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Nutrient contents of pistachio trees (*Pistacia vera L.*) growing in district of Şanlıurfa and the relationship between their microelement deficiency and some soil properties

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SUMMARY – This research as carried out in the Halfeti and Birecik Provinces of Şanlıurfa ere pistachio is the prevalent fruit. In this research, a total of 11 plant samples, which consist of two different varieties, were taken and analysed chemically, then analysis results were evaluated statistically. Research results showed that N, K, Mn, Fe and Zn content of plant samples were significantly deficient. Additionally, significant relationships ($p < 0.05$) were determined between nutrient content of plant samples and lime, clay, silt, sand, CEC, P_2O_5, Cu and Fe contents of soils.

Key words: Microelement deficiency, nutrient content, pistachio trees, Halfeti and Birecik Provinces of Şanlıurfa.

RESUME *– "Teneurs en nutriments des pistachiers (*Pistachia vera *L.) cultivés dans la contrée de Şanlıurfa et relation entre leur déficit en microéléments et certaines propriétés du sol". Cette recherche a été menée dans les provinces de Halfeti et Birecik, de Şanlıurfa, où la pistache est le fruit prédominant. Dans cette étude ont été utilisés au total 11 échantillons de plantes, de deux variétés différentes, qui ont été prélevés et analysés chimiquement, et ensuite les résultats des analyses ont été évalués statistiquement. Les résultats de la recherche ont montré que les teneurs en N, K, Mn, Fe et Zn des échantillons de plantes étaient significativement déficitaires. En plus, une relation significative ($p < 0,05$) a été définie entre la teneur en nutriments des échantillons de plantes et les teneurs des sols en limons, argile, vase, sable, CEC, P_2O_5, Cu et Fe.*

Mots-clés *: Déficit en microéléments, teneur en nutriments, pistachier, provinces de Halfeti et Birecik de Şanlıurfa.*

Introduction

The main aim of obtaining of high quality and quantity of plant production is to determine the type of variety and amount of nutrients needed by plants. The time and appropriate method for taking of leave samples are the main factors effecting nutrient content of plant samples.

The evaluation of the results which are obtained from chemical analyses are achievement by comparing with the standard values. Standard value refers that average leave data obtained from analyses of many representative normal leaves.

There is a direct relationship between the plant nutrient content and soil properties. Physical and chemical structure of soils, variety and standard nutrient contents of plants, additionally, climatic factors are the well known relationships.

Standard nutrient content of pistachio leaves are stated; 1.80-2.20% N; 0.06-0.13% P; 0.80-1.20% K; 2.20-3.70% Ca; 0.50-0.90% Mg; 43-170 ppm Fe; 6-90 ppm Cu; 10-25 ppm Zn and 20-50 ppm Mn by Tekin *et al.* (1986).

Nutrient removal per ha by pistachio fruits and leaves are determined approximately 135 kg N, 131 kg K, 86 kg Ca, 39 kg Mg and 18 kg P by Brown *et al.* (1994). According to the researchers, in plant fruit production year, K, N and P requirement were increased 30, 22, 14% respectively.

This research was carried out to determine the nutrient content statue of the pistachio trees and to find relationships between microelement deficiency of pistachio trees and some physical and chemical properties of soil in Birecik and Halfeti Region of Şanlıurfa Province.

Materials and methods

In this research, total 22 plant and soil samples were used and some physical, chemical and statistical analyses were applied.

The plant analyses were carried out according to Kacar (1995). Texture (Bouyoucos, 1951), lime (Allison and Moode, 1965), pH (Grewelling and Peach, 1960) and CEC (Jackson, 1958) analyses are applied on soil samples. Statistical analysis were done with SPSS program and evaluated according to Düzgüneş (1963).

Results and discussion

In this research, some physical, chemical and statistical analyses were done on plant and soil samples. Physical, chemical and statistical analyses results were shown at Tables 1, 2, 3 and 4.

Table 1. Texture, lime, pH and CEC contents of soil samples

No.	Locations	Depth (cm)	Pistachio variety	Clay (%)	Silt (%)	Sand (%)	Lime (%)	pH (H_2O)	CEC (meq/100 g)
1	Birecik-Bağlarbaşı	0-20	Uzun	21.4	8.4	70.2	47.5	7.85	23.8
		20-40		28.7	24.0	47.3	44.4	7.81	24.7
		40-60		32.9	24.0	43.1	43.4	7.83	25.6
2	Birecik-Mirkelam[†]	0-20	Kırmızı	12.1	15.6	72.3	53.0	7.82	20.9
		20-40		18.3	22.9	58.8	52.6	8.00	21.3
3	Birecik-Arat Dağı	0-20	Kırmızı	30.8	26.0	52.1	42.1	7.89	31.8
		20-40		37.1	22.9	40.0	38.4	8.06	32.5
		40-60		27.7	32.3	40.0	36.0	7.78	32.3
4	Birecik-Telaza	0-20	Uzun	7.9	27.1	65.0	35.7	7.89	15.3
		20-40		6.8	28.2	65.0	36.0	7.96	14.8
		40-60		4.8	21.9	73.3	33.4	7.81	13.9
5	Birecik-Bağlarbaşı	0-20	Kırmızı	14.2	35.4	50.4	52.0	7.99	22.4
		20-40		24.6	29.1	46.3	49.2	7.87	24.4
		40-60		25.6	26.0	48.4	49.3	7.92	24.3
6	Birecik-Ayran-1	0-20	Uzun	22.5	22.9	54.6	61.8	7.83	24.5
		20-40		18.3	27.1	54.6	63.4	7.91	24.2
		40-60		22.5	22.9	54.6	61.2	7.95	24.7
7	Birecik-Ayran-2[††]	0-20	Kırmızı	24.6	37.5	37.9	86.8	7.91	15.7
8	Halfeti-1	0-20	Kırmızı	26.7	30.2	43.1	30.6	7.96	44.9
		20-40		30.8	25.0	44.2	29.8	7.92	47.7
		40-60		33.9	26.1	40.0	27.7	7.94	47.4
9	Halfeti-2[††]	0-20	Uzun	26.7	28.1	45.2	34.3	7.99	42.7
10	Halfeti-3	0-20	Kırmızı	13.1	28.1	58.7	50.3	7.78	24.3
		20-40		16.2	31.3	52.5	52.8	7.83	25.6
		40-60		20.4	28.1	51.4	57.3	7.79	26.7
11	Halfeti-4	0-20	Kırmızı	60.0	16.7	23.3	5.7	7.73	86.7
		20-40		60.0	14.6	25.4	4.4	7.84	89.7
		40-60		60.0	14.6	25.4	5.3	7.95	91.3

[†]Because of R horizon, soil samples weren't taken from the 40-60 cm depth.

[††]Because of R horizon, soil samples weren't taken from the 20-40 and 40-60 cm depth.

Table 2. Macro and extractable microelement contents of soil samples

No.	Locations	Depth (cm)	Macronutrients			Micronutrients (ppm)			
			N (%)	P_2O_5 (ppm)	K_2O (ppm)	Fe	Mn	Zn	Cu
1	Birecik-Bağlarbaşı	0-20	0.05	7.36	241	1.804	4.513	0.442	1.705
		20-40	0.05	8.56	125	1.080	1.829	0.591	1.053
		40-60	0.05	5.26	136	1.062	2.586	0.619	0.934
2	Birecik-Mirkelam[†]	0-20	0.06	5.90	152	1.008	5.890	1.321	3.699
		20-40	0.06	5.63	159	1.659	4.444	0.450	1.745
3	Birecik-Arat Dağı	0-20	0.07	8.63	130	1.000	3.205	0.700	1.213
		20-40	0.07	4.99	152	1.152	3.233	0.703	1.106
		40-60	0.05	8.96	175	1.333	2.125	0.397	1.253
4	Birecik-Telaza	0-20	0.07	7.59	201	2.383	3.845	0.411	3.766
		20-40	0.07	8.62	156	2.926	3.343	0.257	3.101
		40-60	0.08	7.15	177	3.252	2.035	0.184	0.707
5	Birecik-Bağlarbaşı	0-20	0.07	10.2	152	1.587	6.165	0.697	2.476
		20-40	0.07	10.6	214	2.781	3.033	0.318	1.359
		40-60	0.06	9.36	201	2.817	3.047	0.237	0.588
6	Birecik-Ayran-1	0-20	0.06	6.62	148	1.659	3.894	0.647	5.402
		20-40	0.06	5.26	135	1.659	3.894	0.647	5.402
		40-60	0.06	4.88	185	1.659	3.894	0.647	5.402
7	Birecik-Ayran-2[††]	0-20	0.07	8.62	196	2.926	3.130	0.459	1.239
8	Halfeti-1	0-20	0.07	4.89	163	3.035	5.132	1.307	2.569
		20-40	0.07	6.95	148	2.347	3.618	0.563	1.678
		40-60	0.06	6.89	152	2.057	4.307	0.835	1.718
9	Halfeti-2[††]	0-20	0.06	7.59	174	1.768	4.362	1.346	4.763
10	Halfeti-3	0-20	0.05	8.96	177	2.636	5.091	0.857	1.239
		20-40	0.05	8.59	196	1.759	4.327	0.633	1.332
		40-60	0.06	12.6	204	3.397	2.724	0.282	1.386
11	Halfeti-4	0-20	0.09	8.49	104	1.840	6.440	0.703	2.622
		20-40	0.08	10.2	155	0.971	2.744	0.450	1.279
		40-60	0.05	7.36	174	1.225	3.508	0.448	1.293

[†]Because of R horizon, soil samples weren't taken from the 40-60 cm depth.
[††]Because of R horizon, soil samples weren't taken from the 20-40 and 40-60 cm depth.

Table 3. Macro and microelement contents of leave samples

No.	Locations	Pistachio variety	Macronutrients (%)			Micronutrients (ppm)			
			N	P	K	Zn	Fe	Mn	Cu
1	Halfeti-1	Kırmızı	2.57	0.45	0.31	1.86	0.12	0.78	3.63
2	Halfeti-2	Uzun	2.13	0.25	0.31	14.08	92.86	28.27	12.75
3	Halfeti-3	Kırmızı	2.14	0.32	0.27	13.90	89.95	15.09	4.27
4	Halfeti-4	Kırmızı	1.96	0.29	0.32	17.98	58.30	10.05	8.82
5	Bağlarbaşı-1	Kırmızı	1.96	0.46	0.30	12.14	52.61	9.14	7.23
6	Bağlarbaşı-2	Uzun	2.10	0.36	0.28	11.48	61.27	10.52	7.02
7	Ayran-1	Uzun	1.57	0.37	0.29	4.64	4.45	1.47	1.73
8	Ayran-2	Kırmızı	1.49	0.63	0.38	13.05	45.85	8.06	7.87
9	Arat Dağı	Kırmızı	2.06	0.62	0.28	12.45	50.99	8.88	6.60
10	Mirkelam	Kırmızı	2.15	0.48	0.20	8.63	30.42	5.61	7.02
11	Telaza	Uzun	2.32	0.59	0.23	10.21	35.02	6.34	6.59

Table 4. The statistical analyses results between soil and plant characteristics[†]

n = 29	r	Soil properties													Plant properties						
		Clay	Silt	Sand	Lime	pH	CEC	N	P_2O_5	K_2O	Fe	Mn	Zn	Cu	N	P	K	Fe	Cu	Zn	Mn
Soil prop.	Clay	1																			
	Silt	–0.421	1																		
	Sand	–0.890	–0.023	1																	
	Lime	–0.647	0.478	0.480	1																
	pH	–0.047	0.194	–0.042	0.060	1															
	CEC	0.913	–0.454	–0.788	–0.805	–0.069	1														
	N	0.185	–0.091	–0.144	–0.370	0.024	0.283	1													
	P_2O_5	0.026	0.100	–0.067	–0.131	–0.418	0.104	0.119	1												
	K_2O	–0.358	0.040	0.345	0.299	–0.060	–0.323	–0.279	0.290	1											
	Fe	–0.464	0.243	0.360	0.232	–0.039	–0.320	0.223	0.199	0.371	1										
	Mn	–0.002	–0.032	0.007	–0.076	0.078	0.170	0.175	–0.106	–0.091	–0.114	1									
	Zn	0.063	0.059	–0.090	–0.061	0.157	0.143	–0.064	–0.372	–0.284	–0.313	0.066	1								
	Cu	–0.155	0.261	0.029	0.141	0.194	–0.072	0.127	–0.231	0.050	–0.113	0.491	0.497	1							
Plant prop.	N	–0.120	–0.030	0.146	–0.484	0.065	0.064	0.075	–0.011	–0.024	0.074	0.163	0.249	0.020	1						
	P	–0.390	0.366	0.290	0.232	0.257	–0.483	0.200	–0.252	0.017	–0.008	–0.177	–0.177	0.173	0.136	1					
	K	0.586	0.200	–0.749	–0.067	0.074	0.468	0.056	0.020	–0.042	–0.088	0.007	0.099	0.129	–0.336	–0.238	1				
	Cu	0.322	–0.166	–0.269	–0.384	0.066	0.305	0.095	0.109	–0.004	–0.507	0.146	0.175	0.436	0.062	–0.030	0.096	1			
	Zn	0.391	–0.165	–0.342	–0.288	–0.296	0.354	–0.002	0.443	0.088	–0.408	0.028	–0.149	0.068	–0.234	–0.212	0.131	0.709	1		
	Fe	0.098	0.027	–0.118	–0.060	–0.310	0.070	–0.290	0.489	0.247	–0.272	0.039	0.018	0.053	–0.047	–0.326	0.027	0.574	0.845	1	
	Mn	0.081	0.061	–0.118	–0.083	–0.137	0.088	–0.251	0.376	0.211	–0.240	0.073	0.211	0.232	–0.019	–0.382	0.078	0.667	0.721	0.920	1

[†] $p < 0.05$ ($0.361 < r < 0.4$); $p < 0.01$ ($r > 0.463$).

Physical and chemical properties of soil samples showed clay texture, high lime content (Kacar, 1995) and alkaline reaction (Jones, 1984). CEC of soil samples varied between 13.9-91.3 meq/100 g (Table 1).

Soil samples were low in content of N and P (Anonymous, 1991), and Fe and Zn (Lindsay and Norvell, 1978; Haktanır, 1987; Scheffer *et al.*, 1989; Eyüpoğlu *et al.*, 1996, 1998; Kızılgöz *et al.*, 1998). On the other hand, Cu and Mn content of soil samples were found adequately (see Table 2).

According to the results of chemical analyses (see Table 3), plants have low content of N, sufficient level of the P and low content of K (Bergmann, 1988; Aktaş, 1994; Marschner, 1996).

As seen in Table 3, the plant samples have adequate level of Cu (average 6.68 ppm) and Mn (average 9.47 ppm). But Fe (average 47.44 ppm) and Zn (average 10.94 ppm) level of plants were determined inadequate (Boehle and Lindsay 1969; Stangel, 1969; Bergmann, 1988; Scheffer *et al.*, 1989; Aktaş, 1994; Marschner, 1996; İnce, 1997).

Significant positive relationships were found between: clay content of soil-K content of plants; CEC-K; P-Fe; clay-Zn; silt-P; P-Zn; P-Mn and Cu-Cu. Additionally, significant negative relationships were obtained between sand-P; lime-N; CEC-P; Fe-Cu; clay-P; lime-Cu and Fe-Zn (see Table 4).

Conclusion

Chemical and physical analyses showed that the N, P, Fe and Zn content of pistachio trees were indicated inadequate level. It is inevitable that the plant nutrient deficiency of pistachio trees will be increased with irrigation. Besides, significant relationships ($p < 0.05$) were determined between nutrient content of plant samples and lime, clay, silt, sand, CEC, P_2O_5, Cu and Fe content of soil samples. Our recommendation to solve the mentioned problems:

(i) Similar studies should be done for the other fruit varieties (e.i. grape, almond).

(ii) Fertilizer studies should be started (especially leave fertilizer).

(iii) Rootstock varieties should be resistant to especially Fe and Zn deficiency.

(iv) Plant nutrient content of region soils should be accurately analysed.

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