

Mineral Composition of Pistachio (*Pistacia vera* L.) from Siirt, Turkey

AHMET KAZANKAYA*, FIKRI BALTA, NESLIHAN ÖZTÜRK and FERIT SÖNMEZ†

Department of Horticulture, Faculty of Agriculture

University of Yüzüncü Yıl, Van 65080, Turkey

Fax: (90)(432)2251331; E-mail: akazankaya@hotmail.com

This study evaluates fruit-leaf nutrient contents and some pomological characteristics of pistachio selections from Siirt, south-eastern Turkey. Based on average values of two years, pistachio selections had 1.21-1.93 g fruit weight, 0.46-0.81 g kernel weight and 31.5-49.0 % kernel percentage. Their splittings were high, medium and low. Harvest time was between 20 September and 05 October. Fruits of selections contained 3.04-4.20 % N, 0.168-0.441 % P, 0.348-1.084 % K, 0.189-2.819 % Ca, 0.762-2.445 % Mg, 11,14-330.36 ppm Fe, 2.36-4.82 ppm Mn, 4.23-31.49 ppm Zn and 0.43-22.71 ppm Cu. Their leaf nutrient contents were 1.12-2.18 % N, 0.006-0.132 % P, 0.44-2.47 % K, 2.82-6.35 % Ca, 2.97-4.67 % Mg, 25.3-314.8 ppm Fe, 6-67 ppm Mn, 11.0-33.2 ppm Zn and 4.75-91.79 ppm Cu. Findings of selections were compared with those of 'Siirt' Turkish pistachio cultivar.

Key Words: Minerals, *Pistacia vera* L.

INTRODUCTION

Turkey is one of origin centers of pistachio (*Pistacia vera* L.)^{1,2}. In Turkey, the most important production region of pistachio is southeastern Anatolia where include in Siirt, Gaziantep, Kahraman Maras, Urfa, Diyarbakir, Mardin, Batman, Sirnak and Adiyaman provinces and meets 94 % of Turkey's pistachio production³. Turkey's annual pistachio production is expected to increase under irrigated conditions in frame of the GAP (The South-East Anatolia Regional Project) during future years^{2,4}. The most known pistachio cultivars of Turkey are Uzun, Kirmizi and Siirt. The cultivar Siirt has larger kernels with oval nuts and high splitting percentage and its alternate bearing is less than other cultivars⁵. Turkey is rich in native pistachio populations, but enough selection studies regarding desirable fruit and tree characteristics are limited. Promising pistachio genotypes need morphological

†Department of Soil Science, Faculty of Agriculture, University of Yuzuncu Yil, Van 65080, Turkey.

and nutritional identification. On the other hand, the commercial growing of the edible species *Pistacia vera* L. in Turkey is traditionally performed under unirrigated conditions on stony, rock, calcereous and poor arid soils of this region having 300-500 mm annual rainfall. Therefore, yield per tree is low.

Pistachio nuts are also valuable with respect to mineral contents (Ca, Mg, K, P, Cu, *etc.*), in addition to their vitamins⁴ and unsaturated fatty acids which are essential for the human diet. Mineral composition that is closely related to growing conditions, influences fruit quality and nutrition. Although many researches have been reported related to mineral contents of pistachio cultivars in Turkey⁶⁻¹⁰, findings associated with leaf-fruit mineral compositions of promising selections that are valuable for breeding efforts, are limited. This study aimed at determination of leaf-fruit nutrient composition of promising pistachio selections from Siirt, Turkey.

EXPERIMENTAL

The study was carried out in Siirt and Pervari districts during 2004 and 2005. In 43 promising pistachio genotypes (*Pistacia vera* L.) selected from the native pistachio population in these districts, some fruit characteristics such as fruit weight, kernel weight, kernel percentage and splitting were described. The 30 fruit samples were used in describing fruit traits in each genotype. These genotypes were harvested from 20 September to 05 October. These genotypes are native grown under unirrigated conditions on stony, rock, calcereous and poor arid soils of these districts. For mineral content analysis, plant samples were oven-dried at 68 °C for 72 h and then were ground. Nitrogen was determined by kjeldahl method, phosphorus was spectrophotometrically determined by the iodo-phenol-blue method. Potassium, calcium, magnesium, iron, manganese, zinc and copper contents in the extracts were determined by using atomic absorption spectrophotometry¹¹. Contents of N, P, K, Na, Ca, Mg, Fe, Zn, Mn ve Cu in fruit and leaf samples were analyzed¹².

RESULTS AND DISCUSSION

According to average data of two years, pistachio selections had 1.21-1.93 g fruit weight, 0.46-0.81 g kernel weight and 31.5-49.0 % kernel percentage. Their splittings were high, medium and low. The splitting was high in 14 genotypes. Harvest time was between 20 September and 05 October. Therefore, harvest times were late September and early October. Pistachio nuts are harvested in late August and September in Turkey depending on cultivars and locations⁴. The desirable important characteristics of pistachio cultivars include large nuts and kernels, high percentage of splitting, regular bearing every year and high percentage of green kernels¹.

The most popular pistachio cultivars of Turkey are Uzun, Kirmizi and Siirt. The nuts of Uzun and Kirmizi cultivars are long and their green kernels are small and have excellent taste. The cultivar Siirt has larger kernels with oval nuts and high splitting percentage. Most pistachio varieties have been found by selection². Tekin and Akkök³ reported 37-94 % splitting percentage and 38-47 % kernel percentage for 16 promising pistachios from Gaziantep, Sanli Urfa, Kahraman Maras and Adiyaman provinces. Karaca and Nizamoglu¹³ recorded 86 % splitting percentage and 44 % kernel percentage for Siirt variety. Akkök and Karaca¹⁴ determined 53.1 g kernel weight and 63 % splitting percentage for Siirt. When findings are compared to those with Siirt variety and related references, many pistachio genotypes from this study were promising regarding some fruit traits.

Fruits of selections contained 3.04-4.20 % N, 0.168-0.441 % P, 0.348-1.084 % K, 0.189-2.819 % Ca, 0.762-2.445 % Mg, 11.14-330.36 ppm Fe, 2.36-4.82 ppm Mn, 4.23-31.49 ppm Zn and 0.43-22.71 ppm Cu. Their leaf nutrient contents were 1.12-2.18 % N, 0.006-0.132 % P, 0.44-2.47 % K, 2.82-6.35 % Ca, 2.97-4.67 % Mg, 25,3-314.8 ppm Fe, 6-67 ppm Mn, 11.0-33.2 ppm Zn and 4.75-91.79 ppm Cu. When nutrient compositional findings of selections were compared with those of Siirt, Turkish pistachio cultivar, some genotypes had higher fruit and leaf nutrient contents than Siirt cultivar. Also, fruits contained higher N and P leaves, while leaves had higher K, Ca, Mg and Mn contents than fruits. In addition, leaf and fruit Fe, Cu and Zn contents depended on genotypes. Küçüköner and Yurt⁶ reported that fruits of Ohadi, Halebi, Uzun, Kirmizi and Siirt varieties contained 684-766 mg/100 g K, 136-146 mg/100 g Mg and 1.19-1.51 mg/100 g Cu, respectively. Çağlarirmak *et al.*¹⁰ recorded that pistachio nuts contained 116-117 mg/100 g Mg, 633-651 mg/100 g K, 167-175 mg/100 g Ca, 0.72-0.77 mg/100 g Cu, 2.74-2.82 mg/100 g Zn and 0.54-0.61 mg/100 g Fe. Malakouti⁹ reported that fruits of pistachio varieties grown in calcareous soil in Iran contained 3.2 % N, 0.62 % P, 1.5 % K, 0.14 % Mg, 65 mg/kg Fe, 10 mg/kg Mn and 0.12 mg/kg Zn. According to findings, nuts of our genotypes contained higher Mg and lower K and Cu than reported by Küçüköner and Yurt⁶. In addition, they contained higher Ca and Mg and lower K, Cu, Zn and Fe than reported by Çağlarirmak *et al.*¹⁰.

Tekin *et al.*⁸ determined 1.80-2.20 % N, 0.06-0.13 % P, 0.8-1.2 % K, 2.2-3.7 % Ca, 43-170 ppm Fe, 20-50 ppm Mn, 10-25 ppm Zn and 3-4 ppm Cu in the leaves of pistachio varieties. Reporting that leaf nutrients in pistachios are influenced by technical and cultural practices, Seferoglu *et al.*¹⁵ determined 1.12-2.46 % N, 0.085-0.150 % P, 0.81-2.02 % K, 1.30-3.70 % Ca and 0.40-0.92 % Mg in pistachio leaves. Malakouti⁹ reported that leaves of pistachio varieties grown in calcareous soil in Iran contained 2 % N,

TABLE-1
SOME FRUIT CHARACTERISTICS OF PISTACHIO GENOTYPES FROM SIIRT

Pistachio genotypes	Fruit weight (g)	Kernel weight (g)	Kernel percentage (%)	Splitting	Harvest time
56PR01	1.60	0.77	47.5	Medium	25-30 September
56PR02	1.37	0.46	34.0	High	20-25 September
56PR03	1.68	0.66	39.0	Low	25-30 September
56PR13	1.53	0.65	43.0	High	25-30 September
56PR17	1.49	0.67	44.5	Medium	25-30 September
56PR30	1.48	0.56	38.0	Medium	1-5 October
56PR32	1.51	0.61	41.0	High	1-5 October
56PR35	1.27	0.49	38.0	Low	1-5 October
56PR36	1.30	0.58	45.0	Low	1-5 October
56PR37	1.36	0.65	48.0	Medium	1-5 October
56PR38	1.30	0.52	39.5	Medium	25-30 September
56PR39	1.31	0.60	45.0	Medium	20-25 September
56PR40	1.22	0.52	42.0	High	25-30 September
56PR41	1.36	0.51	38.0	Medium	25-30 September
56PR43	1.45	0.46	31.5	High	1-5 October
56PR44	1.36	0.53	37.5	Low	1-5 October
56PR45	1.40	0.61	43.0	Medium	25-30 September
56PR46	1.23	0.55	44.0	Medium	25-30 September
56PR47	1.28	0.53	41.5	Medium	25-30 September
56PR48	1.54	0.63	42.0	Medium	25-30 September
56PR49	1.40	0.58	41.0	Low	1-5 October
56PR50	1.41	0.53	37.5	Medium	1-5 October
56PR51	1.38	0.60	43.0	High	25-30 September
56PR52	1.34	0.60	44.0	Medium	25-30 September
56PR53	1.34	0.58	43.0	High	20-25 September
56PR54	1.57	0.67	42.5	Medium	25-30 September
56PR55	1.51	0.63	42.5	Medium	1-5 October
56PR56	1.48	0.63	43.0	High	1-5 October
56PR57	1.36	0.57	42.0	Low	20-25 September
56PR58	1.39	0.64	45.0	High	1-5 October
56PR59	1.27	0.51	39.5	Low	25-30 September
56PR60	1.45	0.65	44.0	Medium	20-25 September
56PR61	1.53	0.67	44.0	High	25-30 September
56PR63	1.31	0.53	39.5	Low	1-5 October
56PR64	1.27	0.63	49.0	High	25-30 September
56PR65	1.42	0.67	46.0	Low	1-5 October
56PR66	1.21	0.52	43.0	Medium	1-5 October
56PR67	1.44	0.59	40.5	Low	25-30 September
56PR68	1.37	0.57	42.5	Medium	25-30 September
56PR69	1.44	0.67	46.0	High	20-25 September
56PR70	1.65	0.56	35.5	Low	20-25 September
56PR71	1.93	0.81	43.0	Low	1-5 October
56PR72	1.57	0.64	41.5	High	20-25 September
Siirt	1.32	0.65	49.2	High	1-5 October

TABLE-2
FRUIT NUTRIENT CONTENTS OF PISTACHIO GENOTYPES FROM SIIRT

Pistachio genotypes	N (%)	P (ppm)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)
56PR01	3.51	3114	0.55	0.46	1.19	93.12	7.57	27.64	5.48
56PR02	3.69	2994	0.57	0.37	0.76	63.10	6.71	21.98	6.10
56PR03	3.71	4192	0.66	0.44	0.98	82.80	8.26	29.74	10.16
56PR13	4.01	2156	0.58	0.86	1.28	51.65	6.49	20.92	6.83
56PR17	3.97	3293	0.73	0.79	1.53	68.91	7.05	24.24	6.32
56PR30	3.04	4371	0.52	0.71	1.28	41.34	7.19	24.87	19.31
56PR32	3.51	3473	0.55	0.60	1.15	70.99	9.61	28.06	12.33
56PR35	3.74	4413	0.58	0.71	1.25	69.71	10.88	31.49	12.98
56PR36	4.07	2216	0.35	0.52	1.09	56.31	4.02	15.62	8.70
56PR37	4.11	3054	0.48	0.59	1.10	81.77	6.79	28.51	12.31
56PR38	3.97	2455	0.64	0.61	1.23	58.70	6.47	23.53	8.53
56PR39	3.44	2335	0.42	0.52	1.08	91.00	5.43	17.82	10.34
56PR40	3.65	2695	0.62	0.88	1.53	105.71	6.79	20.92	9.24
56PR41	3.59	3713	0.91	0.99	1.79	127.97	8.88	26.72	12.31
56PR43	3.81	3412	1.08	2.81	2.44	149.98	4.82	19.44	22.71
56PR44	3.87	2575	0.53	0.72	1.37	104.44	5.38	19.22	8.36
56PR45	3.11	1916	0.49	0.82	1.60	44.92	4.63	12.29	3.64
56PR46	3.24	1916	0.57	0.76	1.48	262.11	6.46	22.29	9.74
56PR47	4.12	1677	0.34	0.75	1.48	49.85	3.34	12.34	6.75
56PR48	4.10	2216	0.43	0.67	1.26	71.02	5.19	20.87	7.22
56PR49	4.01	2096	0.67	0.71	1.44	90.54	7.08	25.55	9.32
56PR50	4.14	2575	0.54	0.63	1.33	54.74	9.03	24.74	11.55
56PR51	3.97	1856	0.43	0.53	1.19	90.30	4.71	19.07	10.71
56PR52	3.85	2695	0.54	0.54	1.26	40.92	3.98	19.12	8.71
56PR53	4.01	1976	0.45	0.67	1.34	73.79	5.76	31.28	8.91
56PR54	3.98	2755	0.43	0.51	1.16	53.99	4.76	21.72	13.01
56PR55	3.12	2096	0.44	0.46	1.17	69.78	3.60	28.11	12.42
56PR56	3.20	2096	0.50	0.64	1.44	79.71	2.92	19.20	10.73
56PR57	3.14	2156	0.43	0.50	1.33	51.54	3.54	21.83	10.29
56PR58	3.20	2156	0.62	0.53	1.19	46.58	2.36	25.66	8.94
56PR59	3.51	2335	0.37	0.65	1.26	170.32	4.99	23.63	8.94
56PR60	3.97	2455	0.50	0.48	1.34	74.50	3.42	23.50	12.14
56PR61	4.12	2216	0.66	0.55	1.16	84.91	3.42	23.66	7.49
56PR63	4.01	1976	0.60	0.59	1.17	330.36	5.97	21.41	9.06
56PR64	4.07	2395	0.64	0.58	1.48	39.51	7.76	20.51	12.61
56PR65	4.20	1916	0.53	0.79	1.40	43.59	2.61	21.51	7.49
56PR66	3.90	3293	0.58	0.18	1.15	62.38	3.94	21.34	7.21
56PR67	3.87	3409	0.56	0.65	1.29	98.09	3.09	23.57	5.95
56PR68	4.12	2994	0.50	0.62	1.45	48.03	4.89	29.93	10.12
56PR69	3.64	4192	0.43	0.76	1.50	79.99	3.61	25.43	11.30
56PR70	3.98	2994	0.62	0.42	0.93	44.99	5.85	25.41	8.70
56PR71	3.44	3892	0.56	0.40	1.01	46.06	6.30	6.61	0.43
56PR72	3.52	3770	0.53	0.43	1.06	11.14	6.90	4.23	1.56
Siirt	4.12	3772	0.57	0.53	1.19	104.47	8.55	24.05	9.46

TABLE-3
LEAF NUTRIENT CONTENTS OF PISTACHIO GENOTYPES FROM SIIRT

Pistachio genotypes	N (%)	P (ppm)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)
56PR01	1.57	462	1.16	4.75	3.78	88.8	49.2	17.0	7.87
56PR02	1.54	404	0.95	3.62	3.75	65.1	26.7	17.6	8.43
56PR03	1.29	519	1.42	4.54	3.38	48.5	43.0	20.9	9.50
56PR13	1.96	462	1.39	3.62	4.16	44.9	19.0	16.4	9.33
56PR17	1.99	409	1.07	4.48	4.04	25.3	25.0	23.4	5.92
56PR30	1.90	519	1.89	4.44	3.68	87.3	50.0	21.0	8.52
56PR32	1.96	462	1.42	4.15	4.32	88.5	28.0	16.5	6.65
56PR35	1.99	346	1.20	4.98	3.83	101.1	34.0	18.1	6.11
56PR36	1.62	692	1.99	5.44	3.45	193.5	34.0	28.1	6.95
56PR37	1.85	519	1.01	4.18	3.47	184.9	31.0	23.6	6.61
56PR38	2.13	519	1.02	5.02	3.49	104.8	43.0	14.0	7.61
56PR39	1.23	346	1.46	3.41	3.69	160.7	22.0	19.9	8.35
56PR40	1.68	461	1.07	4.40	4.01	192.9	38.0	16.1	7.09
56PR41	1.71	519	1.37	4.83	3.92	256.3	40.0	15.8	8.03
56PR43	1.40	404	0.69	4.34	3.64	221.1	25.0	17.6	5.28
56PR44	1.60	593	1.04	3.74	3.55	144.8	17.0	18.5	8.19
56PR45	1.85	692	1.31	4.44	3.17	272.2	25.0	17.3	8.53
56PR46	1.54	577	1.16	3.44	4.40	241.5	22.0	17.6	8.04
56PR47	2.02	693	0.58	4.24	3.26	160.2	20.0	16.8	5.63
56PR48	1.43	750	1.04	4.11	4.67	92.2	10.0	20.9	25.98
56PR49	2.18	1327	1.66	6.35	4.43	225.7	33.0	25.6	11.01
56PR50	1.12	461	0.55	4.57	3.02	44.0	32.0	14.1	9.25
56PR51	1.88	462	1.53	2.82	3.62	131.8	15.0	24.5	6.69
56PR52	1.37	750	1.13	4.49	3.87	183.2	37.0	16.0	10.17
56PR53	1.34	634	1.33	4.41	3.88	171.3	21.0	18.4	8.70
56PR54	1.13	577	1.82	3.64	4.37	156.3	37.0	32.9	5.68
56PR55	1.60	1154	1.66	5.78	3.05	73.4	67.0	33.2	91.79
56PR56	1.57	577	1.99	3.10	3.79	166.9	17.0	17.3	10.01
56PR57	1.71	115	0.44	4.57	3.48	82.4	28.0	17.3	6.32
56PR58	1.68	115	1.37	4.53	3.88	188.4	16.0	18.6	34.82
56PR59	1.37	115	1.17	4.05	3.82	167.3	17.0	17.3	10.20
56PR60	1.40	115	0.71	3.88	3.58	52.8	6.0	11.1	6.95
56PR61	1.79	289	1.05	3.04	3.29	94.4	19.0	19.2	4.75
56PR63	1.74	981	1.22	3.80	2.98	100.3	12.0	15.8	9.14
56PR64	1.62	58	1.91	2.97	3.69	168.5	15.0	11.0	8.43
56PR65	1.51	347	0.54	5.63	3.26	159.9	24.0	11.2	8.77
56PR66	2.02	115	1.71	3.19	3.01	157.3	13.0	17.4	5.28
56PR67	1.93	173	2.47	3.48	3.53	163.5	34.0	17.0	6.29
56PR68	1.65	58	2.21	4.36	4.07	79.6	28.0	22.9	9.35
56PR69	1.40	173	1.35	4.76	4.08	187.7	21.0	22.4	10.00
56PR70	1.48	173	1.96	5.28	3.20	221.7	21.0	27.7	9.21
56PR71	1.99	403	1.78	3.18	3.57	197.3	13.0	27.5	8.34
56PR72	1.90	173	2.16	4.03	2.97	314.8	13.0	21.7	10.73
Siirt	1.34	288	2.27	5.16	3.96	279.3	53.0	26.9	19.06

0.12 % P, 1.6 % K, 2.5 % Ca, 0.5 % Mg, 110 mg/kg Fe, 50 mg/kg Mn, 40 mg/kg Zn and 12 mg/kg Cu. Brown *et al.*¹⁶ recorded that pistachio leaves on year uptake more N, P and Zn from the soil than off year. Zeng *et al.*¹⁷ recorded that K application increased pistachio yield and quality. In most pistachios grown in Turkey, deficiencies of P, N, Fe and Zn have been reported⁷.

Leaf and fruit nutrient data indicated that they varied by different ecological conditions, soil structure and technical and natural practices.

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