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Determination of Some Physical and Chemical Properties of Crimson Seedless Grape Variety Soils in Vineyards of Alaşehir for Growing Quality Grape

ATEŞ, Fadime[1]* KUŞTUTAN, Fulya[1]

Abstract

This study was conducted in 2015 aimed to determine some physical and chemical properties of Crimson Seedless grape variety grown soils in vineyards of Alaşehir district, which is the largest grape producing vineyard area of Manisa Province in Turkey. According to the results of vineyard soil samples analyses; 80% loamy and 20% soil samples had clay–loamy textures; 20% soil samples were found with strong alkaline, the 60% having slight alkalineand 20% Mild acid, 100% were salt–free. These soil samples are placed into low class category in terms of total organic matter due to its 80% low and 20% calcareous level. Soil samples contain 60% medium, 20% high and 20% very high level of P; 20% very low, 30% low and 50% medium level of K; Soil samples having 20% low, 40% medium and 40% high Mg level; also containing 40% very low, 20% low and 40% medium level of Ca; Soil samples possessing 40% low and 60% critical level of Zn; also having 60% critical and 40% adequate Fe; Nitrogen contents were found low while Cu and Mn contents in sufficient amount in case of all soil samples. In addition to this, the presence of significant bilateral relations relating to some physical and chemical properties of vineyard soils were also determined.

Keywords: Vitis vinifera L., Crimson Seedless grape variety, Physical and chemical properties of soil, Nutrient, Alaşehir/Manisa.

TÜBİTAK ULAKBİM

1Manisa Viticulture Research Institute, Republic of Türkiye Ministry of Agriculture and Forestry, 45125 Manisa, Türkiye
*corresponding author: fadimeates2@yahoo.com

Introduction

Grape; diversity of assessment forms, domestic market consumption and share of exports have important place in the agriculture of Turkey. For this reason, it is a valuable product that constitutes a large farmer's field of work and a direct source of income. Turkey situated on the most favorable belt for grape production in the view point of climate and soil condition in the world, has a potential for rich genetic resources with a very old and rooted viticulture culture due to its geographical location where the gene centers of the temple are intersected and cultivated for the first time (Çelik, 2011).

Turkey is a major producer of grapes in the world and viticulture is one of the major branches of agriculture with respect to production area and its large share of income in Turkish national economy. Grapevine is grown in almost all parts of Turkey and has been produced commercially in many regions of the country for many years.

Turkey is among the largest grapevine growing countries of the world with approximately 468.792 hectares of vineyard area and 4.01 million tons of grape production (5th in area; 6th in production). Grape production are mainly consumed. For table grapes (52.8%), raisins (36.4%) and must-wine (10.8%) in Turkey (Anonymous, 2015 a).

The Aegean Region (especially Manisa and its environs) compared to other regions is in the first place, accounting for 28% of total vineyard area and 45% of production. According to the statistical data obtained; In Alaşehir, 19.860 hectares grape are grown and 492.121 tons of fresh grapes are produced (Anonymous, 2015 b).

Mineral nutrients are divided into two types: macronutrients and micronutrients. Macronutrients are further divided into primary and secondary. Primary nutrients are used in large quantities by plants and they include nitrogen, phosphorus and potassium. Secondary nutrients include calcium, magnesium and sulfur. Micronutrients are needed in very small amounts and they include boron, copper, iron, manganese and zinc (Harry and Brady, 1969).

Soil analysis has been routinely used to assess soil conditions for plant growth and the need for supplemental fertilizers (Havlin et al., 2005). Chemical soil analysis indicates the potential availability of some nutrients that roots may take up under conditions favourable for plant growth (Römheld, 2012). Soil analysis can also be informative concerning possible toxicities of salt and boron. Soil pH can also be useful in predicting mineral nutritional problems. In spite of the importance of soil analysis in the fertilizer recommendation programmes for annual crops, it has lostfavour over the years for perennial deep-rooted crops, such as fruit trees and vines, because of the difficulty in defining with sufficient accuracy the root zones from which deep-rooting plants take up most of their nutrients (Winkler et al., 1974; Römheld, 2012)

The objective of this study was to determine some physical and chemical properties of Crimson Seedless grape variety grown soils in vineyards of Alaşehir district, which is the largest grape producing vineyard area of Manisa Province in Turkey.

Material and methods

Materials

Experimental site

Experiments were conducted in 2015 in Alaşehir district of Manisa in West Turkey (38°20′N, 28°38′W). Alaşehir district is the largest grape producing vineyard area of Manisa Province. The area has a transition towards a continental climate from a Mediterranean climate. The annual average temperature of 16.7 ^{0}C and a mean annual rainfall of 598 mm, The summer months, including the harvest period, are quite hot with mean temperatures of 30 ^{0}C.

Crimson Seedless grape variety

'Crimson Seedless' is a late-ripening, red seedless table grape developed by the U.S. Dept. of Agriculture Horticultural Crops Research Laboratory at Fresno, Calif. (Ramming et al., 1995). 'Crimson Seedless' is currently the latest ripening seedless table grape grown in California, extending the availability of fresh fruit into the late fall. The cultivar has firm, crunchy berries and excellent flavor. However, inadequate color development and small berry size can detract from its quality (Dokoozlian et al., 1995).

Methods

The soil samples taken from total of 20 vineyars representing in Alaşehir district of Manisa where Crimson Seedless grape variety growing areas at fruit setting period at depths of 0-60 cm and brought to the laboratory. The texture of the soil was determined according to Bouyoucos (1955); pH values were determined in 1:2.5 soil:water dilution according to Jackson (1967); soil salinity (%) were determined as electrical conductivity (EC) of a 1:5 soil:distilled water suspension set have been different places of according to Richards (1954); Organic matter was determined using a wet oxidation technique (Nelson and Sommer, 1982); The amount of lime (CaCO3) was determined according to Çağlar (1958); Total nitrogen (N), was determined by the Kjeldahl method (Kacar, 1995); Available phosphorus (P) was determined according to Olsen et al., (1954); Available calcium (Ca), magnesium (Mg) and potassium (P) were determined by extraction with 1 N ammonium acetate according to Bayraklı (1987); Available iron (Fe), manganese (Mn), zinc (Zn) and copper (Cu) by extraction with 0.05 DTPA-TEA, according to Lindsay and Norvell (1978).

Some physical and chemical properties of soils assessed by Pearson correlation coefficient and relations with each other are examined.

Results and discussion

Soil Analysis Results

The minimum, maximum and average values of soil samples analyzed soils of Crimson Seedless grape variety are given in Table 1 collectively.

Table 1. Analysis results of some physical and chemical properties of soils of Crimson Seedless grape variety

The lime content of soil samples varied between 35.42-53.79 %. The trial soils were classed to 80% loamy and 20% soil samples had clay–loamy textures. The trial areas often had loamy textures (Table 1).

As can be seen from Table 1, soil sample pH values seem to show differences between 5,86 - 8,56. The trial soils were classed to %20 strong alkaline (8.50-9.00), 60% light alkaline class (7.0-7.9) and 20% mild acid (5.60-60) according to Jackson (1967) and Kacar (1995). The optimal pH values for vineyards vary between 5.50-8.50, according to Çelik (2011). The soil pH was the limiting factor for viticulture (Table 1).

The soil salinity of the samples varied between 0.02-0.14%. According to Soil Survey Staff (1951), the trial soil samples were found that they were at saltless level (0.00-0.15 %). The salt values of the vineyard soils were not a limiting factor (Table 1).

In Table 1, the lime content of the samples varied between 0.81-10.62 %. The trial soils were classed to 80% low lime level (0.00-2.50%) and 20% above the critical value (10.00-20.00%). According to Evliya (1964), the soil samples were sufficient in lime (2.50-5.00%).

The soil organic matter of the samples varied between 0.80%-1.00%. Organic materials of all trial soil were determined to be in the low (<2.00%) class to according to Rauterberg and Kremkus (1951), According to Özbek (1975), the importance of organic material for grapes is much more than for other nutrient materials (Table 1).

The total nitrogen content in the trial soil varied between 0.04-0.05%. All the samples were found to be low nitrogen level which was determined by Anonymous (1990) to be 0.045 % (Table 1).

As can be seen from Table 1, the phosphorus content of the samples varied between 6.66-89.71 ppm. The trial soils phosphorus were classed to 60% adequate level (7.00-20.00 ppm), 20% above the critical value (20.00 ppm<) and 20% very high level (>20.00 ppm)to according to Olsen et al. (1965).

In Table 1, the potassium content of the samples varied between 0.04-30.51 ppm. The trial soils potassium were classed to 20% very low level (100.00-200.00 ppm), 30% low level and 50% adequate value (200.00-250 ppm) to according to Kacar (1995).

As can be seen from Table 1, the calcium content of the samples varied between 236.10-2008.00 ppm. The trial calcium of the trial soils were

Looking at the correlations among nutrient element contents of the soil characteristics of the soil in 0-60 cm depth, the correlation was significant and positive between saturation percentage (SP) and salt at the 5% significance level (0.487); significant and negative between SP and lime content at the 5% significance level (-0.457); significant and positive between SP and organic matter at the 1% significance level (0.526); significant and positive between SP and nitrogen at the 1% significance level (0.526); significant and negative between SP and phosphorus at the 1% significance level (-0.563); significant and positive between SP and potassium at the 1% significance level (0.871); significant and positive between SP and magnesium at the 1% significance level (0.500); significant and positive between SP and calcium at the 5% significance level (0.470); significant and positive between pH and magnesium at the 1% significance level (0.833); significant and positive between pH and calcium at the 1% significance level (0.699); significant and negative between pH and iron at the 1% significance level (-0.941); significant and positive between pH and copper at the 5% significance level (0.407); significant and negative between pH and manganese at the 1% significance level (-0.944); significant and positive between salt and potassium at the 1% significance level (0.675); significant and negative between salt and zinc at the 1% significance level (-0.525); significant and positive between salt and iron at the 1% significance level (0.631); significant and positive between salt and manganese at the 1% significance level (0.572); significant and negative between lime and organic matter at the 1% significance level (-0.993); significant and negative between lime and nitrogen at the 1% significance level (-0.993); significant and positive between lime and phosphorus at the 1% significance level (0.987); significant and negative between lime and potassium at the 1% significance level (-0.524); significant and positive between organic matter and nitrogen at the 1% significance level (1.000); significant and negative between organic matter and phosphorus at the 1% significance level (-0.998); significant and positive between organic matter and potassium at the 1% significance level (0.618); significant and positive between organic matter and calcium at the 5% significance level (0.405); significant and negative between nitrogen and phosphorus at the 1% significance level (-0.998); significant and positive between nitrogen and potassium at the 1% significance level (0.618); significant and positive between nitrogen and calcium at the 5% significance level (0.405); significant and negative between phosphorus and potassium at the 1% significance level (-0.651); significant and positive between potassium and magnesium at the 1% significance level (0.699); significant and positive between potassium and calcium at the 1% significance level (0.743); significant and negative between potassium and zinc at the 5% significance level (-0.448); significant and positive between magnesium and calcium at the 1% significance level (0.974);

significant and negative between magnesium and zinc at the 1% significance level (-0.535); significant and negative between magnesium and iron at the 1% significance level (-0.637); significant and positive between magnesium and copper at the 5% significance level (0.564); significant and negative between magnesium and manganese at the 1% significance level (-0.608); significant and negative between calcium and zinc at the 1% significance level (-0.627); significant and negative between calcium and iron at the 5% significance level (-0.487); significant and positive between calcium and copper at the 1% significance level (0.632); significant and negative between calcium and manganese at the 5% significance level (-0.427); significant and negative between zinc and copper at the 1% significance level (-0.551); and significant and positive between iron and manganese at the 1% significance level (0.962).

Conclusions

According to the results of soil samples analyses of Crimson Seedless grape variety vineyards; 80% loamy and 20% soil samples had clay–loamy structure; 20% soil samples were found with strong alkaline, the 60% having slight alkalineand 20% Mild acid, 100% salt–free.

These soil samples are placed into low class category in terms of total organic matter due to its 80% low and 20% calcareous level. Soil samples contain 60% medium, 20% high and 20% very high level of P; 20% very low, 30% low and 50% medium level of K. Soil samples having 20% low, 40% medium and 40% high Mg level; also containing 40% very low, 20% low and 40% medium level of Ca. Soil samples possessing 40% low and 60% critical level of Zn; also having 60% critical and 40% adequate Fe.

Nitrogen contents were found low while Cu and Mn contents in sufficient amount in case of all soil samples. In addition to this, the presence of significant bilateral relations relating to some physical and chemical properties of vineyard soils were also determined.

As a result of this research, it is determined that it would be beneficial to enrich vineyard areas of Crimson Seedless grape variety in Alaşehir/Manisa, where the organic matter is decomposed rapidly due to high temperatures.

At least once in every two years regularly with old barnyard manure as well as supplementing. And also it is supplemented with nitrogenous and zinc fertilizers to research areas where N and Zn deficiencies are found in the soil.

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Table 1. Analysis results of some physical and chemical properties of soils of Crimson Seedless grape variety

Soil properties	**Average**	**Maximum**	**Minimum**
Saturation (%)	43.12	53.79	35.42
Texture	Loamy	Clay-loamy	Loamy
pH	7.86	8.56	5.86
Soil salinity (%)	0.06	0.14	0.02
Lime ($CaCO3$)	3.09	10.62	0.81
Organic matter (%)	0.96	1.00	0.80
N (%)	0.05	0.05	0.04
P (ppm)	24.81	89.71	6.66
K (ppm)	125.30	305.10	40.00
Mg (ppm)	158.82	234.10	60.82
Ca (ppm)	1131	2008	236.10
Zn (ppm)	0.48	0.74	0.30
Fe (ppm)	4.33	8.55	2.04
Cu (ppm)	1.51	3.38	0.70
Mn (ppm)	3.29	7.86	1.49

Soil	Saturasyon (%)	pH	Soil salinity (%)	$CaCO_3$ (%)	Organic matter (%)	N (%)	P (ppm)	K (ppm)	Mg (ppm)	Ca (ppm)	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)
Saturation (%)	1	0.363 ns	0.487*	-0.457*	0.526**	0.526**	-0.563**	0.871**	0.500**	0.470*	0.021 ns	-0.251 ns	-0.360 ns	-0.218 ns
pH		1	-0.384 ns	0.140 ns	-0.111 ns	-0.111 ns	0.050 ns	0.336 ns	0.833**	0.699**	-0.107 ns	-0.941**	0.407*	-0.944**
Soil salinity (%)			1	-0.302 ns	0.395 ns	0.395 ns	-0.385 ns	0.675**	0.074 ns	0.183 ns	-0.525**	0.631**	-0.316 ns	0.572**
$CaCO_3$ (%)				1	-0.993**	-0.993**	0.987**	-0.524**	-0.184 ns	-0.336 ns	-0.034 ns	-0.121 ns	-0.115 ns	-0.358 ns
Organic matter (%) (%)					1	1.000**	-0.998**	0.618**	0.253 ns	0.405*	-0.053 ns	0.131 ns	0.108 ns	0.351 ns
N (%)						1	-0.998**	0.618**	0.253 ns	0.405*	-0.053 ns	0.131 ns	0.108 ns	0.351 ns
P (ppm)							1	-0.651**	-0.306 ns	-0.450*	0.061 ns	-0.077 ns	-0.121 ns	-0.296 ns
K (ppm)								1	0.699**	0.743**	-0.448*	-0.104 ns	0.006 ns	-0.070 ns
Mg (ppm)									1	0.974**	-0.535**	-0.637**	0.564**	-0.608**
Ca (ppm)										1	-0.627**	-0.487*	0.632**	-0.427*
Zn (ppm)											1	-0.203 ns	-0.551**	-0.129 ns
Fe (ppm)												1	-0.334 ns	0.962**
Cu (ppm)													1	-0.243 ns
Mn (ppm)														1

Table 2. Soil characteristics of Crimson Seedless grape variety vineyards and correlation coefficients of some nutrients

*= significant at 5% ** = significant at 1% ns: not significant