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Determination of mineral nutrition contents of grape and pistachio cultivars grown as interplanted orchard

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Abstract. In this experiment, the amount of mineral nutrition uptake of 'Honusu' grape and 'Kirmizi' pistachio cultivars which are commonly grown in the same area of Southeastern Turkey was determined. Also, the influences on mineral nutrition uptake of these plants each other grown in the same conditions was compared. In a mixed plant orchard, the amount of N uptake of grape and pistachio differed one of the other depending on the mineral nutrients content of the soil. Although the soil of the orchard had enough amount of K and Ca, it was determined that 'Honusu' grape cultivar and 'Kirmizi' pistachio cultivar could not have enough benefit from K and Ca mineral nutrition. In addition, there was no problem or competitions between plants regarding Cu uptake from the orchard soil, which contained enough amount of Cu. Moreover, depending on P, Fe and Zn content of soil, pistachio plants had more uptake and benefit from the mineral nutrition compared to the grape cultivar. Depending upon Mg content of the soil, 'Honusu' grape cultivar also showed higher uptake and had more benefit from Mg mineral nutrition compared to 'Kirmizi' pistachio cultivar.

Keywords. Pistachio – Grape – Nutrients – Interplant – Macro – Micro elements.

Détermination de la teneur en nutriments minéraux pour des cultivars de raisin et de pistache plantés sous forme mixte

Résumé. *Dans le cadre de cette expérience, on a déterminé la quantité de nutriments minéraux absorbés par des cultivars de raisin 'Honusu' et de pistache 'Kirmizi', qui sont couramment plantés dans la même zone. On a également comparé l'influence de la nutrition minérale de ces plantes l'une par rapport à l'autre, cultivées dans les mêmes conditions. Dans un verger mixte, selon la teneur en nutriments minéraux dans le sol, la quantité d'absorption de N a varié entre la vigne et le pistachier. Bien que le sol du verger possède une teneur suffisante en K et Ca, il a été déterminé que le cultivar de vigne 'Honusu' et le cultivar de pistachier 'Kirmizi' n'ont pas assez bénéficié de la nutrition minérale de K et Ca. En outre, il n'y a pas de problème ou de compétition entre les plantes pour ce qui est de l'absorption de Cu à partir du sol du verger, qui contient suffisamment de Cu. De plus, en fonction de la teneur en P, Fe et Zn du sol, les plants de pistachier absorbaient et tiraient davantage de profit que la vigne de la nutrition minérale citée auparavant. Selon la teneur en Mg du sol, le cultivar de vigne 'Honusu' absorbait et tirait un plus grand profit de la nutrition minérale en Mg comparé au cultivar de pistachier 'Kirmizi'.*

Mots-clés. *Pistachier – Vigne – Nutriments – Plantation mixte – Macroéléments – Microéléments.*

I – Introduction

Pistachio and grape are very important crops for South East Anatolia region of Turkey. They are growing together. In fact main crop is pistachio tree. It has a very long juvenile period under non-irrigated soil conditions. Grape is very short time bearer crop. Farmers prefer to plant them together because of the income starts early from grape then long time passes for pistachio. Pistachio and grape can be grown under high lime content soil conditions and have big advantage in high temperature, low relative humidity and long summer period conditions.

Pistachio is grown most intensively in Iran, Syria, Turkey and USA. The other pistachio producing countries are in the Near East, North Africa and Southern Europe. According to four

years average (2002-2005), the production in Iran is over 240,000 tons which is approximately half of (47.46%) the world production (510,000 tons). The second country, USA, produces 119,000 tons (23.40% of world production) and the next one is Turkey with a yield of 53,000 (10.52% of total world production) (Anonymous, 2007). Total vineyard area in Turkey is 567,000 ha (4th in the world), and the fresh grape production is 3,700,000 tons (5th in the world). The South East Anatolia region of Turkey has 129,624 ha in production, with a yield of 643,284 tons.

Nutrition status of soil and leaves should be known to prepare a correct fertilization programme. Then, it is determined which elements are sufficient and which are in deficit in relation to plant needs. The amount of elements is very important as well as soil pH. Some elements opposite to another elements. That means if some elements are high in soil, another one may not be uptaken by the plants. There are antagonisms between the elements which is of vital important for plant. For example; excessive of Ca causes the Fe deficiency, excessive of P, causes the Zn deficiency, etc. Leaf and soil analysis should be done to make correct fertilization programmes for plants, and antagonism between elements should be kept in mind (Özbek, 1977).

Winkler *et al*. (1974) reported that leaf and soil analysis are very important to determine nutritional statutes of grapes. To harvest a good yield, leaf samples should be taken during blooming time, and contents on leaf petiole should consist of 2.5-5% N, 0.3-0.6% P, 1.5-2.5% K and 0.5-0.8% Mg approximately.

Leaf samples were collected from the nonbearing branches (Uriu and Crane, 1977) before the fruit shell became red. This date is suitable for pistachio because most of elements are constant according to Tekin, *et al.* (1995)

According to some soil analyses of pistachio growing lands, there is enough elements or nutrients in soil but they are not taken by leaves because of antagonism and lack of water.

Fertilization is a very important factor to obtaint high quality and yield from the trees. But pistachio trees suffer from salinity and alkalinity. Fertilization depends on irrigation and pH of soil. Some elements can not be translocated because of high pH. The availability of nutrients are changed at pH critical levels (Ak and Parlakcı, 2007; Westwood, 1978)

The soil in the area under pistachio plantation is mostly inadequate in N, P, K and organic matter contents. A survey conducted in 30 pistachio orchards in Southeast Anatolia (Tekin *et al.*, 1985) revealed that in many orchards the trees were markedly deficient in phosphorus and zinc and slightly deficient in nitrogen, iron and manganese. The level of potassium was found adequate in many orchards though there were some districts where the trees showed slight deficiencies. In this region pH of the soils varies between 7.5 and 9.3 and the organic matter content is very low. Especially zinc deficiency effects on fruit set.

One of the experiments on nitrogen consumption of pistachio were done by Weinbaum and Muraoak (1989). According to this experiment, when the yield is 12 kg, fruit consumption was 954 g whereas leaves consumed 151 g of nitrogen. The leaves turned yellowish and then falled down when the nitrogen level was below 1.8. At levels higher than 1.8 at the leaves did not fall down, and remained until the end of vegetation period.

The objective of this experiment was the determination of: (i) mineral nutrition content in the leaves of interplanted plants of grape (cv. 'honusu') and pistachio (cv. 'kirmizi') at the province Gazianatep; (ii) deficiencies of macro and micro nutrients; and (iii) to make a comparison between both cvs about the uptake of elements under same soil and rain fed conditions.

II – Materials and methods

This work was carried out in a pistachio and grape orchard in Gaziantep province (Turkey). The soil and leaf analysis was done at the laboratory of the Pistachio Research Institute in Gaziantep. This orchard is growing under rainfed conditions.

The pistachio trees (cultivar 'Kirmizi') are planted 10x10 m, and are 30 years old; the vineyard is established between the pistachio trees. The grape Cultivar is 'Honusu'. Soil sampling was done at different depths (0-20 cm, 20-40 cm, 40-60 cm). Physical and chemical analysis of soils were carried out (Table 1). Leaf sampling from grape was taken two times in a vegetation period: at blooming time and at veraison (onset of rapid maturation or near harvest) (Levy, 1968). Pistachio leaves samples were taken on 16-31 July (before fruit shell became red) (Tekin *et al*., 1990). Macro and micro elements were determined according to leaf samples.

Table 1. Some chemical and physical traits of soil

Traits	Depth			Average
	0-30 cm	30-60 cm	60-90 cm	
pH	8.00	8.00	8.10	8.03
Lime (%)	71.40	73.30	74.20	72.97
Salt (%)	0.02	0.02	0.01	0.02
Structure	50 (loamy)	50 (loamy)	50 (loamy)	50.00
Organic matter (%)	1.80	1.30	1.30	1.47
P (ppm)	2.50	0.60	0.10	1.07
K (ppm)	245.40	215.20	212.30	224.30
Ca (ppm)	4530.0	4080.0	4640.0	4416.67
Mg (ppm)	606.00	678.00	728.00	670.67
Fe (ppm)	9.90	8.20	7.10	8.40
Zn (ppm)	0.40	0.50	0.30	0.40
Cu (ppm)	1.00	0.80	0.90	0.90
Mn (ppm)	7.00	7.20	7.80	7.33

III – Results and discussion

The macro and micro elements contents of grape and pistachio leaves is given in Table 2. According to Table 2 some elements are not uptaken by plants because of high pH of soil. But especially Fe and Cu contents of leaves were very high although the soil condition is not suitable for the uptake of these elements.

The elements contents of pistachio leaves were compared with the maximum and minimum critical levels which were determined by Tekin (2002). As it can be seen in Table 3, nitrogen, potassium and calcium levels were under minimum critical levels. However phosphorus, magnesium, iron, zinc, copper and manganese were sufficient. Magnesium content of leaves was at critical level. Tekin (1992) reported that Mg contents of pistachio leaves taken in Gaziantep province were between 0.59% and 0.83%. He has determined that these levels were included between the critical limits. But when Mg decrease from 0.50% deficiency symptoms will start. The level determined in this experiment (Mg = 0.48) is just in the starting point of deficiency symptoms. As a summary of this experiment, some elements were blocked in soil because of the very high pH.

The elements contents of grape leaves were compared with the maximum and minimum critical levels which were determined by Ibrikci *et al*., (2004). As it is seen in Table 4, nitrogen,

potassium, phosporus, calcium, zinc and manganese levels were under minimum critical levels. However, magnesium, iron and copper were sufficient.

Table 2. Some macro and micro element contents of grape and pistachio leaves

Elements	Grape		Pistachio
	Blooming time	At veraison	Before fruit shell became red
N (%)	1.32	1.16	1.20
P (%)	0.15	0.09	0.09
K (%)	0.99	0.36	0.39
Ca (%)	1.13	1.10	1.43
Mg (%)	0.52	0.64	0.48
Fe ppm	68.67	135.33	127.67
Zn ppm	3.30	7.23	19.83
Cu ppm	14.33	12.67	29.00
Mn ppm	0.97	38.00	22.90

Table 3. Comparison of pistachio leaves contents in elements with the critical levels of these elements according to Tekin (2002)

Elements	Result of this exp.	Critical levels
N (%)	1.20	1.80-2.20
P (%)	0.09	0.06-0.14
K (%)	0.39	0.80-1.20
Ca (%)	1.43	2.20-3.70
Mg (%)	0.48	0.50-0.90
Fe ppm	127.67	43-170
Zn ppm	19.83	10-25
Cu ppm	29.00	6-90
Mn ppm	22.90	20-50

Table 4. Comparison of grape leaves contents in elements with the critical levels of these elements according to Ibrikci *et al.* (2004) at blooming time

Elements	Result of this exp. (blooming time)	Critical levels (blooming time)
N (%)	1.32	2.30-2.80
P (%)	0.15	0.25-0.45
K (%)	0.99	1.20-1.60
Ca (%)	1.13	1.50-2.50
Mg (%)	0.52	0.25-0.60
Fe ppm	68.67	60-175 (Jones *et al*., 1991)
Zn ppm	3.30	20-70
Cu ppm	14.33	6-12
Mn ppm	0.97	30-100

As it is well known Zn is one of the very important elements for both species. When Zn is compared between the two species, it is observed that it was uptaken enough by pistachio but not by grape, although they were growing in the same soil conditions.This situation shows that Zn is a problem for vineyard and that each crop should be considered separately for leaf fertilizer treatments.

IV – Conclusion

South East Anatolia part of Turkey is very dry and has high temperatures in summer time or growing period of plants. This region is very calcareous and has very low rainfall. The plants, which are resistant to dry conditions, were grown without irrigation facilities for a long time. Now some suitable areas are being irrigated thanks to the Ataturk dam project. The experimenlat orchard where this experiment was run, is not irrigated so far. Soil has very high lime and very low organic matter contents because of low rain and high temperatures. Some of the elements are not uptaken by plants because of high pH. But farmers know that no other plant or fruit tree can be grown in this soil conditions. Besides of these two crops, olive is growing in such difficult conditions. Deficiency of element causes low yields and quality. Pistachio shows a strong alternate bearing habit.

The nutrients available to plant roots depend upon many factors, among which are climate, plant species, rootstock type, soil type, total nutrients in the soil, soil moisture, soil oxygen content, humus content, soil pH, and base saturation (Westwood, 1978). Depend upon the soil content, N availability was variable in either pistachio or grape but there was no problem with potassium and manganese up taking, although the two species were grown as interplanting or mixed growing system. According to the results, N, K, Ca, Mg are in deficit in pistachio trees, and N, P, K, Ca, Zn, Mn are in deficit in vineyard. These results show that in such a bad soil and climate conditions pistachio trees benefit from soil elements better than grape.

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