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NUTRITIONAL PROBLEMS OF CARDINAL GRAPES GROWN IN ÇANAKKALE, TURKEY

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Abstract

The purpose of this study was to determine the nutritional status of the Cardinal grapes that are grown in Çanakkale. Leaf and soil samples were taken from 18 different vineyards to ensure a uniform sampling area. Although all of the soil samples contained suitable pH values for grapes, levels of organic matter content were found to be low. Lime ($CaCO_3$) content was at an insufficient level in 72% of the soils at 0-30 cm depth and in 61% of the soils at 30-60 cm depth. Phosphorous (P) content was at low and medium levels in 94% of the soils. Potassium (K) was found to be insufficient in 50% of the soils. In both depths, the iron (Fe) content of 33% of soils was lower than the critical level. Manganese (Mn) content was at an insufficient level in 22% of the soils. There were no nutritional problems with respect to zinc (Zn) and copper (Cu) in the soils.

Nitrogen (N), calcium (Ca), phosphorous (P), iron (Fe) and copper (Cu) contents of leaf blades were higher than those of leaf petioles. Potassium (K), magnesium (Mg) and manganese (Mn) contents of leaf petioles were higher than those of leaf blades. There were no differences between zinc (Zn) contents in leaf blades and leaf petioles.

The N content of 89% of the leaf blades and P content of 61% of the leaf blades was higher than the critical level. There were no nutritional problems with respect to K in leaf blades. The Ca contents of leaf blades and leaf petioles were found to be at insufficient levels. The Mg contents of leaf blades and leaf petioles were found to be sufficient. There were no nutritional problems in leaf blades and leaf petioles with respect to Fe, Mn, Zn and Cu.

Introduction

The northwestern Turkish province of Çanakkale spread over an area of 9737 km^2 is situated on the Gelibolu (Gallipoli) and Biga peninsulas. The weather is a combination of Mediterranean and Black Sea climates. Rain generally falls in the spring and winter. The sea temperature rises to its highest level in July and August. The annual average temperature, humidity and rainfall in Çanakkale are 14.8^{o}C, 80% and 623 mm., respectively.

Viniculture has been carried out throughout an area of 565000 ha in Turkey. The vineyards comprise an area totalling 7246 ha, with a portion of 1.28% being in Çanakkale. The 52358 tonnes of grape obtained from that area and subsequently consumed as wine and food, contribute to the local economy (Anon., 1995).

In studies carried out on both the size of vineyard areas and the yield per hectare, the viniculture area of 6513 hectares in 1997 (Anon., 1997) has decreased to 6489 hectares in 2003 (Anon., 2003). The main aim of this research was to determine the effect of nutrition on the decrease in yield per hectare, by examining the soil samples and leaf samples in the vineyards.

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There are various methods for investigating nutrition in vineyards. With the increasing importance of leaves analysis of the nutrition of vineyards, various researchers have attempted to determine nutrition element reference values for different parts of leaves, in different physiological periods (Beanie & Forshey, 1954; Larsen *et al*., 1956; Cahoon, 1970). Because of this, some researchers have recommended the leaf opposite the first cluster during the flower initiation and ripe fruit periods for analysis of the nutrition status (Cook, 1966). Some others believe that the leaf petioles of the leaf opposite the first cluster at the end of flower imitation period should be analysed (Beanie & Forshey, 1954; Cook, 1966; Kovancı & Atalay, 1977; Robinson *et al*., 1982). Levy (1968), who worked on leaves analysis methods in France, has standardized the method into two periods, and using the leaves opposite of the first cluster. According to Levy's standardization, the value in dry material (2.5% K_2O), accepted as the average of four periods, was reported to be too high and instead the value of 1.75% was suggested. Robinson *et al*., (1982) found the following critical values at the end of flower initiation period in the stalk petioles of the leaves: 0.22-0.53% for nitrogen, 0.20–0.46% for phosphorus, 0.50–4.00% for potassium, over 30% for magnesium, over 26 ppm for zinc, over 25 ppm for manganese, and over 30 ppm for boron.

Although there are not many studies about the contents of microelements in vineyards, Viets & Lindsay (1973) reported the microelements as either inadequate, borderline, or high, as follows: iron: 2.0-4.5 ppm; zinc: 0.5-1.0 ppm; copper: 0.2 ppm; manganese: 1.0 ppm; and boron: 0.5-1.3 ppm. In order to find out the areas in which there is presently a lack of nutrition, and those in which there will be a lack of nutrition in the future, nutrition element values and problems were studied in the field-grown Cardinal grape variety in Çanakkale.

Although Turkey cultivates various kinds of grapes for market, it has been unable to reach the desired level in both quality and output, even though it participates with special grape-producing countries having a yield of 3450000 tons. Our research has attempted to define the problems of nutrition, by analysing leaf and soil samples that typify the vineyard production areas using Cardinal grapes in Çanakkale city. This research in productivity studies in this region will hopefully contribute to a future rise in quality and output by increasing soil fertilization.

Materials and Methods

Soil and leaf samples, which typify the environs, were taken from a total of 18 vineyards. The soil samples were taken from three different places in every vineyard at depths of 0-30 cm and 30-60 cm. Soil and plant samples were taken between the 15th and the 20th of July, 1997.

The texture of the soil was determined according to Bouyoucos (1951); pH values were determined in 1:2.5 soil:water dilution according to Jackson (1958); the amount of lime ($CaCO_3$) was determined according to Çağlar (1949); phosphorus was determined according to Olsen *et al*., (1954); potassium was determined by extraction with 1 N ammonium acetate according to Bayraklı (1987); and iron, manganese, zinc and copper by extraction with 0.05 DTPA-TEA, according to Lindsay & Norvell (1978).

A total of 30 leaf samples were taken as per the suggestion of Levy (1968). Thus, samples were taken from 10 vines, in every vineyard, during their fruit-holding season, and they consisted of one leaf (leaf petiole+leaf blade) facing the first bunch. In the samples that were prepared for analysis after the cleaning, drying and grinding processes, according to Kacar (1972), the total nitrogen was analysed by the Kjeldahl process: phosphorus with vanadomolybdophosphoric yellow colour process, and potassium by flamephotometre. Calcium, magnesium, iron, manganese, zinc and copper were analysed with the AAS (Atomic Absorption Spectrofotometre) according to Bayraklı (1987). The values were a statistical analysed by the MINITAB package program.

Results and Discussion

The average, minimum and maximum values, according to depths of the analysed soil samples are given in Table 1.

Soil sample pH values seem to show differences that are due to depth: 4.6-7.7 in 0-30 cm depths and 5.5-7.8 in 30-60 cm depths: 17% of the soils that are in depths of 0-30 cm are in the class of strong acids (4.0-4.9); 28 % of them are in the middle acidity class (5.0-5.9); 22% are light acids (6.0-6.9); and 33% are light alkaline (7.0-7.9). With regard to soils at the depth of 30-60 cm, 33% of them are in the range of middle acidity (5.0-5.9); 28% are light acids (6.0-6.9) and 39% are in the light alkaline class (7.0-7.9), according to Tüzüner (1990). The optimal pH values for vineyards vary between 5.5-8.5, according to Çelik (1998). The limit values of the 5 Cardinal growing samples that were in the 0-30 cm depth appeared to be under the proper pH value for grapes, with only 28% having insufficient pH, while there seemed to be no problem with pH values in the 30-60 cm depth.

The organic matter of the soil samples varied between 0.2-1.6% in each of the two depths. All the samples in each of the two depths, according to organic materials of Rauterberg & Kremkus (1951), have been determined to be in the low (<2%) class. According to Özbek (1975), the importance of organic material for grapes is much more than for other nutrient materials. Although grapes can grow in soils that are relatively poor in nutrient materials, their development is not normal, and their productivity decreases significantly when the soil is poor in organic material (Çelik, 1998).

A amount of lime vary between 0.1-36.6%, and according to Evliya (1964), the soil samples that were poor in lime at the depths of 0-30 cm were as follows: 72% was poor in lime (<2.5 %); 6% was rich in lime (5-10%); 5% of it was structure+marn (10-20%); and 17% of it was structure+lime (20-50%). In the soil samples that were in the 30-60 cm depths, 61% were poor in lime (<2.5%); 11% were sufficient in lime (2.5-5%), 11% were stucture+marn (10-20%) and 17% were structure+lime (20-50%).

Table 1. Some physical and chemical properties of soil samples.

	0-30 cm			30-60 cm		
Soil properties	**Average**	**Minimum**	**Maximum**	**Average**	**Minimum**	**Maximum**
pH (1:2.5)		4.60	7.70		5.50	7.80
Organic matter (%)	0.89	0.30	1.60	0.63	0.20	1.60
Lime (%)	6.89	0.10	35.60	7.68	0.10	36.60
P (ppm)	8.90	2.37	25.32	9.45	2.07	26.57
K (ppm)	305.50	78.00	897.00	251.33	78.00	819.00
Fe (ppm)	12.73	1.90	26.90	10.30	1.10	24.90
Mn (ppm)	11.89	1.60	27.80	10.67	1.30	25.70
Zn (ppm)	1.20	0.60	2.80	0.83	0.50	1.40
Cu (ppm)	0.98	0.50	2.10	1.03	0.20	2.40
Sand (%)	71.99	37.40	89.10	73.51	50.00	86.60
Silt (%)	17.20	7.30	37.80	17.85	8.80	31.50
Clay (%)	10.80	1.50	29.60	8.91	2.90	20.40

The phosphorus contents of the samples varied between 2.37-25.32 ppm and 2.07-26.57 ppm, in the 0-30 cm and 30-60 cm depths respectively. According to Olsen *et al*. (1954), it has been found that 33% of the phosphorus content was at the low level (<7 ppm); 61% of it was at the middle level (7-20 ppm) and 6% of it was at the high level (20 ppm<) in the 0-30 cm depth. In the 30-60 cm depth, 39% was at the low level (<7 ppm); 55% was at the middle (7-20 ppm) and 6% was at the high level (20 ppm<).

The potassium content in the soil varied between 78-897 ppm in the 0-30 cm depth, and 78-819 ppm in the 30-60 cm depth. According to Fawzi & El-Fouly (1980), 50 % of the samples of soil in the 0-30 cm depth were found to be deficient (<150 ppm); 5% were low (150-200 ppm); 17% were high (300-400 ppm), and 28% were very high (400ppm<). The soil samples in the 30-60 cm depth were found to be 44% deficient in potassium (<150 ppm); 11% was low (150-200 ppm); 17% was adequate (200-300 ppm); 6% was high (300-400 ppm) and 22% was very high (400 ppm<).

The iron component of the soil samples varied between 1.9-26.9 ppm and 1.1-24.9 ppm in the 0-30 cm and 30-60 cm depths, respectively. Thirty-three % of the amounts of iron in both depths of the samples were found to be below the critical value and 67% were above the critical value, which was the 4.5 ppm critical value determined by Lindsay & Norvell (1978).

Manganese component of the vineyard soils varied between 1.3-27.8 ppm in the 0-30 cm and 30-60 cm depths, respectively. According to the limited value 3-5 ppm suggested by Sillanpää (1982), the following results were found in the 0-30 cm depths: 22% of the soil samples were below the given limited values; 11% were within the limited values; and 67% were above those limited values. In the 30-60 cm depths, 22% of the soil samples were below the given limited values, 17% were within the limited values and 61% of them were above those limited values.

The zinc component in the grapes varied between 0.6-2.8 ppm and 0.5-1.4 ppm, in the 0-30 cm and 30-60 cm depths, respectively. All the samples in both of the depth ranges were above the critical value, which was determined by Viets & Lindsay (1973) to be 0.5 ppm.

The copper components varied between 0.5-2.1 ppm in the 0-30 cm depth and 0.2-2.4 ppm in the 30-60 cm depth. The critical value of 0.2 ppm, which was determined by Viets & Lindsay (1973) was found to be above that level in all the samples.

The texture of the soils in the 0-30 cm depth was determined to be as follows: 11% were sandy-loam; 17% were sandy-clay-loam; 28% were loamy-sand; 5% were loamy; and 39% were sandy. In the 30-60 cm depth 33% were sandy-loam; 45% were loamy-sand; and 22% were sandy. According to Çelik (1998), the most suitable soil is loamy soil, for vineyards.

The average, maximum, and minimum values of the samples of the leaf blades and leaf petioles of the examined grapevines are given in Table 2. Nitrogen was determined to be between 1.62-3.97% in the leaf blade and between 0.51-1.12% in the leaf petiole. According to the 2% total nitrogen limit value, which was suggested for the leaf blade by Fregoni (1984), 16 samples were found to be above that value having a value of 89%. Phosphorus varied between 0.10-0.29% in the leaf blades and between 0.05-0.45% in the leaf petioles. Sixty-one % were found to be above the critical value, according to the critical value of 0.15% for leaf blades as suggested by Fregoni (1984). Potassium varied between 2.28-5.22% in the leaf blades and 3.48-8.04% in the leaf petioles. Both the blades and petioles were determined to be in the efficient level, according to the limited value of 1.20-1.40% as suggested by Fregoni (1984). Calcium varied between 1.36-

2.11% in the leaf blades and 1.16-1.83% in the leaf petioles. The results of the leaf blade and petiole analysis have been found to be insufficient according to the limited values of between 2.5-3.5%, as suggested by Fregoni (1984). Magnesium varied between 0.21-0.35% in the leaf blades and 0.12-0.37% in the leaf petioles. All the leaf blade samples were found to be sufficient in magnesium. All of the 17 leaf petiole samples, except for one, were found to be at a sufficient level, according to the reference value of 0.2% as suggested by Levy (1968).

Table 2. The maximum and minimum values of leaf blade and leaf petiole.

Elements	Leaf blade			Leaf petiole		
	Average	Minimum	Maximum	Average	Minimum	Maximum
N (%)	2.52	1.62	3.97	0.827	0.51	1.12
P (%)	0.16	0.10	0.29	0.161	0.05	0.45
K (%)	3.36	2.28	5.22	5.573	3.48	8.04
Ca (%)	1.73	1.36	2.11	1.516	1.16	1.83
Mg (%)	0.26	0.21	0.35	0.324	0.12	0.37
Fe (ppm)	282	99	341	180	105	294
Mn (ppm)	142	53	213	167	101	241
Zn (ppm)	47	29	69	48	25	79
Cu (ppm)	27	6	125	14	3	48

Iron in the examined leaf blades varied between 99-341ppm and between 105-294 ppm in the leaf petiole. Manganese varied between 53-213 ppm in the leaf blade and between 101-241 ppm in the leaf petiole. When compared to the limited values of 60-150 ppm, according to the S. S. S. A. (Anon., 1967), it was found that one sample of the leaf blades was within these limits while 17 samples were found to be above those values. Also, when findings were compared to the limited values given as 50-300 ppm according to Fregoni (1984), it was found that in 50% of the samples, manganese remained in these limits, while in 50% of the samples, manganese was greater than the 300 ppm value. The Fe composition of the leaf petiole samples was above the critical value of 35 ppm found by Bergman (1992).

Manganese content varied between 53-213 ppm in the leaf blade of the vines, and between 101-241 ppm in the leaf petiole. Manganese levels in all the leaf blade samples were fixed, as it was between the limits of the 20-400 ppm as suggested by Fregoni (1984) to be a sufficient value. Manganese components of the leaf petiole samples were above the value in all the grapevines, when compared to the critical value of 25 ppm, which was determined by Christensen *et al*., (1984).

Alexander & Woodham (1964) determined the critical value of zinc to be 35 ppm. In the leaf samples, zinc varied between 29-69 ppm in leaf blades and 25-79 ppm in leaf petioles. In those samples, zinc levels were determined to be above the critical value in all but two samples. For the leaf petiole samples, it was determined that all the samples, except one, were above the critical value of 26 ppm suggested by Christensen *et al*., (1984).

In the leaf blade, copper varied between 6-125 ppm, and in the leaf petiole samples, it varied between 3-48 ppm. It was found that in half of the leaf blade samples, copper levels were between the 5-20 ppm efficiency limit value, which was stated by Chapman (1966). The other half was above the efficiency limit value. Comparing these results with the efficiency limit value of 6-12 ppm given by Bergman (1992), our research on the leaf petiole values showed that 11% were lower than the 6 ppm value, 44% were between the limit values and 45% were above the limit values. The statistical connections between soil characteristics and plant samples nutrient element comprehensions are given in Table 3.

Examining the connections, between soil characteristics and the nutrient element comprehensions of the plant samples, as being 26 leaf blades and 12 leaf petioles, totally 38 connections have been determined between the soil characteristics in 0-30 cm depths and the correlation coefficients of the nutrient elements concerning to the leaves. Out 31 leaf blades and 12 leaf petioles a total of 43 connections have been determined between the soil characteristics in the 30-60 cm depths and the correlation coefficients concerning of the leaves.

The results obtained from the soil and plant samples were in accordance with the results of the study that was performed by Demirer *et al*., (1998); Müftüoğlu *et al*., (2000); Demirer *et al*., (2001); Müftüoğlu *et al*., (2001), who had previously studied the grape vine soils in the region.

Conclusion

In the regions growing Cardinal grapes, it has been determined that there is no problem with reference to pH and that all the samples have a low level of organic matter. The amounts of lime were poor in 72% of the soil samples in the 0-30 cm depths, and in 61% of the soil samples in 30-60 cm depths. In almost all of the samples, phosphorus levels were found to be in the low and middle levels. The potassium component in the soil, at both of the depths, was found to be deficient in nearly half of the samples. In the soil samples at both of the depths, iron levels were found to be 33% below the critical value, and 67% were found to be above the critical value. In 75% of the vineyard soils manganese was either within the limit values or above those values, in both of the depths. Also, zinc and copper components at both of the depths were found to be above the critical values. The texture of the studied soils was determined to be sandy-loam, sandy-clay-loam, loamy-sand, loam, and sandy.

Nitrogen, calcium, phosphorus, iron and copper values were higher in the leaf blade than they were in leaf petiole, while potassium, magnesium and manganese values were higher in the leaf petiole than in leaf blade. Zinc values did not differ between leaf blade and the leaf petiole. The nitrogen values in the leaf blade were found to be above the standard values in 89% of the samples, 61% of the samples were found to be above the critical values for phosphorus, while all the samples were found to be at the sufficient level for potassium. All the samples were found to be below the standard values with regard to calcium. Regarding magnesium, all the leaf blade samples were found to be sufficient, and all the leaf petiole samples, except one, were also found to be at the sufficient level. All of the leaf blade and the leaf petiole samples, with regard to iron and manganese, and nearly all of those samples studied with regard to zinc, were found to be at the sufficient level. Analysis of all of the leaf blade samples determined that copper levels were either between the efficiency limit values, or above the sufficiency limit. Eighty-nine % of the leaf petiole values were determined to be either between the limit values or above those values. Consequently, all the regions that are growing Cardinal grapes should use organic matter, phosphorus and potassium. The regions that have pH values under 5.5 should also use lime, however the iron components should also be followed.

Table 3. The soil characteristics in 0-30 cm and 30-60 cm depths and the correlation coefficients of the nutrient elements of leaves.

Soil		Leaf blade							Leaf petiole			
		N	P	Ca	Mg	Fe	Mn	Zn	K	Ca	Fe	Mn
0-30 cm	pH	-	0.699**	0.808**	0.747**	-	-0.793**	-	-	0.838**	-	-
	O. M.	-	0.522*	-	-	-	-0.519*	-	-	0.476*	0.655**	-
	Lime	0.619**	0.643**	0.576*	-	-0.591**	-0.606**	-	-	0.727**	0.483*	-
	K	-	-	0.623**	0.484*	-0.610**	-0.720**	-	0.511*	0.787**	-	0.487*
	Fe	-	-0.593**	-0.660**	-0.558*	-	0.699**	-	-	-0.716**	-	-
	Mn	-	-0.633**	-0.643**	-0.532*	-	0.764**	-	-	-0.710**	-	-
	Zn	-	-	-	-	-	-0.634**	-	-	-	-	-
	Cu	-	-	-	-	-	-	0.620**	-	-	0.503*	-
	P	-	-0.535*	-	-	-	-	-	-	-0.556*	-	-
30-60 cm	pH	-	0.670**	0.771**	0.751**	-	-0.798**	-	-	0.821**	0.530*	-
	O. M.	-	-	-	-	-0.790**	-0.564*	0.509*	-	0.519*	0.510*	-
	Lime	0.622**	0.676**	0.601**	0.536*	-0.666**	-0.652**	-	0.499*	0.776**	-	-
	K	-	0.575*	0.536*	0.537*	-0.687**	-0.794**	-	-	0.694**	0.566*	-
	Fe	-	-0.724**	-0.775**	-0.664**	-	0.606**	-	-	-0.751**	-	-
	Mn	-	-0.703**	-0.781**	-0.626**	-	0.626**	-	-	-0.741**	-	-
	Zn	-	0.695**	0.647**	0.471*	-	-0.639**	-	-	0.742**	-	-
	Cu	-	-	-	-	-	-	0.598**	-	-	0.542*	-

References

Alexander, D. McE. and R.C. Woodham. 1964. Yield responses by Sultanas to applications zinc super phosphate. *Australian Journal of Experimental Agriculture and Animal Husbandry*, 4: 169-172.

Anonymous. 1995. D. İ. E. (Devlet İstatistik Enstitüsü). Tarımsal Yapı (Üretim, Fiyat, Değer), T. C. Başbakanlık Devlet İstatistik Enstitüsü, Ankara, 577 s.

Anonymous. 1997. Tarım İl Müdürlüğü İstatistikleri. Tarım Orman ve Köyişleri Bakanlığı Tarım İl Müdürlüğü. Çanakkale.

Anonymous. 2003. Tarım İl Müdürlüğü İstatistikleri. Tarım Orman ve Köyişleri Bakanlığı Tarım İl Müdürlüğü. Çanakkale.

Bayraklı, F. 1987. Toprak ve Bitki Analizleri (Çeviri ve derleme). Ondokuz Mayıs Üniversitesi Ziraat Fakültesi Yayın No: 17. Samsun.

Beanie, J.M. and C.G. Forshey. 1954. A survey of the nutrient element status of Concord grapes in Ohio. *Prog. Amer. Soc. Hortic. Sci*., 64: 21-28.

Bergman, W. 1992. *Nutritional Disorders of Plants Development, Visual and Analtytical Diagnosis*. Gustav Fisher Verlag Jena Stuttgart New York.

Bouyoucos, G. J. 1951. A recalibration of the hydrometer methods for making mechanical analysis of soils. *Agronomy Journal*, 43: 434-438.

Cahoon, G.A. 1970. *Survey of Foliar Cotent of American and Frenc Hybrid Grapes in Fourteen Reseach-Demostration Vineyards in Southern Ohio Rest*. Summ. Ohio Agr. Res.and Dev. Ctr. Res. Circ. 44: 24-27.

Chapman, H.D. 1966. *Diagnostic Criteria for Plants and Soils*. University of California, Division of Agricultural Sciences, 793 pp.

Christensen, L.P., A.N. Kasimatis and F.L. Jensen. 1984. *Grapevine nutrition and fertilization in the San Joaquin Valley*. University of California Div. Agric. Sci. Publication, pp. 33-37.

Cook, J.A. 1966. Grape nutrition. In: *Temperate to Tropical Fruit Nutrition*. (Ed.): N.F. Childers. Horticulture Publications, Rutgers-The State Univ. New Brunswick, N. J. pp. 777-812.

Çağlar, K.Ö. 1949. Toprak Bilgisi. Ankara Üniversitesi Ziraat Fakültesi Yayın No. 10. Ankara.

Çelik, S. 1998. Bağcılık (Ampelololoji), Cilt-1. Trakya Üniversitesi, Tekirdağ Ziraat Fakültesi, Bahçe Bitkileri Bölümü, Tekirdağ.

Demirer, T., N.M. Müftüoğlu, A. Aydın, C. Türkmen and F. Ateş. 1998. Çanakkale ili üzüm bağlarının beslenme problemlerinin belirlenmesi üzerine bir araştırma. V. Ulusal Tarım ve Hayvancılık Kongresi, 20-22 Ekim 1998, 359-363, Konya.

Demirer, T., N.M. Müftüoğlu, F. Ateş and C. Türkmen. 2001. Amasya üzümü beslenme problemlerinin tespiti üzerine bir araştırma. Ekoloji Çevre Dergisi, Nisan-Mayıs-Haziran 2001, Yıl: 10, Sayı: 39, ISSN: 1300-1361, 7-12.

Evliya, H. 1964. Kültür Bitkilerinin Beslenmesi, Ankara Üniversitesi Ziraat Fakültesi Yayınları: 36.

Fawzi, A.F.A. and M.M. El-Fouly. 1980. Soil and leaf analysis of potassium in different areas in Egypt, In: *Role of potassium in crop production*, (Eds.): A. Saurat. & M.M. El-Fouly. I.P.I., Bern, pp. 73–80.

Fregoni, M. 1984. Nutrient Needs in Vine Production, 18th Coll. Int. Pot. Ins., Bern, pp. 319-332.

Jackson, M.L. 1958. *Soil Chemical Analysis*. Prentice Hall, Inc., Englewood Cliffs, New Jersey.

Kacar, B. 1972. Bitki ve Toprağın Kimyasal Analizleri II. Bitki Analizleri, Ankara Üniversitesi, Ziraat Fakültesi Yayınları: 453, Uygulama Kılavuzu 155, Ankara Üniversitesi Basımevi, Ankara, 646 s.

Kovancı, İ. and İ.Z. Atalay. 1977. Bağlarda Toprak İlişkileri. Uluslararası Gübre Semineri, Ekim 06.07.1977, Ankara, 17 s.

Larsen, R.P., A.L. Kenworthy, H.K. Bell, S.T. Bass and E.J. Benue. 1956. Nutritional conditions of Concort vineyard in Michigan. 1. Nutrient-element content of petioless in relation to production. *Mich. Agric. Exp. Stn. Quarterly Bull*., 39: 63-70.

Levy, J. F. 1968. L'application du diagnostic foliaire a la determination de bessions alimantaires des Vignes, Le Controle da la Fertilization des Plantes Cultuves (III. Collog. Evr. Medit., Sevilla, 1968), pp. 295-305.

Lindsay, W.L. and W.A. Norwell. 1978. Development of a DTPA micronutrient soil test for zinc, iron, manganese and copper. *Soil Science Society Amer. J*., 42: 421-428.

Müftüoğlu, N.M., T. Demirer, F. Ateş and C. Türkmen. 2000. Çanakkale ilinde yetiştirilen Karasakız üzümünün beslenme problemlerinin belirlenmesi. Selçuk Üniversitesi Ziraat Fakültesi Dergisi, Cilt: 14, Sayı: 24, 18-27, ISSN: 1300-5774, Konya.

Müftüoğlu, N.M., T. Demirer and F. Ateş. 2001. Bozcaada ilçesinde (Çanakkale) Bozcaada Çavuşu yetiştirilen alanlarda beslenme problemlerinin belirlenmesi. Türk-Koop Ekin, Temmuz-Eylül 2001, Yıl: 5, Sayı: 17, ISSN: 1301-515X, 67-72.

Olsen, S.R., C.V. Cole, F.S. Watanabe and L.A. Dren. 1954. *Estimation of available phosphorus in soil by extraction with sodium bicarbonate*. U. S. Dept. of Agri. Circ. 939, Washington D. C.

Özbek, N. 1975. Bağ-Bahçe Bitkilerinin Gübrelenmesi, I. Bağların Gübrelenmesi, Ankara Üniversitesi Ziraat Fakültesi Yayınları: 576, Ders Kitabı: 193, Ankara, 85 s.

Rauterberg, E. and F. Kremkus. 1951. Bestimmung von Gesamthumus und Alkali Löslichen Humusstoffen in Boden. *Z. Pflanzenernahr Düng, v. Bodenk*., 54: 240-249.

Robinson, J.B., M.G. Mc Carty and P.R. Nicholas. 1982. Petioles analysis as a tool in assesing the nutritional status of vineyard of *Vitis vinifera* in South Australia. Proceeding of the 90 Int. Plant Nutrition Colloqium 2, pp. 545-550.

Sillanpää, M. 1982. Micronutrients and the Nutrient Status of Soils. A global study. FAO Soils Bulletin. No. 48, FAO, Rome, Italy.

Anonymous. 1967. Soil Testing and Plant Analysis I and II. S. S. S. A. Inc. Mad., Wisconsin.

Tüzüner, A. 1990. Toprak ve Su Analiz Laboratuarları El Kitabı, Tarım Orman ve Köyişleri Bakanlığı Köy Hizmetleri Genel Müdürlüğü, Ankara, 375 s.

Viets, F.G. and W.L. Lindsay. 1973. Testing soils for zinc, copper, manganese and iron. In: *Soil Testing and Plant Analysis*. (Eds.): L.M. Wals. & J.D. Beaton. Soil Science Society of America, Inc. Madison, Wisconsin, pp. 153-172.

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