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Determination of the Nutrition Standard of Soil and Leaf Analysis of Bozcaada Çavusu Grape Variety Grown in Çanakkale, Turkey

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Present study was carried out to determine the nutritional standard of Bozcaada Çavusu grape varieties, grown in Çanakkale. It was studied on the leaf blade and petiole samples, obtained from 20 vineyards on berry set stage and chosen on the soil samples, taken from 0 to 30 cm and 30 to 60 cm depth. There is no problem with pH, texture, exchangeable calcium, potassium, zinc and copper. Organic matter in all soil samples, phosphorus in 11.1 %, iron in 75 %, manganese in 50 % is inadequate. Nitrogen found was not enough in all leaf petiole sample units 60 % of leaf blade, phosphorus was found not enough in 40 % of leaf blade and in 67 % of leaf petioles. Calcium was also found at enough level in 95 % of leaf blade and in all of leaf petiole samples. The magnesium determined was not enough level in all leaf blade and 70 % of leaf petiole samples. The important negative and positive correlation, at 1 and 5 % levels, were obtained between the content of nutrient elements of soil characteristics and leaf blade and leaf petiole, according to the soil depth. On the other side, the important negative and positive correlation, at 1 and 5 % levels, were determined between the content of nutrient elements of leaf blades and leaf petioles.

Key Words: Bozcaada Cavusu grape, Dardanelle (Çanakkale), Nutritional, Turkey.

INTRODUCTION

According to 2001 statistical data, 24774 ton grapes were produced in 5715 ha vineyards in Çanakkale, which has all the suitable conditions for viniculture such as climate and ecology. However, comparing this situation with the production in 1999 and 2001, there is a decrease both in vineyard areas and yield per hectare in the way that 41656 ton yield per hectare in 1999 decreased to 24774 ton yield per hectare in 2001[1].

The main concern of this studies is to determine the effect of nutrition in the decrease of yield per hectare with the soil samples and leaf samples in the vineyards.

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There are various methods for investigating the nutrition in vineyards. With the increasing importance of leave analysis of the nutrition of vineyards, various researchers tried to get nutrition element reference values for different parts of leaves in different physiological periods[2-5].

Because of this reason, some researchers recommend the leave opposite the first cluster during the flower initiation and ripe fruit periods[6]. Some other researchers believe that the leaf petioles of the leave opposite the first cluster at the end of flower imitation period should be analyzed in order to find out the nutrition problem[2,6-8].

Levy[9], who worked on leave analysis methods in France, has standardized the method in two periods and 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 instead of 1.75 % was suggested. Robinson *et al.*[8] found the following critical values at the end of flower initiation period in the stalk petioles of leave; for N: 0.22-0.53 %; for phosphorus: 0.20-0.46 %; for potassium: 0.50-4.00 %; for magnesium: over 30%; for zinc: over 26 ppm; for manganese: over 25 ppm; for boron over 30 ppm.

Although there are not so many studies about the contents of microelements in vineyards, Viets and Lindsay[10] reported the microelements as inadequate, on the border and high as the following (iron: 2-4.5 ppm; zinc: 0.5-1.0 ppm; copper: 0.2 ppm; manganese: 1.0 ppm; boron: 0.5-1.3 ppm).

In order to find out the areas, which is already lack of nutrition and which will be lack of nutrition, was studied about nutrition element values and problems in the field grown Bozcaada Çavusu grape variety in Çanakkale.

EXPERIMENTAL

In Çanakkale, which has seaside both in Ege and Marmara sea, the annual distribution of rain is 622.3 mm and average heat is 14.6ºC (maximum 24.4ºC and minimum 5.9ºC). The detailed climate facts can be seen in Table-1. Bozcaada Çavusu grape variety has female flower structure and is a middle early season kind, it grows strongly and has high yield

TABLE-1
CLIMATIC FACTORS OF THE RESEARCH AREA[29]

Climatic factors	Minimum	Maximum	Average	Total
Temperature (ºC)	5.9	24.4	14.6	–
Rainfall (mm)	7.4	108.9	–	622.3
Evaporation (mm)	37.6	243.8	–	1475.2
Cloudiness (0-10)	1.5	6.8	4.4	–
Wind velocity (m/s)	3.7	5.4	4.6	–

productivity. Its cluster has large pyramidal branches, sometimes winged and has big cluster. It has most of the time thingy berries and it is oval, yellow green opaque, thin skin, fleshy juicy. It has on odour and has 1-2 seeds[11].

The present study was carried out in 20 different vineyards, which are representation of Bozcaada Çavusu grape varieties.

The samples of soil during stage of berry set have been different places of each vineyard of 0-30 cm, 30-60 cm in depth. The texture of soils in the study was determined according to studies of Bouyoucos[12]; pH values were determined in 1:2.5 soil: water dilution according to Jackson[13]. The amounts of lime ($CaCO_3$) were determined by the method of Çaglar[14]; available phosphorus was determined according to Olsen *et al.*[15]; available sodium, calcium, magnesium and potassium were determined by extraction with 1 N ammonium acetate according to Bayrakli[16]. Available iron, manganese, zinc and copper were determined by extraction with 0.05 DTPA-TEA according to Lindsay and Norvell[11].

Total, 50 leave samples have picked up from 50 vines in each vineyard, taken leaves from opposite of the first cluster consisting of leaf blade and leaf petiole according to Levy[9]. All plant analysis was determined with AAS[16].

Data were statistically analysed using MSTAT programme.

RESULTS AND DISCUSSION

Soil analysis: The minimum, maximum and average values of soil samples according to their depth are presented in Table-2.

According to Table-2, the pH values of soil samples are between 5.3-7.8 and this is appropriate for vineyard[17]. According to Saglam[18], the organic matter of the soil must be between 0.3-1.6 % and according to Oraman[19] all samples are inadequate (5-10 % organic matter is adequate). The $CaCO_3$ % ratios of vineyards studied are between 0.1-39.7 % (0-30 cm depth) and 0.1-36.2 % (30-60 cm depth). According to Oraman[19] the ratio of $CaCO_3$ is below 5 % in 55.5 % of samples, between 5-25 % in 19.4 % of samples and above 25 % in 25.1 % of samples. The texture of the fields under investigation, are generally analyzed to be sandy loam, loamy sand, sandy and loam texture soils, which promotes the in depth grow the of vine[17]. The soil with sandy loam texture consists of the majority of soils. The Ca + Mg value is between 2.7-20.6 me/100 g and there is no important difference in terms of depth. In addition to this, the changeable sodium values are found to be 0.1-0.2 me/100 g in 0-30 cm and 30-60 cm in depth. The phosphor values of the samples in both depths are low in 11.1 % (< 7 ppm), medium in 61.2% (7-20 ppm) and high in 27.7 % (20 ppm <). The potassium values are between 0.3-1.9 me/100 g and the available

TABLE-2
PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE FIELDS UNDER INVESTIGATION

Elements	0-30			30-60		
	Min.	Max.	Avg.	Min.	Max.	Avg.
pH (1:2.5)	5.3	7.8	6.972	5.5	7.8	7.060
Organic matter (%)	0.3	1.6	1.060	0.3	1.2	0.750
Loam (%)	0.1	39.7	12.130	0.1	36.2	11.270
CEC (me/100 g)	6.6	29.3	13.860	8.1	21.2	14.094
Ca+Mg (me/100 g)	2.7	20.6	10.510	3.8	18.9	11.570
K (me/100g)	0.3	1.9	0.900	0.1	1.3	0.670
Na (me/100g)	0.1	0.2	0.116	0.1	0.2	0.127
Fe (ppm)	1.0	27.0	6.680	1.1	17.1	5.500
Mn (ppm)	1.2	25.2	6.294	1.3	20.1	5.480
Zn (ppm)	0.6	2.8	0.922	0.5	1.6	0.750
Cu (ppm)	0.5	2.4	1.310	0.4	2.4	0.930
Sand (%)	46.2	84.0	64.540	53.6	82.6	62.694
Silt (%)	11.5	35.1	22.840	10.5	29.4	20.920
Clay (%)	3.0	29.6	12.610	5.7	21.6	13.620
P_2O_5	1.4	14.6	4.523	1.3	15.3	4.675

potassium value is adequate according to Ülgen and Yurtsever[20]. The available iron contents of the soil samples change from 1.0-27.0 ppm for the depth of 0-30 cm and 1.1-17.1 ppm in for the depth of 30-60 cm.

The available iron quantity was reported to be adequate in 25 % of both soil depths and inadequate in 75 % of both soil depths according to the critical value (4.5 ppm) of Lindsay and Norvell[11]. The available zinc contents of the soil are reported to be 0.6-2.8 ppm and 0.5-1.6 ppm for the depth of 0-30 cm and 30-60 cm, respectively.

According to Viets and Lindsay[10], critical value of (0.5 ppm) the depth of soil is adequate or high in all samples. The manganese contents of vineyards are between 1.2-25.2 ppm (0-30 cm depth) and 1.3-20.1 ppm (30-60 cm) depth. These results are inadequate in 55 % of the samples and adequate in 45 % of the samples according to Sillanpa[21] for 0-30 cm depth. Manganese, taken out in 30-60 cm soil depth, is found to be inadequate in 50 % of the samples. The available copper value of the soil is 0.5-2.4 ppm at 0-30 cm depth and 0.4-2.4 ppm at 30-60 cm depth. This value is found to be adequate for all samples according to the critical value (0.2 ppm) of Viets and Lindsay[10].

Leave analysis: Table-3 shows the minimum, maximum and average value of leaf blade and leaf petiole samples.

TABLE-3
MINIMUM, MAXIMUM AND AVERAGE VALUE OF LEAF BLADE AND LEAF PETIOLE SAMPLES

Elements	Leaf blade			Leaf petiole		
	Min.	Max.	Avg.	Min.	Max.	Avg.
N (%)	1.54	2.67	1.747	0.47	1.03	0.55
P (%)	0.10	0.29	0.149	0.07	0.33	0.14
K (%)	2.10	3.5	2.490	3.70	6.30	03.56
Ca (%)	10.60	1.93	1.539	1.39	1.79	1.47
Mg (%)	0.14	0.28	0.212	0.25	0.36	0.27
Fe (ppm)	91.80	343.20	203.600	101.50	333.60	182.90
Mn (ppm)	34.60	192.80	77.710	64.20	191.30	112.16
Zn (ppm)	23.80	80.60	41.90	23.80	82.50	52.84

Nitrogen: The nitrogen contents of leaf blades and petioles change from 1.54-2.67 % and 0.47-1.03 %. According to the critical value of Fregoni[22], 60 % of leaf blades is inadequate, 40 % is adequate and for leaf petioles this element is found to be inadequate for all samples.

Phosphorus: The phosphorus contents changes among 0.10-0.29 % in leaf blade and 0.07-0.33 % in leaf petiole, according to critical value of Fregoni[22], 60 % is adequate and 40 % is inadequate in leaf blade. The phosphorus content in leaf petiole, according to critical value of Robinson *et al.*[8] 33.4 % is adequate and 66.6 % is inadequate.

Potassium: The potassium contents change between 2.1-3.5 % in leaf blade and 3.7-6.3 % in leaf petiole. Potassium in all the samples was higher than the critical value (0.44 %) as suggested by previous workers[23,24].

Calcium: The calcium contents change between 1.06-1.93 % and 1.39-1.79 %. When the results of leave analysis are compared to the critical value (1.27-3.19 %) of Kenworthy and Martin[24], the calcium is inadequate in 5 % and adequate in 95 % of leaf blades.

Magnesium: The magnesium contents change between 0.14-0.28 % in leaf blade and 0.25-0.36 % in leaf petiole. According to leave analysis results and consideration of the reference value (0.3 %) of Levy[9], magnesium is found to be inadequate in 70 % of leaf petioles and all of the leaf blades.

Iron: The iron contents change between 91.8-343.2 ppm in leaf blade and 101.5-333.6 ppm in leaf petiole. There is no iron problem in terms of nutrition according to SSSA[25] and Fregoni[22]. The results for leaf blades are

60-150 ppm, 50-300 ppm for the depth of 0-30 cm and 30-60 cm, respectively. The iron contents of leaf petioles are adequate and at high level (35 ppm) according to critical value of Bergmans[26].

Manganese: The manganese contents change between 34.6-192.8 ppm in leaf blade and 64.2-191.3 ppm in leaf petiole. All manganese values are adequate, even high when compared to the values of Fregoni[22] (20-400 ppm) and Christensen *et al.*[27] (value 25 %).

Zinc: Zinc contents change between 23.0-80.6 ppm in leaf blade and 23.8-82.5 ppm in leaf petiole. According to critical value (35 ppm) of Alexander and Woodham[28] the 30 % of leaf blades samples are inadequate. The zinc value of leaf petioles is inadequate in 5 % of samples according to critical level (26 ppm) of Cristensen *et al.*[27].

Copper: Copper contents change between 8.1-103.8 ppm in leaf blade and 2.3-126.9 ppm in leaf petiole. According to adequate value (5-20 ppm) of Chapman[23] all of leaf blades samples are adequate even higher. When compared to adequacy value (6-12 ppm) according to Bergman[26], the samples in leaf petiole are determined to be inadequate in 55%.

The relations between characteristics of soil and nutrition elements of leaf samples were analyzed by correlation. The results are represented in Table-4.

TABLE-4
CORRELATION BETWEEN CHARACTERISTICS OF SOIL AND NUTRITION ELEMENTS OF LEAF SAMPLES

X	Y	r1	r2	r3	r4
pH	P	-0.564*	-0.522*	–	–
	Ca	–	–	-0.733**	0.687**
	Mg	-0.479*	–	–	–
	Fe	-0.610**	-0.659**	–	–
	Mn	-0.727**	-0.786**	–	–
Organic matter	N	–	–	–	0.609*
	Ca	–	–	0.532*	–
	Mg	–	–	–	-0.560*
	Mn	-0.592**	–	–	–
$CaCO_3$	Mg	–	–	0.598*	–
	Fe	-0.494*	-0.575*	0.523*	–
CEC	N	0.558*	–	–	–
	Ca	–	–	0.533*	0.589*
	Mg	–	-0.494*	–	–
	Fe	–	-0.509*	–	–
	Mn	–	-0.538*	–	–
	Cu	–	–	–	0.524*

X	Y	r1	r2	r3	r4
(Ca + Mg)	N	0.439*	–	–	–
	Ca	–	–	0.623**	0.635**
	Mg	-0.519*	-0.495*	–	–
	Fe	-0.512*	-0.628**	0.568*	0.754**
	Mn	–	-0.620**	–	–
K	N	–	–	–	0.518*
	Mg	–	–	-0.475*	–
	Mn	–	-0.516*	–	–
Na	N	–	0.614**	–	–
	K	0.492*	-0.492*	–	–
	Mg	–	–	-0.553*	–
	Cu	–	–	0.486*	–
Fe	P	–	0.510*	–	–
	Ca	–	–	-0.833**	-0.829**
	Fe	–	0.519*	–	–
	Mn	0.767**	0.791**	–	–
Mn	Ca	–	–	0.838*	0.819**
	Fe	0.469*	0.492*	–	–
	Mn	0.765**	0.832*	–	–
Zn	Ca	–	-0.717**	–	–
	Cu	–	0.615**	–	–
Cu	N	–	0.545*	–	–
	Mg	–	–	–	0.545*
Sandy	Ca	–	–	-0.643**	-0.652*
	Mg	–	0.568*	–	–
	Fe	–	0.661**	-0.511*	-0.645*
	Mn	0.661**	0.663***	–	–
Silt	N	–	—	0.534*	–
	Ca	–	–	0.499*	0.655**
	Mg	–	-0.473*	–	–
	Fe	–	-0.551*	–	0.681**
	Mn	-0.709**	-0.581*	–	–
Clay	N	0.644**	–	–	–
	Ca	–	-0.473*	0.596*	0.655**
	Mg	–	-0.551*	–	–
	Fe	–	-0.581*	–	0.681**
	Mn	–	-0.581*	–	–
P_2O_5	N	0.583*	–	–	–
	K	-0.486*	–	–	–
	Mg	0.503*	0.502*	–	–
	Fe	–	–	–	-0.530*

X: soil elements; Y: nutrition in leave; r1: leaf blade × 0-30 cm depth; r2: leaf blade × 30-60 cm depth; r3: leaf petiole × 0-30 cm depth; r4: leaf petiole × 30-60 cm depth; **: 1 % important; *: 5 % important.

The correlation in 30-60 cm depth between nutrition elements of leaves and characteristics soil are more in number than the correlation of 0-30 cm depth. There is also a negative correlation between pH values and nutrition on elements in leaves in both depths. The correlation between nutrient in leaf blade and leaf blade, leaf blade and leaf petiole, leaf petiole and leaf petiole were also calculated. These results are shown in Table-5.

TABLE-5
THE CORRELATION AMONG CONTENT OF NUTRIENT IN LEAF BLADE AND LEAF BLADE, LEAF BLADE AND LEAF PETIOLE, LEAF PETIOLE AND LEAF PETIOLE

Leaf blade	Leaf petiole	B × B = r	B × P = r	P × P = r
N	K	-0.482*	–	–
P	Mg	0.503*	–	–
P	Fe	0.525*	–	–
K	Mg	–	-0.650**	–
K	Zn	–	-0.476*	–
K	Cu	–	0.478*	–
Ca	Mg	0.735**	–	–
Ca	Cu	-0.620**	–	–
Mg	K	–	-0.498*	–
Mg	Fe	0.684**	-0.549*	–
Mn	Ca	–	-0.663**	–
Mn	Mn	–	0.583*	–
Cu	Fe	–	0.514*	–
Zn	Cu	–	–	-0.601**

B: Leaf blade; P: Leaf petiole; **= 1 % important; *: 5 % important

The results was showed that the correlation between the nitrogen with potassium; phosphorus with magnesium and iron; calcium with magnesium and copper were positive or negative at 1 or 5 % values in leaf blades. There are positive and negative correlations at 1 and 5 % level between potassium in leaf blades with magnesium and zinc in leaf petioles, the magnesium in leaf blades with potassium and iron in leaf petioles, the manganese in leaf blades with calcium in leaf petioles, the copper in leaf blades with iron in leaf petioles.

Although there is a lack of organic materials in the vineyards of Bozcaada Çavusu grape variety, there is no problem of alkali. The fields are adequate in potassium, zinc and copper even higher. Phosphorus is inadequate in 11 %, iron is inadequate in 75 % and manganese is inadequate in 50 % of vineyards. Potassium, iron and manganese are adequate in all plants; calcium is adequate in 95 % of plants. Zinc in 70 % of leaf blade and 95 % of leaf petiole, copper in all of leaf blade and 45 % at leaf petiole, phosphorus in 60 % of leaf blade and 33 % of leaf petiole are adequate, nitrogen is inadequate in 60 % of leaf blade and 100 % of leaf petiole.

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