Bulgarian Journal of Agricultural Science, 18 (No 1) 2012, 92-99
Agricultural Academy

HEAVY METAL CONTENTS OF AEGEAN REGION TOBACCOS ACCORDING TO QUALITY GROUPS AND STALK POSITION

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Abstract

EKREN, S., A. GOKCOL and C. SONMEZ, 2012. Heavy metal contents of Aegean region tobaccos according to quality groups and stalk position. *Bulg. J. Agric. Sci*., 18: 92-99

The study was carried out in Akhisar district of Ege Region in Turkey where tobacco is very popular in the growing period of 2004-2005. In this research, nine fields which are differences in terms of the quality and efficiency in the villages called Haciosmanlar, Arabacibozkoy, Derekoy, Mecidiye and Suleymanli were selected. Chromium, cobalt, nickel, zinc, arsenic, cadmium and lead contents of the tobaccos were analyzed. All analysis showed that there were significant differences among tobacco samples analyzed in different years, priming and also quality groups.

After two years results of the study, arsenic, lead, chromium, cadmium, cobalt, zinc and nickel were measured as 0.18-0.98 ppm, 7.45-38.40 ppm, 4.37-28.60 ppm, 0.05-1.50 ppm, 1.10-5.45 ppm, 43.9-140.9 ppm, 6.00-10.85 ppm, respectively.

Key words: tobacco, minor or trace elements, quality, Ege Region

Introduction

In today's world there is a strong campaign against smoking, because of its harmful effect on people's health. In spite of that, tobacco and tobacco products present a means for enjoyment to over 20% of the world population (Pelivanoska 2007). The production of tobacco in the world wide and effects of human consumption of tobacco make it desirable to study the trace elements in tobacco products.

Some trace elements in tobacco are hazardous for human metabolisms even at very low level of smoke. As this product provides routes of entry into the body system it is particularly important to characterize the consumption of elements that may have toxic properties. Large number of toxic elements is found in tobacco leaves. This situation is an important problem as many trace elements, in particular the heavy metals, are accumulating in soils where intensive fertilizer application is practiced (Camas et al., 2007).

It is known that tobacco intakes the heavy metals from soils and accumulates them in leaves. The content of heavy metals in tobacco leaves is variable and depends on the growing conditions, main-

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ly on the soil composition and properties (Bojinova et al., 1994). Some portions of these metals are transferred by the smoke into the human body, where they accumulate by damaging the organs (mainly kidney and liver) and act as promoters in conjunction with carcinogens.

We have seen that the mortality rate of diseases caused by smoking is more than 350 000 per year in the USA and so it can be seen that it is worrying public health problem. Besides the heavy metals, more than 4000 individual chemical constituents of cigarette smoke have been identified and most of the constitutents are responsible for various cancers in the body and especialy 90 % of lung cancers. Because of a large consumption of tobacco and tobacco products in the world, studies on heavy metals in tobacco leaves are necessary.

Toxic elements and other substances which are partly or completely vitalized in the smoke of tobacco are inhaled and absorbed through lungs during smoking by both active or passive smokers: the metabolism is altered by these toxic substances: Cu and Zn concentrations in the tissues of smokers are found to be significantly higher: the effects of other biologically important elements such as, Al, As, Cd, Cr, Pb, Mn, Hg, Ni, Po-210 and Se are also altered in the tissues of smokers.

The altered mechanisms related with trace elements in the body of smokers have been suggested to be a risk factor for cardiovascular diseases (CDV). The concentration of heavy metals is known to be affecting the functions of liver, kidney, lung and heart. Similarly, the adverse health effects of toxic elements on the fetus through maternal smoking and on infants through parental smoking are of special concern. High concentration of Al, Cu, Cr and Ni in body tissues are known to be hazardous especially for respiratory and urinery systems (Camas et al., 2007).

Turkey is known as producer's high quality oriental tobacco which is very suitable for the ecological and social structure of our country, has been widely grown in several regions of Turkey for centuries as the family agriculture. One of the important characteristics of Turkish tobacco is its aroma. Also, Turkish tobaccos have low nicotine content. They have poor burning quality and low filling values. In spite of these undesirable qualities, they are highly valuable in the international markets because of their blending capability. Ege type tobaccos account for two thirds of the annual tobacco leaf production of the country and for 85-90 % a of total tobacco export (Sekin et al., 2002).

Aegean tobaccos sold in the foreign markets are used in blends for which, tobaccos purchased from the farmers of different districts are sorted and blended in the factories for sale, where tobacco is grown districts and localities are important because they take part in exported bales and affect the quality of the products. Ege Region as the manipulation processing center is one of the most important oriental tobacco markets of the world.

The aim of this study was to determinate the heavy metal content in small leaf oriental tobacco grown in Ege Region of Turkey.

To authors' knowledge there are no published report documenting Ege Region tobacco plants in terms of heavy metal contents. As explain the upper part of this paper, Ege Region is known for producing the high quality oriental tobacco. Therefore it seems to be necessary to analyze the heavy metal contents.

Material and Methods

The research was carried out in Akhisar where tobacco is very popular in Ege Region in the period of 2004-2005. In this study, nine tobacco farmers which are known to show differences in terms of the quality and yield in the villages called Haciosmanlar (H1, H2, H3); Arabacibozkoy (A1, A2); Derekoy (D1); Mecidiye (M1) and Suleymanli (S1, S2) were identified.

Tobacco samples are taken from both the bales of producers which was stated above during the

"tobacco marketing" period and experts in Akhisar working for Tobacco Industry and Trade Company (TTL Tobacco Company). Low, middle and upper leaves of 9 producers' tobacco differ from each other in terms of quality and yield has been harvested separately. After these leaves have been dried in the sun they have been baled in a way that each one represent each priming. Some samples are taken from these baled tobacco samples in a way that they represent low, middle and upper priming in the quality group. The amount of samples taken from each priming of each producer is 100 g. Tobacco seeds used in producers' fields in Akhisar belong to Sarıbaglar tobacco type.

In 2004, the first year of this study, 27 tobacco samples and in 2005, 27 samples as well, totally, 54 tobacco samples in different quality group are studied. Chromium, cobalt, nickel, zinc, arsenic, cadmium and lead elements of tobacco were analyzed in spectrophtometer.

Dried tobacco samples were digested with HNO_3:$HCLO_4$ (4:1, v/v) and than Cr, Cu, N, Zn, As, Cd and Pb contents in the solutions was determined spectrofotometrically by using atomic absorbsion (Kacar 1972).

Statistical analyses

The data obtained from each component with 2 replications and 3 factors were subjected to statistical variance analyses (ANOVA) using F test according to Açıkgöz et al. (2004). Variable in each component were subjected separately to variance analysis. The means of the variables were grouped by using Least Significant Difference (LSD) values at 5 % levels of probability.

Results and Discussion

It is well known that, there are major and important differences among tobacco types. Within each type there are also wide differences among grades or stalk position (upper stalk, middle stalk and lower stalk position) and also one single leaf. For example, total nitrogen and total alkaloid content of the leaves are low in the center stalk position and high in both bottom and upper position (Tso, 1990).

In our study, there were some differences among the quality and stalk position. The variations of the contents of the heavy metals are considered to genetic characteristics, fertilizers, irrigations, climate, soil characteristics and also the storage conditions.

The arsenic concentration in oriental tobacco is much less than that of other tobacco types (Tso 1990). The results of the arsenic contents are presented in Table 1. Average arsenic contents in the second year (0.52 ppm) were higher than in the first year (0.43 ppm). Results obtained showed that the highest arsenic content was recorded for A1 farmers of 1st priming group (0.98 ppm) in the second year. On the other hand, the lowest arsenic were observed for H1 farmers at the 1st priming (0.18 ppm) in the first year.

The arsenic content of tobacco increased with increasing rate of fertilizer application. The factors contributing to the variation in concentration of As at different localities are texture and Fe content of the soils, the absorbtion having been higher from coarse textured than from fine textured soils and having increased as the Fe content decreased. In general, the As content of tobacco is higher in soil where Fe is added than when none is applied. The content of As is usually higher in the tobacco roots than in the leaves (Tso, 1990). To the author's knowledge, there is no report documeting about arsenic content of Ege Tobaccos.

In Table 2, lead contents varied between 7.45-34.70 ppm in the first year; 9.34-38.40 ppm in the second year of our study. According the two years results, average lead contents changed in between 8.97 and 33.07 ppm. The lead contents in A2 farmers were found to be highest in contrast to the others.

Table 1
Arsenic contents of Aegean region tobaccos (ppm)

Farmers	2004				2005				Years Ave.
	Primings			Ave.	Primings			Ave.	
	1st	2nd	3rd		1st	2nd	3rd		
M1	0.55^{ab}	0.58^{ab}	0.60^{ab}	0.58^{b}	0.42^{bc}	0.49^{abc}	0.55^{bc}	0.49^{c}	0.53^{b}
H1	0.18^{c}	0.62^{ab}	0.22^{d}	0.34^{d}	0.42^{bc}	0.25^{c}	0.27^{d}	0.31^{de}	0.33^{de}
H2	0.20^{c}	0.62^{ab}	0.22^{d}	0.34^{d}	0.29^{c}	0.24^{c}	0.22^{d}	0.25^{e}	0.30^{e}
H3	0.27^{c}	0.20^{d}	0.42^{cd}	0.30^{d}	0.28^{c}	0.57^{ab}	0.36^{cd}	0.40^{cd}	0.35^{de}
S1	0.32^{bc}	0.38^{bcd}	0.21^{d}	0.30^{d}	0.40^{bc}	0.59^{ab}	0.66^{ab}	0.55^{bc}	0.43^{cd}
S2	0.38^{bc}	0.49^{abc}	0.33^{d}	0.40^{cd}	0.55^{b}	0.74^{a}	0.87^{a}	0.72^{a}	0.56^{b}
A1	0.69^{a}	0.74^{a}	0.83^{a}	0.75^{a}	0.98^{a}	0.69^{a}	0.73^{ab}	0.80^{a}	0.78^{a}
A2	0.77^{a}	0.43^{bcd}	0.44^{cd}	0.55^{bc}	0.46^{bc}	0.42^{bc}	0.71^{ab}	0.53^{bc}	0.54^{b}
D1	0.33^{bc}	0.32^{cd}	0.26^{d}	0.30^{d}	0.65^{b}	0.68^{a}	0.65^{ab}	0.66^{ab}	0.48^{bc}
Average	0.41^{ab}	0.49^{a}	0.39^{b}	0.43^{b}	0.50^{a}	0.52^{a}	0.56^{a}	0.52^{a}	
LSD(p<0.05)(Farmer) 0.104 LSD:Least significant difference	(Year) 0.049 (Priming) 0.060			(YxP) 0.085 (FxY) .147 (FxYxP) 0.55					

Table 2
Lead contents of Aegean region tobaccos (ppm)

Farmers	2004				2005				Years Ave.
	Primings			Ave.				Ave.	
	1st	2nd	3rd		1st	2nd	3rd		
M1	10.70^{e}	22.05^{b}	11.90^{d}	14.88^{d}	28.60^{b}	12.60^{d}	12.20^{f}	17.80^{e}	16.34^{e}
H1	8.65^{f}	24.80^{a}	8.20^{e}	13.88^{d}	16.40^{g}	9.34^{e}	25.40^{c}	17.05^{e}	15.46^{f}
H2	11.15^{de}	15.10^{d}	22.40^{b}	16.22^{c}	18.60^{f}	14.40^{c}	14.80^{e}	15.93^{f}	16.07^{ef}
H3	25.15^{a}	8.70^{e}	16.40^{c}	16.75^{c}	21.30^{e}	14.40^{c}	30.30^{b}	22.00^{d}	19.38^{c}
S1	18.75^{b}	22.33^{b}	12.90^{d}	17.99^{b}	14.70^{g}	14.50^{c}	15.10^{e}	14.77^{g}	16.38^{e}
S2	7.45^{f}	9.51^{e}	9.96^{e}	8.97^{f}	9.86^{h}	15.50^{c}	17.80^{d}	14.39^{g}	11.68^{g}
A1	14.70^{c}	22.90^{b}	17.10^{c}	18.23^{b}	35.30^{a}	24.00^{b}	17.10^{d}	25.63^{b}	21.93^{b}
A2	25.95^{a}	18.80^{c}	34.70^{a}	26.48^{a}	23.20^{d}	37.60^{a}	38.40^{a}	33.07^{a}	29.78^{a}
D1	12.65^{d}	9.35^{e}	8.99^{e}	10.33^{e}	25.60^{c}	23.10^{b}	24.10^{c}	24.27^{c}	17.30^{d}
Average	15.02^{c}	17.06^{a}	15.84^{b}	15.97^{b}	21.51^{a}	18.44^{b}	21.69^{a}	20.54^{a}	
LSD(p<0.05)(Farmer) 0.724 LSD:Least significant difference	(Year) 0.341 (Priming) 0.418			(YxP) 0.591 (FxY) 1.023 (FxYxP) 1.773					

In spite of this, the presence of heavy metals like Pb in food and industrial crops are not acceptable in terms of health care even if the plants don't exhibit toxicity due to biomagnification (Kabata Pendias & Pendias, 1992).

Heavy metals in five tobacco types grown in Gerece and Italy reported the highest Pb content in Burley tobacco (11-15 mg/kg), in Virginia it ranged 5.0-9.0 mg/kg and in orientals Basma, Kabakulak and Samsun 8.0-12.0 mg/kg (Metsi et al., 2002) .

The values determined for the leaf concentration in our study are higher than those indicated in some scientific sources (Adamu et al., 1989; Gondola and Kadar, 1993), but they are almost within the limits of the normal concentration of the element in the plants 0.1-10 mg/kg (Kabata Pendias & Pendias, 1984).

Table 3
Chromium contents of Aegean region tobaccos (ppm)

Farmers	2004				2005				Years Ave.
	Primings			Ave.	Primings			Ave.	
	1st	2nd	3rd		1st	2nd	3rd		
M1	7.95^{c}	6.10^{de}	7.50^{c}	7.18^{c}	17.55^{d}	17.30^{e}	12.80^{f}	15.88^{e}	11.53^{e}
H1	7.25^{cd}	5.10^{fg}	6.45^{de}	6.27^{d}	4.43^{h}	5.21^{h}	6.40^{i}	5.35^{h}	5.81^{h}
H2	10.10^{a}	7.30^{c}	11.85^{a}	9.75^{a}	22.25^{a}	27.60^{b}	23.70^{c}	24.52^{a}	17.13^{a}
H3	4.37^{g}	8.60^{b}	10.50^{b}	7.82^{b}	15.20^{e}	28.60^{a}	24.30^{bc}	22.70^{b}	15.26^{b}
S1	4.60^{g}	4.55^{g}	6.20^{e}	5.12^{e}	7.00^{g}	20.30^{c}	11.60^{g}	12.97^{f}	9.04^{f}
S2	5.60^{f}	5.40^{ef}	5.40^{f}	5.47^{e}	11.10^{f}	9.30^{g}	8.20^{h}	9.53^{g}	7.50^{g}
A1	6.25^{ef}	9.30^{b}	7.30^{c}	7.62^{b}	20.10^{b}	20.70^{c}	19.20^{d}	20.00^{c}	13.81^{d}
A2	6.70^{de}	6.40^{d}	9.85^{b}	7.65^{b}	20.60^{b}	15.10^{f}	24.70^{a}	20.13^{c}	13.90^{d}
D1	9.25^{b}	13.75^{a}	7.00^{cd}	10.00^{a}	19.20^{c}	19.10^{d}	18.00^{e}	18.77^{d}	14.38^{c}
Average	6.90^{c}	7.39^{b}	8.01^{a}	7.43^{b}	15.27^{c}	18.13^{a}	16.54^{b}	16.65^{a}	
LSD(p<0.05) (Farmer) 0.289 LSD:Least significant difference	(Year) 0.136		(Priming) 0.167		(YxP) 0.236	(FxY) 0.409	(FxYxP) 0.709		

Table 4
Cadmium contents of Aegean region tobaccos (ppm)

Farmers	2004				2005				Years Ave.
	Primings			Ave.	Primings			Ave.	
	1st	2nd	3rd		1st	2nd	3rd		
M1	0.30^{b}	0.10^{c}	0.06^{d}	0.15^{d}	0.60^{ef}	0.50^{e}	0.30^{d}	0.47^{f}	0.31^{e}
H1	0.32^{b}	0.06^{c}	0.08^{d}	0.15^{d}	1.30^{ab}	0.70^{de}	1.00^{a}	1.00^{bcd}	0.58^{c}
H2	0.34^{b}	0.10^{c}	0.44^{c}	0.29^{c}	0.70^{de}	1.30^{ab}	0.90^{a}	0.97^{cd}	0.63^{c}
H3	0.08^{b}	0.12^{c}	0.10^{d}	0.10^{d}	1.10^{bc}	0.60^{e}	0.60^{bc}	0.78^{e}	0.43^{d}
S1	0.20^{ab}	0.10^{c}	0.07^{d}	0.12^{d}	0.40^{f}	0.60^{e}	0.30^{d}	0.43^{f}	0.28^{e}
S2	0.05^{b}	0.06^{c}	0.20^{d}	0.10^{d}	0.70^{de}	0.90^{cd}	0.60^{bc}	0.73^{e}	0.42^{d}
A1	0.90^{a}	0.80^{ab}	1.36^{a}	1.02^{a}	1.50^{a}	1.30^{ab}	0.40^{cd}	1.07^{ab}	1.04^{a}
A2	0.40^{b}	0.60^{b}	0.80^{b}	0.60^{b}	0.90^{cd}	1.50^{a}	0.90^{a}	1.10^{a}	0.85^{b}
D1	0.30^{b}	0.90^{a}	0.80^{b}	0.67^{b}	0.80^{de}	1.10^{bc}	0.80^{ab}	0.90^{d}	0.78^{b}
Average	0.32^{b}	0.32^{b}	0.43^{a}	0.36^{b}	0.89^{a}	0.94^{a}	0.64^{b}	0.83^{a}	
LSD(p<0.05) (Farmer) 0.083 LSD:Least significant difference	(Year) 0.039 0.048		(Priming)		(YxP) 0.068	(FxY) 0.118	(FxYxP) 0.204		

The chromium contents varied significantly in each farmer and priming groups. According to two years results, chromium contents changed from 4.37-28.60 ppm as shown in Table 3. The highest value for chromium contents was obtained for D1 farmers (13.75 ppm) and while for H3 (28.60 ppm) in the second year.

Cadmium examination of the tobacco was intensified in the past decade mainly due to its possible association with health issues. The content of cadmium is presented in Table 4. In 2004, the average content of cadmium exceeds 1.00 ppm only in tobacco sample in A1 where it achieved 1.02 ppm (Table 4). The lowest cadmium content (0.10 ppm) was noted in H3 and S2 farmers. In the second year of this study, maximum cadmium content was observed in A2 farmers (1.10 ppm) while minimum cadmium content was found in S1 (0.43

Table 5
Cobalt contents of Aegean region tobaccos (ppm)

Farmers	2004				2005				Years Ave.
	Primings			Ave.	Primings			Ave.	
	1st	2nd	3rd		1st	2nd	3rd		
M1	2.49^{b}	1.60^{ab}	1.98^{bc}	2.02^{bc}	1.80^{cd}	1.70^{c}	1.70^{b}	1.73^{e}	1.88^{de}
H1	1.73^{b}	1.10^{b}	1.68^{c}	1.50^{c}	3.25^{ab}	3.30^{ab}	1.80^{b}	2.78^{b}	2.14^{cd}
H2	2.10^{b}	1.69^{ab}	3.10^{a}	2.29^{b}	2.60^{bc}	1.90^{c}	2.10^{b}	2.20^{cde}	2.25^{cd}
H3	5.45^{a}	1.13^{b}	2.70^{ab}	3.09^{a}	1.70^{cd}	3.30^{ab}	2.00^{b}	2.33^{bcd}	2.71^{ab}
S1	1.63^{b}	1.40^{b}	1.80^{bc}	1.61^{c}	1.60^{d}	2.40^{bc}	1.60^{b}	1.87^{de}	1.74^{e}
S2	1.80^{b}	1.30^{b}	1.60^{c}	1.57^{c}	1.60^{d}	1.80^{c}	1.60^{b}	1.67^{e}	1.62^{e}
A1	2.00^{b}	2.40^{a}	2.20^{abc}	2.20^{b}	4.10^{a}	2.40^{bc}	1.60^{b}	2.70^{bc}	2.45^{bc}
A2	2.20^{b}	1.60^{ab}	2.10^{bc}	1.97^{bc}	3.10^{b}	1.80^{c}	2.30^{b}	2.40^{bcd}	2.18^{cd}
D1	2.00^{b}	2.50^{a}	2.00^{bc}	2.17^{b}	4.10^{a}	3.80^{a}	3.50^{a}	3.80^{a}	2.98^{a}
Average	2.38^{a}	1.64^{b}	2.13^{a}	2.05^{b}	2.65^{a}	2.49^{a}	2.02^{b}	2.39^{a}	
LSD(p<0.05) (Farmer) 0.385 (Year) 0.182 (Priming) 0.222 (YxP) 0.315 (FxY) 0.545 (FxYxP) 0.944 LSD:Least significant difference									

Table 6
Zinc contents of Aegean region tobaccos (ppm)

Farmers	2004				2005				Years Ave.
	Primings			Ave.	Primings			Ave.	
	1st	2nd	3rd		1st	2nd	3rd		
M1	90.6^{c}	70.4^{de}	80.4^{e}	80.4^{d}	95.2^{e}	129.2^{b}	122.8^{c}	115.7^{c}	98.1^{d}
H1	65.5^{f}	58.4^{g}	43.9^{g}	55.9^{g}	135.2^{b}	139.5^{a}	120.5^{c}	131.7^{a}	93.8^{e}
H2	44.2^{h}	98.1^{c}	90.6^{d}	77.6^{e}	116.2^{c}	140.4^{a}	142.1^{a}	132.9^{a}	105.2^{b}
H3	81.9^{d}	111.1^{b}	97.8^{c}	96.9^{c}	100.1^{d}	93.0^{f}	131.5^{b}	108.2^{d}	102.5^{c}
S1	72.8^{e}	71.9^{d}	100.9^{c}	81.8^{d}	119.6^{c}	100.1^{e}	112.8^{d}	110.8^{d}	96.3^{d}
S2	76.0^{e}	63.3^{f}	109.8^{b}	83.0^{d}	87.1^{f}	77.9^{h}	94.6^{f}	86.5^{f}	84.7^{f}
A1	102.8^{b}	128.5^{a}	69.2^{f}	100.1^{b}	140.9^{a}	124.4^{c}	110.9^{d}	125.4^{b}	112.8^{a}
A2	60.0^{g}	66.2^{ef}	79.7^{e}	68.6^{f}	61.5^{g}	119.6^{d}	103.2^{e}	94.7^{e}	81.7^{g}
D1	123.3^{a}	98.4^{c}	116.9^{a}	112.8^{a}	61.2^{g}	86.1^{g}	76.9^{g}	74.7^{g}	93.8^{e}
Average	79.6^{c}	85.1^{b}	87.6^{a}	84.1^{b}	101.8^{b}	112.2^{a}	112.8^{a}	108.9^{a}	
LSD(p<0.05) (Farmer) 1.870 (Priming) (Year) 0.882 1.080 (YxP) 1.527 (FxY) 2.645 (FxYxP) 4.580 LSD:Least significant difference									

ppm). The cadmium content in tobacco is 3 ppm (Tso, 1990). The values obtained are similar to the ones indicated in other scientific sources (Adamu et al., 1989; Bell et al., 1992; Gondola and Kadar, 1993).

The values of cobalt content range from 5.45 ppm to 1.10 ppm (in 2004) and 4.10 ppm to 1.60 ppm (in 2005) (Table 5).

In our study the concentration of cobalt are found to be higher than the other scientific source (Tso, 1990; Paunescu et al., 2004; URL, 1)

The average zinc concentration in our study was between 43.9 and 128.5 ppm where the lowest values were measured in H1 and the highest in A2 farmers in 2004 respectively zinc concentrations varied from 61.2 to 140.9 ppm in 2005 (Table 6).

The content of zinc in plant material usually ranges 20-100 mg/kg. The main source of zinc for plants is the soil, where it ranges from 10 to 300 ppm. Zinc mobility in soil is low and it is proportionally taken by plants, depending on the available quantities in soil solution and on plant species. In tobacco, the usual rate of zinc is 85 ppm.

In the other studies, zinc contents in Ege tobaccos, changed within the ranges of 18-54 ppm (Gulovali and Gunduz, 1982) and 18-84 ppm (Irget, 1995). Although its functions were not well known in the plants, the deficiency of micro elements in soil affects the growth, development and the leaf quality adversely (Tso, 1990).

According to the results nickel content was the lowest of S1 at 2nd priming (6.40 ppm) and it achieved higher value of H1 and 1st priming (9.94 ppm) in 2004. On the other hand, it observed the highest value of H3 farmers at 3rd priming (10.85 ppm) and reached the lowest value of A2 at 2nd priming (6.58 ppm) in 2005 (Table 7).

The values were similar to the other scientific source[2]. According to his result, nickel content for oriental tobaccos is found 6-19 ppm.

Conclusion

Heavy metal contents of the tobacco samples varied in Turkish Aegean tobaccos according to the farmers (quality grades), years and also, priming groups and significant differences among the farmers were determined in trace elements in tobacco.

The contents of heavy metals in the leaves of the Ege tobacco were in accordance with the data, given in the other scientific sources and they are within the limits of the leaf concentrations in tobacco plants, which are considered normal. On the other hand, some unexpected results are found. To the author's increased concentrations of these elements are indicated only at places, where the soil is highly contaminated by that element. These elements in our study are known to be harmful for human health when the natural concentratinos are altered through smoking in active or passive way.

Acknowledgements

The authors are thankful to Enviromental Engineer Müberra ELBEYLİ, Director of the Department for Water Plants and the Laboratory of Gen-

Table 7
Nickel contents of Aegean region tobaccos (ppm)

Farmers	2004				2005				Years Ave.
	Primings			Ave.	Primings			Ave.	
	1st	2nd	3rd		1st	2nd	3rd		
M1	9.83^{a}	7.00^{d}	9.80^{a}	8.88^{a}	9.60^{ab}	9.50^{c}	9.20^{c}	9.43^{c}	9.15^{c}
H1	9.94^{a}	7.90^{c}	9.35^{a}	9.06^{a}	9.55^{b}	10.25^{ab}	10.10^{b}	9.97^{b}	9.52^{b}
H2	9.88^{a}	9.85^{a}	7.30^{c}	9.00^{a}	10.20^{a}	10.65^{a}	10.80^{a}	10.55^{a}	9.78^{a}
H3	9.60^{a}	7.80^{c}	9.88^{a}	9.09^{a}	9.85^{ab}	10.35^{ab}	10.85^{a}	10.35^{a}	9.72^{ab}
S1	7.40^{c}	6.40^{d}	8.20^{b}	7.33^{b}	7.59^{b}	9.73^{bc}	9.40^{c}	8.91^{d}	8.12^{d}
S2	8.60^{b}	6.80^{d}	6.58^{d}	7.33^{b}	9.40^{b}	9.35^{c}	8.50^{d}	9.08^{cd}	8.20^{d}
A1	6.00^{d}	9.60^{a}	6.70^{cd}	7.43^{b}	9.79^{ab}	9.85^{bc}	7.20^{e}	8.95^{d}	8.19^{d}
A2	7.40^{c}	6.60^{d}	8.50^{b}	7.50^{b}	9.23^{b}	6.58^{d}	9.50^{bc}	8.44^{e}	7.97^{d}
D1	6.90^{c}	8.60^{b}	7.00^{cd}	7.50^{b}	7.08^{b}	6.80^{d}	7.70^{e}	7.19^{f}	7.35^{e}
Average	8.39^{a}	7.83^{c}	8.14^{b}	8.13^{b}	9.14^{a}	9.22^{a}	9.25^{a}	9.21^{a}	
LSD(p<0.05) (Farmer) 0.261 (Year) 0.123 (Priming) 0.151 (YxP) 0.213 (FxY) 0.369 (FxYxP) 0.640 LSD:Least significant difference									

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Received January, 29, 2011; accepted for printing December, 2, 2011