly different at the 0.05 level, [3]: CC(Critical concentrations; Low, normal and high nutrient levels of pear plant [6].

TABLE III. LEAF MINERAL CONTENTS OF AKÇA PEAR CULTIVARS (*PYRUS COMMUNIS* L.) SAMPLED IN THE SECOND YEAR.

Cultivars	N	P	K	Ca	Mg	Fe	Zn	Mn	Cu
	%, dw					mg kg^{-1}, dw			
Akça,Control	1.71 bc[1]	0.15 b	2.88 d	1.55 de	0.55 c	135 c	36 c	102 c	10
2036	**2.32 a**	**0.16 ab**	**3.55 a**	**1.82 b**	**0.61 ab**	139 c	**56 a**	**175 a**	**10**
2039	1.74 bc	0.12 c	2,28 g	1.38 gh	0.56 c	101 f	17 f	74 d	13
2042	2.00 ab	0.14 bc	2.92 d	1.43 fg	0.59 bc	79 ı	21 e	131 b	13
2043	1.66 bc	0.12 c	2.33 fg	1.69 c	0.37 g	124 d	33 c	91 cd	11
2045	1.77 bc	0.14 bc	2.44 f	2.05 a	0.63 a	114 e	28 d	126 b	12
2051	**2.02 ab**	**0.17 a**	**3.38 b**	**1.63 cd**	**0.64 a**	**168 a**	**51 b**	130 b	**13**
2099	1.74 bc	0.14 bc	2.45 f	1.42 fg	0.41 f	128 d	21 e	86 d	9
2100	1.64 bc	0.12 c	2.96 d	1.56 de	0.41 f	**155 b**	17 f	84 d	9
2101	1.52 c	0.14 bc	2.69 e	1.51 e	0.56 c	104 f	33 c	**159 a**	12
2102	1.42 c	0.18 a	1.88 h	1.33 h	0.52 d	94 g	35 c	81 d	13
2103	**2.18 a**	**0.18 a**	**3.24 c**	**1.85 b**	**0.62 a**	**172 a**	**57 a**	**160 a**	**14**
2104	1.64 bc	0.17 a	2.39 fg	1.49 ef	0.47 e	89 h	33 c	106 c	10

[1] : Means followed by the same letter are not significantly different at the 0.05 level.