Research on Determınıng the Nutritional Status of Peach Orchards in Lapseki District of Çanakkale Province

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***Abstract*— The research has been carried out to to define the relationships between some physical and chemical properties of soil in the peach orchards of Çanakkale province, and leaf nutrients and agronomic characteristics of the fruit. For this purpose, soil samples were taken from 10 different parts and 2 different depths in 15 fruit orchards, and leaf samples were taken from 25 trees in each orchard, and fruit samples were taken from each orchard. Chemical and physical properties of these samples were defined. Soil and leaf nutrient contents, which were obtained, were compared to limit values and their qualification levels and correlations were analyzed. According to the obtained data, N and Cu were found to be high, P, K, Ca, Mg and B were adequate and Zn and Mn values were low when the average values of leaves were compared to optimum values determined in the literature. According to soil analysis results, it was concluded that at a 30-60 cm depth all other values except phosporus and manganese were numerically lower than 0-30 cm values depending on depth, but effective root depth nutrient levels were found to be adequate. Despite these positive results, it was found necessary to decrease soil pH and to increase organic matter.**

***Index Terms*— Turkey, Çanakkale, Peach, nutrient content**

I. Introduction

Peach, which is thought to have originated from Northern China, comes after apple in the world fruit production. When the averages of years are observed, it is reported that the amount of production, which was 539. 403 tonnes in 2010, was 540.286 tonnes in 2011, and the aforementioned fruit's share in 2011 fruit production was 3, 14 % (TÜİK, İstatistiklerle Türkiye, 2011).

The largest peach-growing countries in the world are, respectively; Italy, the USA, China, Greece, Spain, France, Russia, Turkey, Mexico and Argentina. The rapid development of peach cultivation is largely due to the fact that its varieties are able to comply with different ecologies, it produces fruit early, it provides an important source of raw material for agro-industries and its fruits are rich in nutritional content. Indeed, 7-12 g sugar. , 0.7- 1 g. nitrogenous substances (Thiamin, Riboflavin, Niacin), and 2-20 mg.
Vitamin C (ascorbic acid), and varying amounts of vitamin A and B exist in 100 g fresh peach.

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Peach may be consumed as fresh fruit, and may be stored for long periods as fruit juice concentrate, as pulp and by drying or deep-freezing. Peaches may also make products such as jam and marmalade, thereby constituting raw materials for such industry.

Despite the fast that peach is a fruit of temperate climate, it can adapt to different climatic conditions, but frequently suffers from late spring frosts as it blooms early like apricot. Plains in Southern Marmara Region, Yalova, Izmit Gulf and its surroundings, Balıkesir plain, Çanakkale and Ezine plains, Pamukova and Adapazarı plains in the north of the region are the areas where there is intense peach production.

In studies conducted on the issue, and Polat and Gezerel (1992), have stated that the relationship between the yield conditions of some peach and nectarine varieties and leaf nutrient levels is not significant in statistical terms.

In their study to determine the nutritional status of various fruit trees, Bozkurt et al., (2000) have found that efficiency nutrient relationships is of no importance in statistical terms. Tümsavaş and Katkat (1995) have determined the reducing effect of iron sulfate and Fe-EDDHA applications on macro element amounts of peach leaves. The purpose of this study is to determine the relationships between some physical and chemical properties of soil in the peach orchards of Çanakkale province, leaf nutrients and agronomic characteristics of the fruit.

II. MATERIAL and METHODS

A. Material

The research was carried out in 15 peach orchards randomly selected in Lapseki and Umurbey districts of Çanakkale province. Research material consists of soil samples taken from 0-30 and 30-60 cm depths in 10 different parts of these orchards, leaf samples taken from 25 trees by drawing a U line in the orchard, from middle leaves of annual shoots, one leaf from each shoot and 8-12 weeks after full bloom date (mid-May, until the second half of July) and 10 fruit samples selected from each garden in triplicat 1,5 months before the harvest

B. Method

Soil samples taken from orchards, where the test was carried out, were air-dried and prepared for physical and chemical analysis by sieving through a 2 mm sieve. Texture in the samples was defined by Bouyoucos Hydrometer Method (Bouyoucos, 1951). Soil reaction was determined via pH meter in a 1:2,5 diluted soil-water mixture (Jackson, 1958), total salt via EC and nomogram method, lime via Scheibler calcimeter, phosporus via Olsen method (Olsen, 1954), available Ca, Na, Mg and K were via 1.0 N ammonium acetate (pH = 7.0) extraction method (Bayraklı ,1987), available Fe, Cu, Zn adn Mn via 0,05 M DTPA, and the obtained extraction (Lindsay and Norvell, 1978), then, was defined via GBC 902 AAS

As reported by Balinger et al., 1966, leaf samples were taken from the 6th, 7th and 8th leaves,starting from the bottom of fruitless shoots. N analysis was determined via Kjeldahl method, available Ca, Fe, Zn, Mn and Cu contents in the extract,which was obtained by wet digestion, were determined via GBC 902 AAS according to Bayraklı (1987), and P was determined according to Barton(1948).

In fruit samples, which were randomly taken from each orchard 1,5 months before the harvest, fruit size (mm) and fruit diameter (mm) were determined via calipers, fruit volume (mL) and fruit weight (g) were recorded by weighing, dry matter was determined by refractometer and pH by PH meter.

While the obtained data was being evaluated statistically , regression-correlation analyses were made (Yurtsever, 1984).

III. RESULTS AND DISCUSSION

Soil Results: The lowest, the highest and average values of measuremenst in 0-30 and 30-60 cm soil depths are show1n in Table 1.

When average values were compared to limit values in Table 1, it was concluded that at a 30-60 cm depth, all other values except phosporus and manganese were numerically lower than 0-30 cm values depending on depth.

Table I: The lowest, the highest, average and limit values at adequate levels which were determined in some features of the soil samples taken from different depths.

Parameter	Limit Values (Adequate)	0-30			30-60		
		Min	Max	Av	Min	Max	Av
pH	6.0-7.5**	5,41	8,80	8,00	5,27	8,63	7,64
Water Saturation		20,00	47,00	29,53	20,00	41,00	28,60
O.M (%)	< 2***	1,10	1,95	1,42	0,95	1,65	1,31
N (ppm)	900-1700*	90,00	256	153,00	100,00	169,00	134,00
P (ppm)	8-25*	5,20	71,00	32,40	12,00	61,90	33,32
K (ppm)	109.6-289,3*	146,00	380,00	255,00	128,00	365,00	229,00
Ca (ppm)	1150-3500*	753,00	4746,00	2675,00	981,00	4086,00	2527,00
Mg (ppm)	160.9-484*	72,00	210,00	144,00	70,00	220,00	142,00
Fe (ppm)	2.5-4.5*	1,73	18,90	6,01	1,43	15,00	5,53
Mn (ppm)	14-50*	3,18	8,70	5,38	7,16	30,00	18,58
Zn (ppm)	0.7-2.4*	0,12	0,60	0,27	0,08	0,62	0,26
Cu (ppm)	>0.2*	3,65	26,20	14,28	2,49	25,50	13,17
B (ppm)	1.0-2.4*	0,05	0,67	0,35	0,06	0,63	0,34
Salt (ds/m)	0-2****	0,10	0,10	0,10	0,10	0,10	0,10

*: Güneş et all., 2007; **:Hoffmann 2010; Kacar and Katkat 2007; ***: Sönmez, 2013; ****: Rhoades,1992

This decrease can be explained by a higher physical, chemical and physiological activity at 0-30 cm depth. Both soil depths were in mid alkaline soil class, and their average pH values were found slightly higher (Hoffmann 2010; Kacar and Katkat (2007) than limit values. The fact that its pH is above 7.5 leads to the loss of nitrogen in the form of ammonnium. The availability of phosphorus, potassium, magnesium, iron, zinc, manganese, copper and boron may decline in the form of fixation, antagonistic interaction and transformation to an insoluble form (Sönmez and Çıtak, 2013).

Therefore, to reduce the pH in these areas, in addition to preferring physiological acidic fertilizers in all fertilizer applications, 100-150 kg da^{-1} sulfur application in burst period or 150-200 kg da^{-1} leonardit application in two different periods, namely post-harvest and pre-burst, will be the solution.

Research soils are poor (Sönmez, 2013) in organic matter, leonardit application will provide support for the solution on this issue as well. For this purpose,it is thought that compost application will also be useful. While phosphorus, potassium, calcium, iron and copper were found to be higher than the limit values of adequate levels, nitrogen, magnesium, manganese, zinc and boron were lower (Güneş et al., 2007). No danger of salt was determined in either soil depth.(Scheffer,Schachtschabel,1993; Rhoades,1992).Values of yield and some quality criterion of peach fruits are shown in Table II.

Table II: Minimum, maximum and average values of yield and some quality criterion of fruits

Parameter	Minimum	Maximum	Average
Fruit Size (cm)	5,64	8,30	6,91
Fruit Diameter(cm)	5,97	8,70	7,44
Fruit Volume (ml)	104,00	338,00	197,96
Av. Single Fruit Weight (g)	107,20	327,10	204,98
Dry Matter(%)	8,00	16,10	11,70
pH	3,10	4,00	3,38

The average fruit size, diameter and volume of the peaches,which form the material, were determined as 91 cm; 7,44 cm and 197,96 ml respectively ; the average single fruit weight as 204,98 g; dry matter as 11,70 % and pH as 3,38. The fruits were found cubic through the measurements of size and diameter and classified as ideal. Dry matter was ideal , but the low pH was entirely due to the deterioration of vitamin C and the formation of metal chelates.

Values of N, P, K, Ca, Mg, Fe, Cu, Zn, Mn and B elements obtained from leaf analysis in the study are shown in Table III.

Table III: Minimum, maximum and average values obtained from soil analysis results

ELEMENT		Optimum*	Minimum	Maximum	Average
N		2.20-3.20	3,89	5,55	4,78
P		0.18-0.35	0,10	0,34	0,21
K	(%)	1.50-3.00	1,43	2,31	2,05
Ca		1.50-2.50	0,95	2,10	1,59
Mg		0.30-0.60	0,37	0,45	0,41
Fe		**100-250	96,00	146,00	120,00
Cu		7-15	6,80	88,70	15,00
Zn	(mg kg^{-1})	15-50	7,85	16,00	11,00
Mn		35-100	4,00	57,70	15,00
B		20-60	34,00	48,00	42,00

* :Sönmez and Çıtak. 2013; ** : Kacar and Katkat. 1998

When average values of leaves were compared to optimum values of peach leaves according to Sönmez and Çıtak (2013), N and Cu were found to be high, P, K, Ca, Mg, B and Fe (Kaçar and Katkat. 1998) were adequate and Zn and Mn values were found to be low. It is thought to be related to the immobility (Jones and Jacobsen, 2001) of Zn and Mn in soil.

The high amount of copper is interpreted as a result of the chemical content of the pesticides used during vegetation.

The relationships between the physical and chemical properties of the soil in the research are shown in Tables IV and V.

Table IV: The relationships between the physical and chemical properties of the soil (0-30 cm)

0-30 cm												
	WATER SAT.	**OM**	**Na**	**P**	**K**	**Ca**	**Mg**	**Fe**	**Mn**	**Zn**	**Cu**	**B**
pH	0,626*	-0,199	0,192	-0,246	0,279	0,733**	0,395	-0,929**	-0,913**	-0,244	-0,238	-0,253
Water Saturation		-0,461	0,161	-0,378	0,440	0,964**	0,709**	-0,540*	-0,679**	-0,081	-0,200	0,170
OM			-0,195	0,223	-0,442	-0,489	-0,298	0,248	0,248	0,075	0,214	-0,604*
Na				-0,085	0,227	0,269	0,337	-0,212	-0,215	0,442	0,540*	0,155
P					0,274	-0,359	0,069	0,083	0,351	0,440	0,516	-0,085
K						0,446	0,321	-0,446	-0,201	0,320	0,382	0,383
Ca							0,712**	-0,639*	-0,744**	-0,088	-0,150	0,080
Mg								-0,446	-0,403	0,001	0,079	0,108
Fe									0,855**	0,258	0,184	0,177
Mn										0,217	0,372	0,243
Zn											0,815**	0,224
Cu												0,176

*: siginificant at % 5; **: significant at % 1

When Table 4 is examined, the relationships concerning 0-30 depth soil can be summarized as follows: (0,626*) 5% positive between pH and water saturation, (0,773**) 1 % positive between pH and Ca, 1 % negative with Fe (-0,929**) ve Mn ile (-0,913**). The fact that soil PH is alkaline positively correlates with Ca rate, but negatively correlates with Fe and Mn regarding antagonism and availability (Kacar and Katkat. 1998).

It was determined that water saturation had 1 % positive relationship with Ca (0,964**) and with Mg ((0,709**), 1% negative relationship with Mn (-0,679**) and 5 % negative relationship with Fe (-0,540*). This was due to clay minerals in Ca and Mg and the increasing saturation of Ca and Mg. As for Fe and Mn, this is directly related to the mobility of ions. It was found that (-0,604*) 5 % negative relationship existed between organic matter and B, and that (0,504*) 5 % positive relationship existed between Na and Cu. A parallel relationship with pH and these ions was determined between Ca and Mg, Fe and Mn. As they both gave the same reaction deepnding on high pH, (0,855*) 5 % positive correllation was formed between Fe and Mn, and (0,815*) 5 % positive correlation formed between Zn and Cu.

Table V: The relationships between the physical and chemical properties of the soil (30-60 cm)

30-60 cm												
	WATER SAT.	**OM**	**Na**	**P**	**K**	**Ca**	**Mg**	**Fe**	**Mn**	**Zn**	**Cu**	**B**
pH	0,738**	-0,219	0,116	-0,193	0,249	0,833**	0,429	-0,899**	0,063	0,038	-0,293	-0,196
Water Saturation		-0,574*	0,163	-0,431	0,322	0,922**	0,545*	-0,556*	0,123	0,009	-0,230	0,176
OM			-0,059	0,249	-0,364	-0,438	-0,363	0,216	-0,533*	0,121	0,077	-0,340
Na				-0,558*	-0,458	0,312	-0,118	0,173	-0,108	-0,251	-0,160	-0,185

P					0,328	-0,357	-0,160	-0,021	-0,196	0,403	0,368	0,144
K						0,343	0,242	-0,29	0,004	0,541*	0,535*	0,336
Ca							0,451	-0,632*	0,069	0,135	-0,141	0,053
Mg								0,448	0,189	0,021	-0,092	0,045
Fe									-0,102	0,045	0,346	0,103
Mn										-0,155	-0,252	-0,160
Zn											0,863**	0,027
Cu												0,220

*: siginificant at % 5; **: significant at % 1

The following results were reached when the analysis results of soil samples taken from a depth of 30-60cm were statistically evaluated: a 1% positive significance between pH and water saturation (0,738**) and Ca (0,833**), and a negative relationship between pH and Fe (-0,899**) were observed.

It was observed that water saturation had 5 % negative relationship with organic matter (-0,574*) and with Fe (-0,556*), and 1 % positive with Ca and a 5 % positive relationship with Mg (0,545*). Organic matter had a negative effect on Mn (-0,533*) at a level of 5% statistically. It was determined that Na, a plant nutrient, positively/negatively correlated with P (-0,558*), K positively correlated with Zn (0,541*) and Cu (0,535*) 5 %, and Ca negatively correlated with Fe (-0,632*). It is thought that this effect is due to the antagonistic relationship between two aforementioned elements. It was determined that Zn had 1 % positive statistical relationship with Cu (0,863**).

The statistical relationships between the values obtained from leaf analyses are shown in Table 6. When the table is examined, it is seen that there exists (-0,557*) 5% negative relationship between N and Ca, (0,626*) 5% positive relationship between K and Ca, and again a significant positive relationship between Mg and Cu (0,580*) and between Fe and Mn (0,540*) at a level of 5 %. All other relationships are found to be statistically insignificant. It is concluded that the obtained results are due to the synergist and antagonist relationships among plant nutrients. It is also thought that plant varieties, climate and soil factors are effective in the results as well.

A negative , though not statistically significant, relationship between K and Mg content of leaves on peach trees has been noted, and the result obtained coincides with the results of Seggewiss ve Jungk (1988) 's study. The researcher have reported an antagonistic relationship between K and Mg intake in their studies on different plants.

Table VI: The relationships between the values obtained from the leaf analyses.

Leaf analyses										
	P	K	Ca	Mg	Fe	Cu	Zn	Mn	B
N	0,177	-0,230	-0,557*	0,031	-0,236	0,011	-0,108	0,130	0,498
P		0,308	-0,232	0,173	0,127	-0,238	0,141	-0,030	0,245
K			0,626*	-0,003	0,020	-0,111	-0,027	0,193	-0,355
Ca				0,198	-0,033	0,193	0,224	0,097	-0,326
Mg					0,272	0,580*	0,385	-0,082	0,283
Fe						-0,165	0,117	0,540*	0,306
Cu							0,328	-0,188	0,105
Zn								0,043	0,118
Mn									0,220

*: siginificant at % 5; **: significant at % 1

When the relationships between the agronomic characteristics of the fruits addressed in the study are examined in Table 7, it is seen that all parameters (fruit diameter, fruit volume and average single fruit weight) except % dry matter have positive effect at a level of 1% statistically, and that % dry matter shows a negative correlation with all parameters.

As the quality criteria of fruit are parameters such as dry matter, organic acids, sucrose and minerals etc., negative correlations with dry matter were formed naturally as the fruit volume increased. The fact that the relationship between pH and dry matter is (-0,182**) 1 % negative can be explained by vitamin C's being stabilized after fragmenting and forming chelates with metal ions depending on a high amount of Fe and Cu in sample plants

Table VII: Analysis results of the agronomic characteristics of fruits.

	Fruit diameter	Fruit volume	Av. Single Fruit Weight	Dry Matter	pH
Fruit size	0,808**	0,317**	0,314**	-0,258**	0,175*
Fruit diameter		0,360**	0,397**	-0,324**	0,229**
Fruit volume			0,447**	-0,322**	0,176*

Av. Single Fruit Weight				-0,333**	0,06
Dry Matter					-0,182**

*: siginificant at % 5; **: significant at % 1

IV. RESULTS AND SUGGESTIONS

Although the soils of the research area are suitable in general for peach, in order to increase the solubility and availability of both Fe, Mn, Zn and macro elements, it seems necessary to increase the level of especially organic matter to a level of 2 % and to decrease the pH (6.5-7.0).For this purpose 100-150 kg -1 elemental sulfur should be mixed to a depth of about 10-15 cm. In order to contribute to organic matter increase and pH decrease, it would be appropriate to apply 150-200 kg da-1 Leonardit and compost, which has matured by being enriched in nutrients and consists of grain and forage legumes, at 5-10 cm soil depth.

Due to the increasing N in the research area, fruits have suffered dillusion and the ratio of dry matter has decreased. Therefore, N application should be reduced or made periodically in a controlled way. Zinc and Mn deficiency is pH and Ca-induced, thus lowering the pH will solve this problem.

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