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Some Heavy Metal Contents Related with Different Physiographic Units and Land Use in Van Lake Basin

Siyami Karaca[1,*], **Füsun Gülser**[1]

[1] *Yüzüncü Yıl University, Faculty of Agriculture, Soil Science & Plant Nutrition Department, 65080 Van-Turkey*

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Abstract: The objective of this study was to determine the relations among some heavy metal contents related with different physiographic units and land use in Van Lake Basin. Surface soil samples (0-20 cm) were taken from forty different points having three different physiographic units (backslope, footslope and terrace) and three different land use (wheat, clover and pasture) in Van Lake Basin. The heavy metal contents (Al, Cd, Cr, Ni, Pb) changed due to land use and physiographic units. The means of Al, Cd, Cr, Ni and Pb varied between 103.567-68.174 ppm, 0.514- 0.448 ppm, 2.789-2.513 ppm, 2.139- 1.923 ppm and 0.247- 0.132 ppm respectively.

Key words: land use, physiographic units, heavy metal contents.

1. Introduction

Differences in soil formation along a hillslope cause differences in soil properties (Brubaker et al., 1993). On the other hand, landscape influences soil texture, penetration resistance (Bruand et al., 2004), root development (Busccher et al.,2001), exchangeable basic and acidic cations (Stutten et al., 2004), soil exchange chemistry (Clien et al., 1997) and nutrient budget (Mallarino, 1996) hence important in fertilizer management (Paz-Gonzales et al., 2000).

Several heavy metals added into soils due to pedogenic process has been exceeded in some local areas even on a regional scale (Mico et al., 2006). Agricultural activities and especially application of sewage sludge, manure, mineral fertilizers and pesticides into soils also significantly contribute to the trace metal status of agroecosystem (Kabata-Pendias and Mukherje, 2007). Some researchers (Zhang and Gong, 1996; Zheng et al., 2006) reported that concentrations of heavy metals in agricultural soils tend to increase with soil development in the soil formation process.

Heavy metal accumulation in soils will probably have along residence time, it is important to understand reasons for the accumulation and to determine soil factors controlling their mobility in the soil and their bioavailability to the plants (Sistani and Novak, 2006). Heavy metal pollution to soils can decreases crop yield and quality and accumulation of heavy metals in crops can lead to potential threat to human health through the food chain (Jackson and Alloway, 1992).

[*] Corresponding Author Phone:+90 432 225 17 01; Fax: +90 432 225 11 04; E-mail: s.karaca@yyu.edu.tr

The objective of this study is to determine of relations of some heavy metal contents with land use and different physiographic units in Van lake basin.

2. Material and Methods

The study was conducted in Van Lake Basin (327356-412776 E ; 4241076-434444 N).It is located on altitude of 1725 m. Van lake basin has a continental climate, having a mean annual rainfall of 384 mm, and a mean annual temperature of 9ºC (Anonymous, 2012). Forty soil samples were collected from 0-20 cm depth in this research. Each soil sample was separately dried in air, ground and pass through a 2 mm sieve to determine the heavy metal levels. The levels of DTPA extractable heavy metals (Al, Cd, Ni, Pb, Cr) were analyzed in dried and grinded samples according to the methods reported by Lindsay and Norvel (1978).

3. Results and Discussion

Descriptive statistics of heavy metal contents according to the different physiographic units are given in Table 1. The heavy metal contents analyzed in this study was not influenced by the different physiographic units statistically. The Al content means were obtained as 97.23 mg kg^{-1}, 81.39 mg kg^{-1} and 82.77 mg kg^{-1} in backslope, footslope and terrace positions respectively (Figure 1). The means of Cd was determined as 0.56 mg kg^{-1}, 0.89 mg kg^{-1} and 0.63 mg kg^{-1} in backslope, footslope and terrace positions respectively. The values of Cr, Ni and Pb means varied between 2.29 and 2.79 mg kg^{-1}, 1.89 and 2.20 mg kg^{-1}, 0.13 and 0.23 mg kg^{-1} respectively.

Table 1. The effects of different physigraphic units on heavy metal contents.

	Phys.*	Min.	Max.	Mean	St. Dv.
Al, mg kg^{-1}	1	12.70	351.50	97.23	102.57
	2	16.10	239.20	81.39	84.49
	3	14.22	243.10	82.78	83.62
Cd, mg kg^{-1}	1	0.28	0.56	0.44	0.11
	2	0.29	0.89	0.51	0.16
	3	0.26	0.63	0.47	0.12
Cr, mg kg^{-1}	1	0.65	7.15	2.79	1.97
	2	0.53	6.54	2.30	1.95
	3	0.63	8.11	2.74	2.41
Ni, mg kg^{-1}	1	1.10	4.26	2.03	0.78
	2	1.21	2.93	1.90	0.51
	3	1.05	4.16	2.21	1.00
Pb, mg kg^{-1}	1	0.80	0.29	0.13	0.06
	2	0.02	0.33	0.13	0.09
	3	0.00	1.98	0.24	0.45

*Physiographic units: 1-Backslope, 2-Footslope, 3-Terrace

The heavy metal contents analyzed in this study was not influenced by the different physiographic units statistically. The Al content means were obtained as 97.23 mg kg^{-1}, 81.39 mg kg^{-1} and 82.77 mg kg^{-1} in backslope, footslope and terrace positions respectively (Figure 1). The means of Cd was determined as 0.56 mg kg^{-1}, 0.89 mg kg^{-1} and 0.63 mg kg^{-1} in backslope, footslope and terrace positions respectively. The values of Cr, Ni and Pb means varied between 2.29 and 2.79 mg kg^{-1}, 1.89 and 2.20 mg kg^{-1}, 0.13 and 0.23 mg kg^{-1} respectively.

The means of Al, Cd, Cr, Ni and Pb obtained in this study were in the acceptable ranges according to reported critical levels (Bergman, 1992). The heavy metal contents were higher in terrace position than in backslope position except Al and Cr contents. It was thought that terrace positions near the roadsides may be contaminated with heavy metals such as; Cd, Ni and Pb by the motorized traffic. Changes in heavy metal contents according to the different land use are given in Tables 2. The effects of land use on heavy metals contents were not significant statistically.

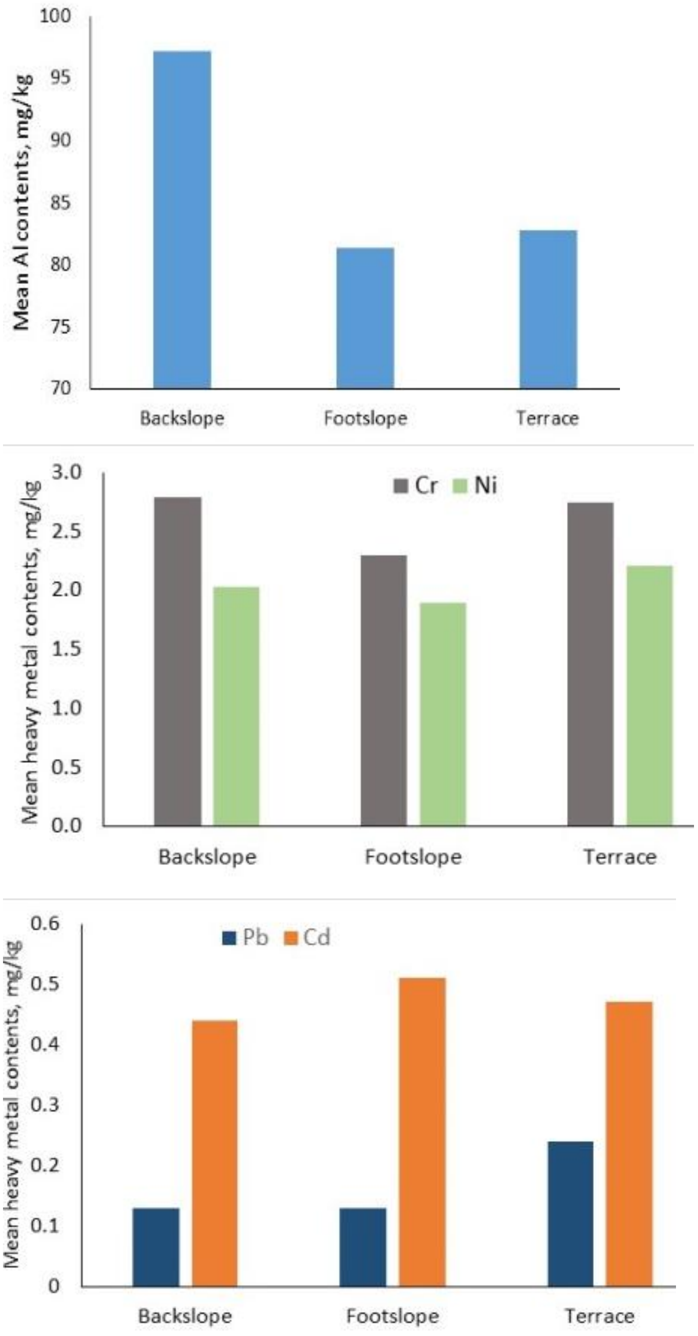

Figure 1. Heavy metal content distribution depends on physiographic units.

Table 2. The effects of different land use on heavy metal contents

	Land use*	Min.	Max.	Mean	St. Dv.
Al, mg kg^{-1}	1	12.69	351.50	87.32	102.42
	2	14.22	239.20	103.57	90.37
	3	13.72	243.10	68.17	78.35
Cd, mg kg^{-1}	1	0.26	0.56	0.45	0.11
	2	0.27	0.89	0.51	0.18
	3	0.29	0.61	0.48	0.10
Cr, mg kg^{-1}	1	0.53	7.15	2.64	2.28
	2	0.66	6.54	2.79	2.14
	3	0.89	8.11	2.51	2.25
Ni, mg kg^{-1}	1	1.10	4.26	2.13	1.03
	2	1.05	2.93	1.92	0.59
	3	1.35	4.16	2.14	0.82
Pb, mg kg^{-1}	1	0.02	1.98	0.25	0.50
	2	0.00	0.21	0.13	0.07
	3	0.02	0.33	0.15	0.09

*Land use: 1-Wheat, 2-Clover, 3-Pasture

The highest Al, Cd and Cr means were obtained as 103.57 mg kg^{-1}, 0,514 mg kg^{-1} and 2.79 mg kg^{-1} in clover fields, respectively. The means of Pb in wheat fields were found as 2.48 mg kg^{-1} and higher than that in the other land uses.

It was determined that the soil heavy metal contents of cultivated wheat and clover fields generally were higher than the non-cultivated pasture lands (Figure 2). The results reveal that cultivation increase soil heavy metal levels. Similarly different researchers reported that agricultural soils are influenced by heavy metals derived from chemical fertilizers, pesticides and anthropogenic activities (Huang et al., 2007; Zeng et al., 2007; Huang and Jin, 2008).

The means of Al, Cd, Cr, Ni and Pb obtained in this study were in the acceptable ranges according to reported critical levels (Bergman, 1992). It is thought that the means of Al content do not have a pollution risk or any threat for plants, because the pH levels in research area are lower than the critical pH range (4.5-5.5) for Al toxicity (Karaca etal., 2014, Peverill et al., 1980).

As a result, heavy metal contents of soils investigated in this study depend on different land use or different physiographic units are fairly low. Therefore, there is no heavy metal pollution risk in the soils of Van Lake Basin.

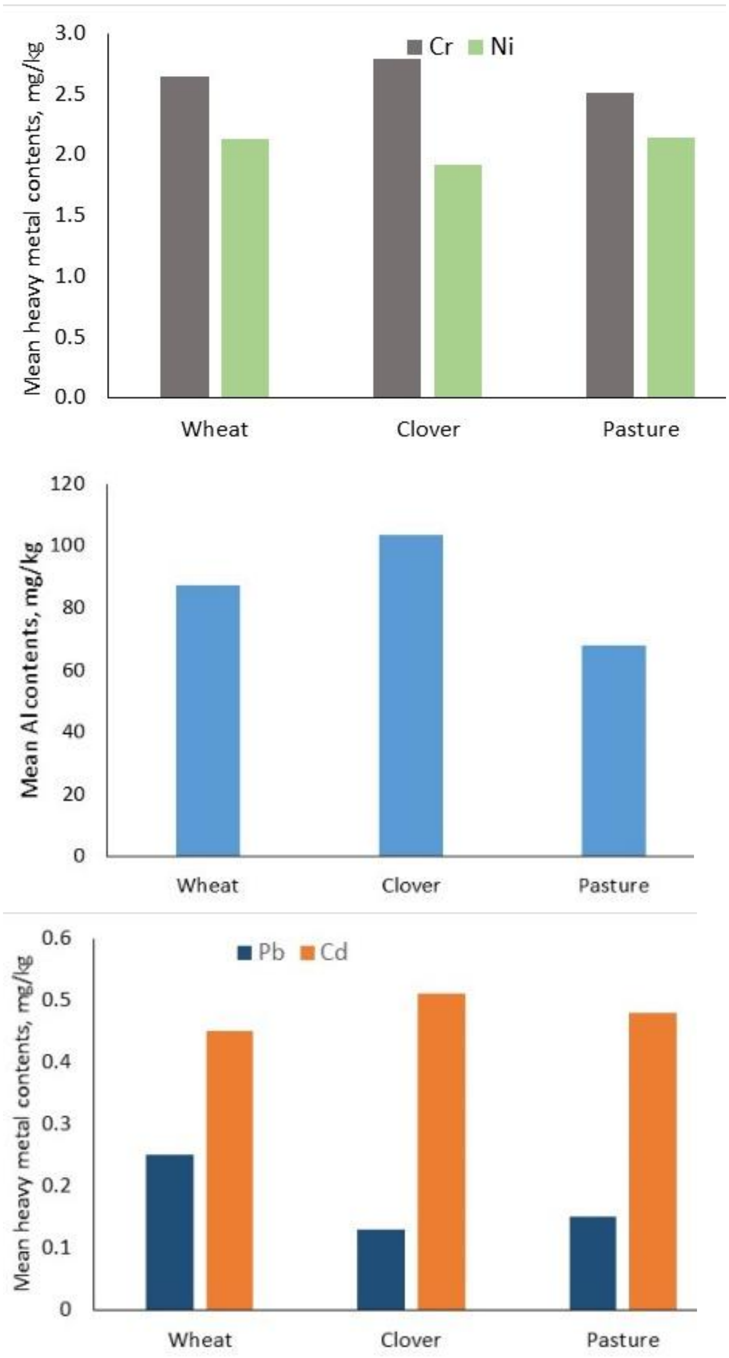

Figure 2. Heavy metal content distribution depends on different land use.

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