Determination of Nutritional Status of Walnut Orchards by Leaf Analysis in Tekirdağ Region*

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This study was conducted to determine the nutritional status of the walnut orchards leaf sample analysis in Tekirdağ region. For this purpose, 46 leaf samples, which were taken from 44 different walnut orchards located in 32 different villages in Çorlu, Saray, Ergene, Kapaklı, Marmara Ereğlisi, Muratlı, Hayrabolu, Malkara, Şarköy, Çerkezköy Districts and were analyzed. By comparing the results of the leaf samples analysis with the nutrient status limits of the investigated orchards the nutrition status have been studied and determined. According to the results, 84.78% N, 4.39% P, 4.35% K, 2.18% Ca, 4.35% Mg, 4.35% S, 2.18% Fe, 8.69% Cu, 65.21% Zn and 4.35% Mn deficiency were determined. On the other hand, 15.22% N, 89.13% P, 95.65% K, 84.78% Ca, 95.65% Mg, 91.30% S, 97.82% Fe, 89.3% Cu, 34.79% Zn and 84.78% Mn were determined sufficient in leaf samples and 6.58% P, 13.04% Ca, 2.18% Cu and 10.87% Mn were found excess level in leaf samples.

Key words: Tekirdağ, walnut, nutrient element, leaf analysis

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Tekirdağ İlindeki Ceviz Bahçelerinin Beslenme Durumlarının Yaprak Analizleriyle Belirlenmesi

Bu çalışma Tekirdağ İlindeki ceviz bahçelerinin beslenme durumlarının yaprak analizleriyle belirlenmesi amacıyla yapılmıştır. Bu amaç doğrultusunda Süleymanpaşa, Saray, Ergene, Kapaklı, Marmara Ereğlisi, Muratlı, Hayrabolu, Malkara, Şarköy, Çerkezköy, Çorlu ilçelerine ait 32 farklı köyde bulunan toplam 44 ceviz bahçesinden alınan 46 ceviz yaprak örneği analiz edilmiştir. Yaprak örnekleriyle ilgili analiz sonuçları sınır değerler ile karşılaştırılarak incelenen bahçelerin besin elementi durumları ve beslenme sorunları tespit edilmeye çalışılmıştır. Elde edilen bulgulara göre ceviz bahçelerinden alınan yaprak örneklerinin %84.78'inde N, %4.39'unda P, %4.35'inde K, %2.18'inde Ca, %4.35'inde Mg, %4.35'inde S, %2.18'inde Fe, %8.69'unda Cu, %65.21'inde Zn ve %4.35'inde ise Mn yetersizliği görülmüştür. Yaprak örneklerinin %15.22'sinde N, %89.13'ünde P, %95.65'inde K, %84.78'inde Ca, %95.65'inde Mg, %91.30'unda S, %97.82'sinde Fe, %89.3'ünde Cu, %34.79'unda Zn ve %84.78'inde Mn içeriğinin yeterli düzeyde olduğu saptanmıştır. Yaprak örneklerinin %6.58'inde P, %13.04'ünde Ca, %2.18'inde Cu ve %10.87'sinde Mn içeriğinin yüksek düzeyde olduğu bulunmuştur.

Anahtar kelimeler: Tekirdağ, ceviz, besin elementi, yaprak analizi

Introduction

Walnut is a kind of nut fruit which belongs to *Dicotiledoneae* class, *Juglandales* tribe, *Juglandaceae* family and *Juglans* genus (Sen 1986). Although there are about 20 species in the genus *Juglans*, mostly *Juglans regia* is cultivated and commercial (Manning 1978). *Juglans regia*, is the widespread walnut species in the world and almost all cultured walnut varieties belong to this species.

Wild forms of walnut species had the opportunity to spread in many parts of the world. It is claimed that walnut is common in 3 natural plant diversity regions (1: Iran Ghilane Area; 2: China; 3. A wide ranging area from Carpathian Mountains of Turkey to Iraq, Iran, Afghanistan, South Russia, India, Manchuria and Korea (Sen 1986).

Due to its origin Anatolian walnut (*Junglans regia*)is having a large span in the world and taken to the outside of its natural habitat by various migrations and trade caravans and today it is in a kind of fruit which is grown almost anywhere in the world outside the tropical regions (Sen 1986, Adiloğlu 2012).

Walnut, has a great importance among fruit tree species due to high nutritional value as of fruits

and trees used in furniture industry. Walnuts are especially consumed as dried fruits. Bark of walnut tree, fruit peel, green fruit peel and leaf parts are widely used in the pharmaceutical and cosmetics industry and used as dyes in the carpet and textile industries (Oliveira et al., 2008).

Significant reductions were determined in walnut trees when they are exposed to salt stress in terms of in length of roots, stems and shoots; leaf area and number; chlorophyll content and yield. When plant is exposed to long salinity stress, ion toxicity and water deficiency occur in older leaves and younger leaves has been shown carbohydrate deficiency symptoms (Sivritepe, 1995; Tıpırdamaz and Ellialtıoğlu, 1994).

Interpretation of soil and plant analysis is of particular importance for walnuts. Because of there are many different species and varieties and leaves at different ages on the same tree, the walnut analysis and fertilizer recommendation is require a special attention. A balanced fertilization is necessary for increasing the yield and quality of the walnut (Ponder and Schlesinger, 1986; Garrett et al., 1991; Jones et al., 1995; Akça et al., 2003; Jacobs et al., 2005; Adiloğlu and Adiloğlu, 2005).

In a study reported by Drosopoulos et al. (1996) the level of some plant nutrient elements in the leaves were determined by samplingfrom 51 different walnut orchards,to determine nutritional status of walnut orchard. According to the analysis results obtained in youngleaves totalN was foundbetween16-35 mg/g,total P between 1.3-2.1 mg/g, total K between8.6-18.5 mg/g, total Ca between 26.1-41.4 mg/g, totalMg between 3.7-4.5 mg/g, total Fe 176-342 mg/kg, total Mn 93-171 mg/g, total Cu between 7.5-15 mg/kg and total Zn 37.5-66.7 mg/kg.

The magnesium deficiency may also lead to a decrease in yield of walnut trees, excessive K, Ca, NH_4, low pH and poor root zone conditions prevents the uptake of these nutrients; compact structure of the soil, excessive and inadequate irrigation, inadequate ventilation or high amounts of fruit load causes this situation (Papadoupolos, 1998;Adiloğlu, 2007). According to Bellitürk (2011), the average P, Ca, Mg, Fe, Mn and Cu contents of the Tekirdağ soil samples were found to be adequate but K and Zn contents were found to be inadequate. On the other hand, organic matter level is highly insufficient in the Thrace Region soils.

The aim of this study was to determine the nutritional disorders of walnut orchards in Tekirdağ Province by identifying some of the macro- and micro-nutrient status via leaf analysis. By allowing the detection of current nutritional problems and challenges this present study can shed light on the solution and can be useful to the nut producers in the region and science

Material and Methods

In this study leaf samples were taken from walnut orchards in Süleymanpaşa, Saray, Ergene, Kapaklı, Marmara Ereğlisi, Muratlı, Hayrabolu, Malkara, Şarköy, Çerkezköy,and Çorlu Districts of Tekirdağ and some information about the sampling places were presented in Table 1.

Field studies were conducted in July 2014. Medium leaves which completed the development on the spring shoots were taken according to the land size and age of the trees in the orchard from 5-10 trees (Pond, 2004). Leaf samples taken from the walnut orchards were brought to the laboratory in paper bags, washed with sterile distilled water and dried at 65^{o}C for 24 hours in owen. The dried samples were grounded in the steel mill and had been made ready for the analysis (Kacar and İnal, 2008).

Total N analysis was performed according to Kjeldahl distillation method by using grounded leaf samples. Phosphorus, potassium, calcium, magnesium, sulphur, iron, copper, zinc and manganese were determined from the samples obtained by wet burning method using ICP-OES (Inductively Coupled Plasma) device (Kacar and İnal, 2008).

Results were given as % dry matter for P, K, Ca, Mg and mg/kg in dry matter for S, Fe, Cu, Zn, Mn. Statistical analysis of the data were conducted using SPSS program (SPSS 2014). Pearson Moments Multiplication Correlation Coefficient method was applied to determine whether to show a positive or negative relationship with each of the elements investigated in leaf samples.

Differences between provinces of which leaf samples were taken were analyzed according to randomized complete blocks using analysis of variance (ANOVA). Duncan Multiple Comparison Test was applied (Yıldız and Bircan, 1991) in comparison of means which found to be significant by ANOVA.

*T*able 1. Some information about the walnut orchards where leaf samples taken

No	District	Village	Land Size (da)	Latitude	Longitude	Altitude	Age of Tree (year)	Variety
1	Süleymanpaşa	Köseilyas	10	41.01083	27.59027	111	7	Chandler
2	Saray	Ayvacık	80	41.48246	27.94152	205	7	Kaman,Yavuz, Bilecik ,Yalova
3	Saray	Sofular	26	41.43322	27.67444	125	9	No Information
4	Ergene	Paşaköy	70	41.40401	27.60344	118	7	Chandler
5	Kapaklı	Uzunhacı	21	41.35191	27.83205	110	6	Chandler
6	Marmara Ereğlisi	Yeniçiftlik	40	41.02596	27.85398	123	4	No Information
7	Süleymanpaşa	Gündüzlü	10	41.08398	27.51235	201	6	No Information
8	Muratlı	Merkez	700	41.18295	27.46423	87	7	Chandler, Pedro, Şebin, Bilecik
9	Muratlı	Merkez	700	41.17933	27.46281	109	5	Chandler, Pedro, Şebin, Bilecik
10	Muratlı	Merkez	700	41.17326	27.46131	143	7	Chandler, Pedro, Şebin, Bilecik
11	Muratlı	İnanlı	30	41.21406	27.48832	71	4	Şebin, Bilecik
12	Muratlı	Ballıhoca	15	41.19988	27.49578	79	7	Yavuz
13	Hayrabolu	Çeneköy	10	41.19102	27.19312	83	10	Şebin, Kaplan, Yalova, Bilecik
14	Hayrabolu	Çerkezmüsellim	10	41.26185	26.99964	152	9	Şebin, Bilecik, Yalova
15	Hayrabolu	Temrezli	2	41.31065	27.08646	49	8	No Information
16	Hayrabolu	Tatarlı	2	41.14468	27.06219	146	10	No Information
17	Malkara	Haliç	10	40.86605	26.79084	211	4	No Information
18	Malkara	Haliç	12	40.86653	26.79120	212	15	No Information
19	Malkara	Çavuşköy	20	40.87954	26.95460	178	9	Chandler
20	Malkara	Gönence	4	40.91129	26.92309	163	5	No Information
21	Süleymanpaşa	Nusratfakı	10	40.94164	27.32588	235	15	No Information
22	Süleymanpaşa	Hacıköy	4	40.99348	27.35788	310	4	Yalova, Şebin
23	Süleymanpaşa	Kaşıkçı	300	41.03997	27.24378	242	4	No Information
24	Malkara	Sağlamtaş	240	40.78605	27.10167	146	5	No Information
25	Şarköy	İshaklı	23	40.74902	27.10401	277	5	Chandler
26	Şarköy	İshaklı	35	40.74570	27.07891	248	4	Chandler
27	Şarköy	Merkez	50	40.63977	27.08535	147	9	No Information
28	Şarköy	Merkez	22	40.64186	27.07637	200	15	No Information
29	Şarköy	Merkez	5	40.65783	27.05673	321	4	No Information
30	Şarköy	Yeniköy	24	40.63605	26.99292	251	4	Şebin
31	Şarköy	Yeniköy	2	40.64598	27.00179	206	11	No Information
32	Şarköy	Hoşköy	6	40.71637	27.27384	244	7	Şebin, Yalova, Bilecik
33	Şarköy	Güzelköy	3	40.73712	27.30565	194	4	No Information
34	Süleymanpaşa	Yeniköy	2	40.82857	27.39655	319	9	No Information
35	Süleymanpaşa	Yeniköy	2	40.85529	27.37316	112	10	No Information
36	Süleymanpaşa	Işıklar	148	40.86471	27.36315	128	6	No Information
37	Süleymanpaşa	Naipköy	17	40.87781	27.39881	135	6	No Information
38	Süleymanpaşa	Naipköy	15	40.87714	27.42436	115	9	No Information
39	Çerkezköy	Veliköy	20	41.26120	27.90494	134	10	Şebin, Yalova, Bilecik
40	Ergene	Velimeşe	2	41.25301	27.88118	154	12	No Information
41	Çorlu	Sarılar	2	41.14032	27.66658	156	10	No Information
42	Çorlu	Merkez	4	41.13673	27.80777	152	8	No Information
43	Çorlu	Türkgücü	2	41.08751	27.82195	76	13	No Information
44	Marmara Ereğlisi	Türkmenli	2	41.04467	27.85107	126	9	No Information
45	Çorlu	Merkez	2	41.16170	27.77684	148	9	No Information
46	Muratlı	Yeşilsırt	2	41.12311	27.48594	90	8	No Information

Result and Discussion

N, P, K, Ca, Mg, Fe, Cu, Zn, Mn determined in leaf samples were evaluated according to the limit value specified by Jones et al. (1991); S is evaluated according to the limit value specified by Sen (1986). The results were detailed discussed below.

The total nitrogen content in the dry matter of leaf samples taken from walnut orchards in TekirdağProvince ranged from 0.99-3.02%. When analysis of leaf samples were compared with Jones et al. (1991) as identified by adequate limits 1.90-2.60%, 84.78% of the walnut orchards (39 samples) contained insufficient nitrogen level, while 15.22% (total 7 samples) of the walnut orchards were found to contain sufficient level of nitrogen.

The phosphorus content was determined to be ranged from 0.11 to 12.32% of the walnut leaf samples taken from the orchards in Tekirdağ. Research result obtained from analysis of leaf samples were compared with the limit values reported by Jones et al (1991).Evaluated results revealed that 4.39% (2 samples) of the samples contained insufficient level, 89.13% (41 samples) contained adequate level and 6:58% (3 samples) containedhigh levels of phosphorus.

In terms of potassium content, it was determined that the level of the leaf samplesranged between 1.02-2.18%. When the research result were compared with the limit values (1.50-2.00%) reported by Jones et al. (1991) it was found that while 4.35% (2 samples)of the samples contained insufficient level, 95.65% (44 samples) contained sufficient potassium level. According to the analysis of the leaf samples the calcium content was found to be between0.31-2.86%. By comparing with the sufficient limit values (1.20-1.60%) determined by Jones et al (1991), 2.18% of the orchards assessed as inadequate, 84.78%as adequate, 13.04% were found to contain high levels of calcium .

The magnesium content was determined to be ranged from 0.12% to 0.54% of the walnut leaf samples taken from the orchards in Tekirdağ. When the research result obtained from analysis of the leaf samples were compared with the limit values determined by Jones et al. (1991) as 0.24%-0.40%, it was determined that at 4.39% (2 samples) of the samples contained insufficient level, 95.65% (44 samples) contained sufficient levelof magnesium. As a result of analysis the sulfur content of the samples ranged from 0.04% to 0.23%. When obtained results were compared with limit values (0.11-0.20%)reported by Şen (1986), it was found that 4.35% (2 samples) of the samples contained insufficient level, 91.30% (42 samples) contained sufficient and 4.35% (2 samples) contained high level of sulphur.

In terms of iron content, it was determined that the level of the leaf samplesranged between 15.10-228.44 mg/kg. When research results were compared with the limit values (50-300 mg/kg) reported by Jones et al (1991), it was determined that while 2.18% (only 1 sample) of the orchards contained insufficient level, 97.82% (45 samples) contained sufficient iron level. According to the analysis the copper content was found to be between 2.61-13.05 mg/kg. When results compared with the limit values (6-50 mg/kg) stated by Jones et al. (1991), it was revealed that while 8. 69% of the orchards contained insufficient, %89.13 contained sufficient 2.18% contained high level of copper.

The zinc content of the leaf samples was ranged between 6.79-49.99 mg/kg. By comparing with the sufficient limit values (20-100 mg/kg) determined by Jones et al (1991), 65.21% (30 samples) of the orchards assessed as inadequate and 34.9% (16 samples) as adequate.

The manganese content of the leaf samples ranged from 1.27 to 552.06 mg/kg. When the research results were compared with the limit values according to Jones et al. (1991) as 25-200 mg/kg, it was determined that at 4.35% (2 samples) of the samples contained insufficient level, 84.78% (39 samples) contained sufficient level and 10.87% (5 samples) contained high level of manganese.

Conclusions

As a result, in order to raise the yield and quality of walnut cultivation in the region practical studies for a balanced nutrition along with other agricultural practices should be implemented. Among the precautions that should be taken, application of appropriate and economical organic fertilizer (manure, green fertilizer, humic acids, leonardit etc.) as farm manure is essential to increase the level of organic matter in walnut

orchards. On the other hand significant amounts ofzinc deficiency was found in the walnut orchards. Zinc fertilization program must be certainly applied according to complete soil and leaf analysis results. Otherwise, very important losses in the yield and quality of the product will prove to be inevitable.

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