Turkish Journal of Agriculture - Food Science and Technology, 7(1): 13-21, 2019
DOI: https://doi.org/10.24925/turjaf.v7i1.13-21.1997

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X | www.agrifoodscience.com | Turkish Science and Technology

Determination of Molybdenum Contents and Relation of Some Heavy Metals in the Soil of Meadow-Pasture Terraces Between Kırıkhan-Reyhanlı

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ARTICLE INFO

Research Article

Received : 02/05/2018
Accepted : 17/12/2018

Keywords:
Molybdenum content
Meadow-Pasture
Heavy metals
Soil
Kırıkhan-Reyhanlı

ABSTRACT

This study was aimed to determine the molybdenum content of meadow - pasture soil between Kırıkhan and Reyhanlı in Hatay province and to determine the relations of the molybdenum content with some heavy metals in the soil. For this purpose, two different depths (0-20 and 20-40 cm) representing grassland pasture lands and 80 soil samples from 40 different points were taken. Cadmium (Cd), Cobalt (Co), Nickel (Ni), Lead (Pb), Copper (Cu), Iron (Fe), and Molybdenum (Mo) contents were determined in the soil samples. The contents of the available Cd, Co, Pb, Cu, Fe, Ni and Mo of the soil were determined by reading the 0.005 M DTPA + 0.01 M CaCl2 + 0.1 M TEA extracts in the ICP instrument. The results of the research shows that the Cd contents of the soils are between 0.01-0.32 ppm; Co contents are from 0.01 to 4.97 ppm; Ni contents 0.00 to 20.00 ppm; Pb contents 3.00-67.00 ppm; Cu contents 0.26-7.48 ppm; The Fe contents are between 4.00 and 61.00 and the Mo contents are between 0.001 and 0.064 ppm. It was determined that there are significant positive relationships between Co, Ni, Pb, Cu and Fe contents of Mo in the soil. It was also determined that there are significant positive significant relationships between Cd and Co; Co with Ni, Pb, Fe and Pb and Cu, Fe and Cu and Fe. No heavy metal pollution was found when the heavy metal contents of the regional soils were compared with the limit values.

Introduction

A large part of the earth forms meadow and meadow areas. These vast areas are irreplaceable resources to obtain animal products that are an important source of nutrition for the world's population. By evaluating this great potential, the people of the country whose cost of animal products will decrease will have sufficient and balanced nutrition possibility. In other words, the grassland-meadow areas come at the top of the sources where the crude feed needed in animal feeding is provided (Yalçın and Çimrin 2017). Soil is a natural entity formed by the decomposition of the rocks and organic matter, which form the basis of the main material, as a result of a great many of chemical, physical and biological processes in a long time and it self-perpetuates its dynamics. The earth is the sole place where humans, animals and plants maintain their lives. (Türkoğlu, 2006). According to the natural and human activities in soils, pollutants, which are usually involved in soil, can be defined as organic (pesticide, hormone) and inorganic (heavy metals) compounds. The most important effects of the pollutants in terms of their environmental impacts are observed through the body of plants getting exposed to soil pollutants, then animals either directly eating those polluted plants or indirectly getting polluted, and still humans consuming those polluted animals and getting harmed. (Türkoğlu, 2006).

Mo is an important element with relatively low toxicity in nature (İpek, 2003). Mo; atomic weight 95.94, is a dark gray black flammable compound which is soluble and insoluble in series VI-B of the periodic table (Barceloux, 1999). Mo content in plants grown in soil; Mo content and pH of wide-area soil vary according to seasonal differences. In plants growing in soil with high Mo content, the dry matter contains 0.5-100 ppm Mo (McDowell 1992). Total concentrations of metals in the soil, chemical forms, mobility and access to the food chain creates a number of basic problems in human, plant and animal health. 15 elements that are usually present in very small amounts in rocks and soils are required for the feeding of plants and animals. Metals such as B, Cu, iron, Mn, Mo, Si, V and Zn are used by plants whereas Cu, Co, I, Fe, Mn, Mo, Se and metals with Zn are important for the feeding of animals. The roles of As, F, Ni, Si, T and V have also been established in recent years in animal nutrition. In large concentrations, many of the trace elements/metals may be toxic to plants and/or animals or may affect the quality of foodstuffs for human consumption (Thornton, 1981). In excess concentrations many of the trace elements may be toxic to plant and animals or may affect the quality of foodstuffs for human consumption. The potentially toxic elements include As, B, Cd, Cu, F, Pb, Hg, Mo, Ni, Se and Zn (Thornton, 1980).

In order to ensure the continuity of meadow pasture areas, which have considerable value in terms of meeting the nutritional needs of the population of the world, it is necessary to take care in certain periods. Continuation of plant breeding in the areas where the agriculture is very much done also reveals the lack of nutrients (Demirtaş, 2005). It is possible to get the highest and most smooth product to get more benefit from grassland and meadow, because the nutrients in the soil are in appropriate amounts for plants (Turan et al., 2010).

Industrial and agricultural activities that take place in the soil pollute the soil structure. These pollutants are found in a certain amount of soil structure. These chemical pollutants in the soil are called heavy metals (Mater, 1998; Sevindik et al., 2017a). Heavy metals have a density greater than 5 g/cm^3. This group contains more than 60 metals including Pb, Cd, Cr, Fe, Co, Cu, Ni, Hg and Zn (Haktanır and Arcak, 1998). Uncontrolled use of heavy metals in the forest leads to environmental problems due to toxic effects even at high and even low concentrations (Kahvecioğlu et al., 2004; Sevindik et al., 2017b). Mankind continuously raises heavy metal levels in the earth with industrial development. Heavy metal pollution in the soil that will disrupt the balance of nutrients important for plants; N, P and K intake of the plant (Dağhan et al., 2013). Heavy metals such as copper, zinc, manganese, iron and molybdenum are naturally found in the soil as well as nutrients necessary for plants. At the same time, it is possible for significant amounts of heavy metals to enter into the soil in various ways (acid rain, fertilizers, trash, etc.). Heavy metals such as Cd, Ni, etc., which are transferred into the soil in this way, are damaged by the organic and inorganic colloidal systems of the soil and damage the live part of the soil. So the work of the saprophytes in the earth will cause the soil structure to become corrupted (Tolunay, 1992). Heavy metals in the ground are strongly held in the upper layers, reducing their movement towards the ground layer. However, as the soil acquires acidity, it can reach the basement waters because the solubility of the heavy metals in the upper layer of the soil increases. Thus, heavy metals can be taken by human beings through drinking water and through the food chain from plant to plant (FBA 1996). We can collect heavy metals in the soil under three groups. These are respectively; (As, Pb, Cd, Cr and Hg), which affect the developmental process of plants (V, Co and Ni) and plant toxic effects in the soil (Fe, Cu, Zn, Mn and Mo). Wherever these heavy metals in the ground are present, excessive concentrations in the soil are toxic to both plants and other living things (Dağhan, 2011). In the study, it was aimed to determine the Mo levels of meadow pasture land in Kırıkhan-Reyhanlı region of Hatay Province and their relation with some heavy metals in the soil and to contribute to the productivity and quality of farm animals fed hereby meadow.

Material and Method

Material

In the study, a total of 80 soil samples were taken from 40 points from the pasture meadow areas of the villages in Kırıkhan-Reyhanlı district of Hatay province, 0-20 and 20-40 cm depth, in order to represent the region (Figure 1 and Table 1). On the same day, the soil samples brought to the laboratory were dried in the form of a shadow air airflow, and they were passed through a 2 mm sieve to prepare for analysis.

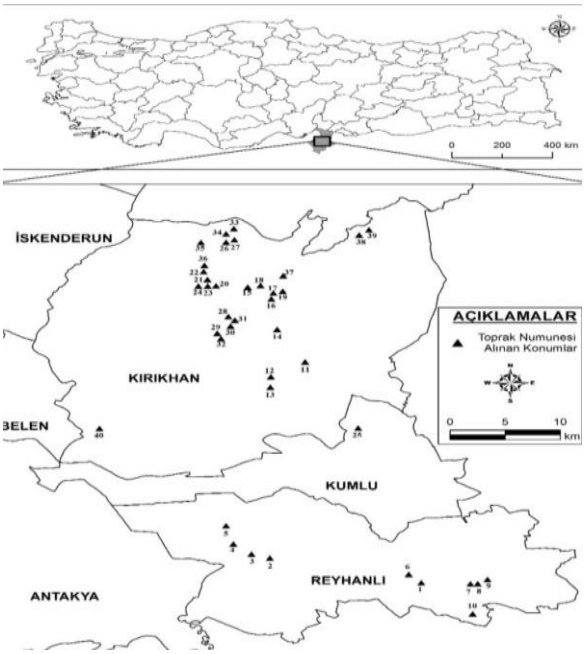

Figure 1 Demonstration of Received Soil Samples on Kırıkhan-Reyhanlı District Map

Method

The structure analyses of the soils were determined by total soluble salt contents and pH values were measured in saturation sludge extract (Richards, 1954). Lime (CaCO3) contents of soil samples were measured with Scheibler calcitres (Allison and Moode, 1965). The structure was constructed by hydrometer method (Bouyoucos, 1952). Organic matter contents of soils were determined by Walkley-Black method which was modified as specified by Jackson (1960). The contents of the available Cd, Co, Pb, Cu, Fe, Ni and Mo of the soil were determined by reading the 0.005 M DTPA + 0.01 M CaCl2 + 0.1 M TEA extracts according to Lindsay and Norvell (1978), in the ICP instrument. Correlation between soil properties and nutrients and regression analyses were done in SPSS 17 statistical program (Düzgüneş et al., 1987).

Findings and Discussion

Some Physical and Chemical Properties of Soils

Some physical and chemical properties of the soil properties (Table 2) used in the research have been reported. The pH content of the study soil ranged from 6.85 to 8.16 with an average of 7.44 and the pH of soil samples was slightly alkaline with neutral. The soil content varies between 0.01% and 0.21%, with an average of 0.06%. Almost all of the soils except for samples 1 and 15 are found to be unsalted. The average amounts of clay, sand and silt in the meadow-pasture soils were 33.10%, 40.30 and 26.50%, respectively. The lime contents of the survey soil ranged from 3.40 to 53.95%, with an average of 16.78%, which was usually determined as medium calcareous soil. Organic matter content of soil was determined as 0.29-5.52%, while average organic matter content was 2.78% (Yalçın and Çimrin 2017).

Table 1 Places where soil samples are taken

Soil No	Sample Location	Coordinates of N/E w/ GPS	Soil No	Sample Location	Coordinates of N/E w/ GPS
1	Terzihöyük	(36.2685-36.5675)	21	Kodallı-2	(36.5449-36.4139)
2	Suluköy	(36.3237-36.4093)	22	Kodallı-3	(36.5373-36.4130)
3	Cumhuriyet-1	(36.2943-36.4291)	23	Kodallı-4	(36.5272-36.4042)
4	Cumhuriyet-2	(36.2933-36.4301)	24	Kodallı-5	(36.5239-36.4052)
5	Cumhuriyet-3	(36.2929-36.4313)	25	Torun	(36.4283-36.5173)
6	Reyhanlı Merkez	(36.2686-36.56689	26	Karaçağıl-1	(36.5802-36.3968)
7	Çakıryiğit-1	(36.2613-36.6088)	27	Karaçağıl-2	(36.5798-36.3934)
8	Çakıryiğit-2	(36.2617-36.6148)	28	Güzelce-1	(36.5791-36.4270)
9	Çakıryiğit-3	(36.2626-36.6186)	29	Güzelce-2	(36.5805-36.4011)
10	Kavalcık	(36.2294-36.6108)	30	Güzelce-3	(36.5957-36.3910)
11	Gölbaşı	(36.4992-36.4739)	31	Güzelce-4	(36.6024-36.3916)
12	Çiloğlan höyüğü-1	(36.4801-36.4466)	32	Güzelce-5	(36.5872-36.3942)
13	Çiloğlan höyüğü-2	(36.4792-36.4461)	33	Saylak	(36.6272-36.4094)
14	Abalaklı	(36.5338-36.4511)	34	Taşoluk	(36.6269-36.3888)
15	Çamsarı-1	(36.5665-36.4463)	35	Balarmudu-1	(36.6404-36.5260)
16	Çamsarı-2	(36.5914-36.4560)	36	Balarmudu-2	(36.6366-36.5223)
17	Çamsarı-3	(36.5732-36.4523)	37	Dedeçınar-1	(36.6322-36.4141)
18	Çamsarı-4	(36.5729-36.4480)	38	Dedeçınar-2	(36.6311-36.4132)
19	Çamsarı-5	(36.5809-36.4374)	39	Dedeçınar-3	(36.6290-36.4125)
20	Kodallı-1	(36.5437-36.4166)	40	Topboğazı	(36.4278-36.3059)

Table 2 Some physical and chemical properties of meadow pastures in Kırıkhan-Reyhanlı, Hatay province*

Soil No	Depth	pH	Salt %	Clay %	Sand %	Silt %	Lime %	O.M. %
1	0-20	7.62	0.21	8.60	41.40	50.00	53.95	2.15
	20-40	7.52	0.11	19.30	38.70	42.00	51.95	1.16
2	0-20	7.09	0.02	24.60	17.40	58.00	52.95	2.90
	20-40	7.38	0.09	45.30	16.70	38.00	48.95	1.86
3	0-20	7.20	0.06	34.60	21.40	44.00	43.96	2.32
	20-40	7.92	0.05	59.30	14.70	26.00	40.96	1.05
4	0-20	7.10	0.08	52.60	17.40	30.00	46.96	3.20
	20-40	7.39	0.07	63.30	8.70	28.00	44.36	2.03
5	0-20	7.85	0.05	54.60	13.40	32.00	45.96	2.27
	20-40	8.00	0.05	65.30	10.70	24.00	41.96	1.74
6	0-20	7.61	0.03	38.60	33.40	28.00	32.77	1.74
	20-40	8.16	0.03	57.30	22.70	20.00	19.58	1.10
7	0-20	7.46	0.08	42.60	29.40	28.00	12.99	5.00
	20-40	7.80	0.05	49.30	24.70	26.00	5.20	3.14
8	0-20	7.19	0.06	38.60	31.40	30.00	27.97	4.36
	20-40	7.68	0.04	51.30	20.70	28.00	10.99	4.18
9	0-20	7.38	0.06	40.60	27.40	32.00	8.59	4.36
	20-40	7.77	0.04	41.30	32.70	26.00	7.79	3.08
10	0-20	7.10	0.07	38.60	33.40	28.00	6.99	4.94
	20-40	7.55	0.05	47.30	28.70	24.00	5.99	5.23
11	0-20	7.11	0.08	48.60	27.40	24.00	10.99	5.35
	20-40	7.39	0.14	23.30	34.70	42.00	9.39	3.20
12	0-20	7.67	0.05	40.60	33.40	26.00	11.19	1.45
	20-40	8.05	0.03	45.30	30.70	24.00	10.59	0.99
13	0-20	7.68	0.09	34.60	37.40	28.00	13.99	0.87
	20-40	7.79	0.10	27.30	36.70	36.00	11.79	0.46
14	0-20	7.50	0.06	42.60	25.40	32.00	6.39	3.49
	20-40	7.38	0.06	49.30	26.70	24.00	5.79	2.61
15	0-20	7.44	0.17	58.60	31.40	10.00	12.99	3.49
	20-40	7.42	0.16	61.30	28.70	10.00	10.99	2.90
16	0-20	7.60	0.10	54.60	25.40	20.00	9.99	2.03
	20-40	7.80	0.07	61.30	30.70	8.00	8.99	1.74
17	0-20	7.47	0.06	48.60	25.40	26.00	12.99	1.68
	20-40	7.86	0.06	59.30	26.70	14.00	16.78	1.39
18	0-20	7.51	0.04	40.60	31.40	28.00	9.79	2.03
	20-40	7.35	0.04	45.30	28.70	26.00	9.99	1.74

Table 2 Some physical and chemical properties of meadow pastures in Kırıkhan-Reyhanlı, Hatay province (Continued)*

Soil No	Depth	pH	Salt %	Clay %	Sand %	Silt %	Lime %	O.M. %
19	0-20	7.80	0.03	36.60	25.40	38.00	13.19	1.16
	20-40	8.00	0.03	45.30	30.70	24.00	9.79	0.81
20	0-20	7.72	0.03	14.60	57.40	28.00	14.99	1.51
	20-40	7.97	0.02	19.30	58.70	22.00	11.39	1.16
21	0-20	7.16	0.07	24.60	55.40	20.00	14.19	5.23
	20-40	7.20	0.06	15.30	42.70	42.00	13.59	5.29
22	0-20	7.38	0.06	28.60	35.40	36.00	15.98	4.66
	20-40	7.50	0.05	29.30	32.70	38.00	12.79	3.83
23	0-20	7.10	0.08	36.60	31.40	32.00	13.99	4.53
	20-40	7.66	0.05	41.30	18.70	40.00	12.99	2.61
24	0-20	7.30	0.06	30.60	35.40	34.00	14.09	3.43
	20-40	7.35	0.05	31.30	30.70	38.00	9.59	3.25
25	0-20	7.28	0.04	22.60	41.40	36.00	7.99	2.67
	20-40	7.33	0.03	27.30	40.70	32.00	6.19	2.27
26	0-20	7.24	0.12	16.60	53.40	30.00	5.99	5.17
	20-40	7.37	0.07	29.30	40.70	30.00	4.00	5.35
27	0-20	7.61	0.03	10.60	59.40	30.00	7.99	2.90
	20-40	7.15	0.03	17.30	68.70	14.00	6.59	2.21
28	0-20	6.94	0.05	18.60	51.40	30.00	12.79	4.42
	20-40	7.04	0.04	19.30	50.70	30.00	9.99	4.30
29	0-20	7.03	0.05	36.60	35.40	28.00	28.97	4.36
	20-40	7.46	0.05	39.30	28.70	32.00	27.77	3.20
30	0-20	7.17	0.08	18.60	43.40	38.00	4.20	5.23
	20-40	7.08	0.06	33.30	30.70	36.00	4.00	5.29
31	0-20	6.91	0.09	40.60	31.40	28.00	32.97	5.05
	20-40	6.85	0.09	45.30	20.70	34.00	34.97	5.52
32	0-20	6.95	0.09	46.60	23.40	30.00	39.96	5.40
	20-40	7.00	0.09	51.30	18.70	30.00	37.56	4.59
33	0-20	7.65	0.03	8.60	77.40	14.00	5.39	1.05
	20-40	8.09	0.01	13.30	78.70	8.00	4.50	0.76
34	0-20	7.31	0.02	10.60	75.40	14.00	4.50	0.87
	20-40	7.25	0.01	15.30	76.70	8.00	4.00	0.29
35	0-20	7.82	0.01	8.60	75.40	16.00	4.20	0.81
	20-40	7.58	0.01	5.30	84.70	10.00	5.00	0.70
36	0-20	7.28	0.01	4.60	85.40	10.00	5.39	1.86
	20-40	7.09	0.01	9.30	80.70	10.00	3.80	1.68
37	0-20	7.70	0.01	6.60	81.40	12.00	4.50	2.09
	20-40	7.13	0.01	13.30	76.70	10.00	4.00	1.63
38	0-20	7.46	0.01	4.60	79.40	16.00	4.00	2.21
	20-40	7.54	0.01	17.30	74.70	8.00	3.60	1.80
39	0-20	7.19	0.01	4.60	83.40	12.00	5.20	0.58
	20-40	7.19	0.01	7.30	82.70	10.00	3.40	0.41
40	0-20	7.86	0.07	38.60	25.40	36.00	36.17	3.66
	20-40	7.14	0.06	47.30	24.70	28.00	32.97	3.60
Min		6.85	0.01	4.60	8.70	8.00	3.40	0.29
Max		8.16	0.21	65.30	85.40	58.00	53.95	5.52
Average	0-20	7.38	0.06	30.30	41.70	28.10	17.95	3.06
Average	20-40	7.50	0.05	36.10	38.90	25.00	15.61	2.50
General Average		7.44	0.06	33.10	40.30	26.50	16.78	2.78

*Yalçın and Çimrin (2017)

Some Nutrient and Heavy Metal Contents of Soil Samples

Some plant nutrients and heavy metal contents of the soil used in the survey are given in Table 3.

Molybdenum: The lowest Mo content of the study area was 0.001 ppm while the highest molybdenum content was 0.064 ppm. The average Mo content of the samples at 0-20 cm depth of soil was 0.020 ppm, while that of 20-40 cm depth was 0.014 ppm, and the average of both depths was 0.017 ppm. The content of Mo is generally reduced, depending on the depth. The available Mo contents of 95 % of the sampled pasture soils were found to be under the critical level (>0.05 ppm) according to Bhattachariyya et al. (1998) (Table 3).

Copper: Cu contents of soils were found to be lowest at 0.26 ppm, while the highest Cu was found at 7.48 ppm. The average Cu content of the soil at 0-20 cm depth was 3.25 ppm while it was 2.73 ppm at 20-40 cm depth and 2.99 ppm at two depths. Considering the limit values reported

by Linsay and Norvell (1978), for the Cu content of the soil samples, it was seen that the whole of the soil was sufficient (>0.2 ppm) in terms of the available Cu content (Table 3). The determination of the heavy metal pollution of the agricultural land around the Antakya-Cilvegözü international roadway of Hatay province and the plants growing in these lands reported similar results in the study named Özkan (2017).

Iron: The lowest Fe content in the study area was 4.00 ppm, while the highest Fe content was 61.00 ppm in the samples. The averages of 0-20 cm depth of soil samples were 22.00 ppm for Fe content and 15.00 ppm for 20-40 cm depth samples. The average of both depths was 18.50 ppm. According to the boundary values of Viets and Lindsay (1973), soil samples showing clearly Fe deficiency (<2.5 ppm) could not be determined. Soils that are likely to show critical Fe deficiency (2.5-4.5 ppm) are 2.50% whereas 97.50% are good (>4.5 ppm) in terms of available Fe (Table 3). Cetinkaya and Sumer (2013), have shown similar results in a study conducted by Karamenderes basin in a different region to reveal the useful micro nutrient elements (Fe, Cu, Zn and Mn) of the soils.

Cadmium: While the Cd content of the survey soil was 0.01 ppm in the samples, the highest Cd content was determined as 0.32 ppm. The average Cd content of the samples at 0-20 cm depth of the soil was 0.06 ppm while it was 0.04 ppm at the depth of 20-40 cm and 0.05 ppm on both sides (Table 3). In the named work, Özkan (2017) reported similar results in the determination of the heavy metal pollution of the agricultural land around the Antakya-Cilvegözü international road which is constructed in this region and Hatay. Tolunay and Bayçu (2009), have shown similar results in the study of urban areas of Istanbul in different regions to determine the contents of Cd, Pb, Zn and Ni.

Table 3 Mo, Cu, Fe, Cd, Co, Ni, Pb contents of Kırıkhan-Reyhanlı Meadow Pasture Areas of Hatay

Soil No	Depth	Structure Class	Mo ppm	Cu ppm	Fe ppm	Cd ppm	Co ppm	Ni ppm	Pb ppm
1	0-20	SiL	0.044	2.86	14	0.03	0.81	5	16
	20-40	L	0.020	1.80	7	0.02	0.14	2	10
2	0-20	SiL	0.056	5.22	40	0.04	2.53	7	28
	20-40	C	0.019	3.31	13	0.03	0.19	2	15
3	0-20	CL	0.017	3.93	17	0.02	2.05	6	29
	20-40	C	0.013	3.43	13	0.01	0.10	2	19
4	0-20	C	0.011	3.14	12	0.03	0.25	3	20
	20-40	C	0.009	3.36	14	0.03	0.12	3	23
5	0-20	C	0.008	3.88	18	0.03	0.23	3	27
	20-40	C	0.009	2.97	13	0.03	0.05	2	21
6	0-20	CL	0.005	2.45	10	0.04	0.34	1	13
	20-40	C	0.001	2.48	7	0.04	0.12	1	12
7	0-20	C	0.006	2.59	17	0.15	1.15	4	23
	20-40	C	0.005	1.75	7	0.10	0.12	2	11
8	0-20	CL	0.006	2.49	22	0.20	2.11	6	32
	20-40	C	0.003	1.95	8	0.13	0.14	3	15
9	0-20	C	0.003	3.13	13	0.11	1.49	4	23
	20-40	C	0.008	1.95	6	0.07	0.15	2	13
10	0-20	CL	0.018	5.17	21	0.32	4.97	7	36
	20-40	C	0.002	4.97	7	0.16	0.38	2	17
11	0-20	C	0.040	3.89	21	0.07	1.05	13	66
	20-40	L	0.027	1.98	6	0.04	0.10	6	40
12	0-20	CL	0.027	2.34	18	0.02	1.10	4	41
	20-40	C	0.022	1.76	9	0.02	0.13	2	29
13	0-20	CL	0.011	2.14	17	0.02	0.33	3	31
	20-40	CL	0.006	1.48	12	0.02	0.12	2	23
14	0-20	C	0.045	4.43	25	0.06	2.74	13	67
	20-40	C	0.019	3.16	11	0.05	0.19	6	42
15	0-20	C	0.064	3.59	26	0.04	0.93	7	38
	20-40	C	0.055	3.13	28	0.04	0.33	7	61
16	0-20	C	0.021	4.13	44	0.03	0.52	7	34
	20-40	C	0.026	3.45	30	0.03	0.15	5	29
17	0-20	C	0.008	4.24	34	0.02	2.04	7	51
	20-40	C	0.006	2.91	17	0.01	0.22	3	33
18	0-20	C	0.012	2.87	22	0.03	0.64	3	48
	20-40	C	0.016	3.06	25	0.05	0.22	2	56
19	0-20	CL	0.006	2.06	16	0.02	0.32	2	33
	20-40	C	0.006	1.68	10	0.02	0.09	1	25
20	0-20	SL	0.004	0.94	24	0.01	0.74	7	9
	20-40	SL	0.009	0.68	14	0.01	0.20	5	7

Table 3 Mo, Cu, Fe, Cd, Co, Ni, Pb contents of Kırıkhan-Reyhanlı Meadow Pasture Areas of Hatay (Continued)

Soil No	Depth	Structure Class	Mo ppm	Cu ppm	Fe ppm	Cd ppm	Co ppm	Ni ppm	Pb ppm
21	0-20	SCL	0.050	2.47	25	0.06	1.91	20	21
	20-40	L	0.030	2.02	22	0.04	0.86	14	14
22	0-20	CL	0.023	3.03	37	0.04	0.48	15	25
	20-40	CL	0.022	2.45	29	0.04	0.36	12	19
23	0-20	CL	0.011	2.93	22	0.04	0.81	11	29
	20-40	SiC	0.007	2.41	18	0.03	0.23	7	22
24	0-20	CL	0.006	7.48	29	0.08	0.08	5	61
	20-40	CL	0.009	5.36	21	0.07	0.11	5	46
25	0-20	L	0.038	2.71	12	0.05	0.38	5	36
	20-40	CL	0.032	2.13	9	0.05	0.18	4	29
26	0-20	SL	0.044	3.38	61	0.10	1.83	4	22
	20-40	CL	0.014	2.46	43	0.05	0.61	2	17
27	0-20	SL	0.010	2.86	19	0.02	0.28	3	24
	20-40	SL	0.016	4.45	29	0.03	0.18	3	25
28	0-20	L	0.029	4.61	28	0.07	0.14	2	59
	20-40	L	0.021	4.02	18	0.06	0.06	2	54
29	0-20	CL	0.025	5.74	25	0.03	0.08	2	38
	20-40	CL	0.016	4.31	12	0.02	0.03	1	21
30	0-20	L	0.032	3.36	20	0.12	0.17	2	52
	20-40	CL	0.019	2.78	10	0.12	0.08	1	46
31	0-20	C	0.028	6.76	43	0.05	0.05	2	53
	20-40	C	0.014	6.17	34	0.03	0.01	2	45
32	0-20	C	0.017	7.05	38	0.02	0.03	2	32
	20-40	C	0.009	5.88	31	0.02	0.01	2	27
33	0-20	LS	0.003	2.53	8	0.04	0.04	0	13
	20-40	SL	0.004	3.42	5	0.05	0.02	0	23
34	0-20	SL	0.003	2.96	12	0.03	0.05	0	8
	20-40	SL	0.003	1.92	8	0.03	0.04	0	6
35	0-20	SL	0.013	0.26	4	0.01	0.02	0	4
	20-40	LS	0.010	0.33	4	0.02	0.03	0	3
36	0-20	LS	0.008	0.61	12	0.05	0.04	0	7
	20-40	LS	0.007	0.58	10	0.04	0.02	0	6
37	0-20	LS	0.007	1.18	12	0.05	0.09	1	8
	20-40	SL	0.004	1.25	14	0.05	0.07	1	9
38	0-20	LS	0.010	2.88	8	0.04	0.05	1	6
	20-40	SL	0.003	2.84	9	0.05	0.09	1	12
39	0-20	LS	0.010	0.79	11	0.04	0.02	1	5
	20-40	LS	0.005	0.50	7	0.03	0.01	1	3
40	0-20	CL	0.027	3.30	17	0.03	0.17	3	24
	20-40	C	0.025	2.58	12	0.02	0.10	2	20
Min			0.001	0.26	4	0.01	0.01	0	3
Max			0.064	7.48	61	0.32	4.97	20	67
Average	0-20		0.020	3.25	22	0.06	0.83	5	30
Average	20-40		0.014	2.73	15	0.04	0.16	3	24
Average			0.017	2.99	18.5	0.05	0.49	4	27

Table 4 Correlation coefficients between molybdenum and some soil heavy metal contents of the pastureland of Hatay province (r)

	Mo ppm	Cd ppm	Co ppm	Ni ppm	Pb ppm	Cu ppm
Cd ppm	-0.15					
Co ppm	0.34***	0.57***				
Ni ppm	0.52***	0.11	0.52***			
Pb ppm	0.45***	0.17	0.24*	0.31***		
Cu ppm	0.23*	0.18	0.21	0.13	0.61***	
Fe ppm	0.44***	0.03	0.34***	0.40***	0.44***	0.56***

*Significant at 0.05 level, *** significant at 0.001 level

Cobalt: The lowest Co content of the grassland was 0.01 ppm and the highest value was 4.97 ppm. The average Co content of the soil at 0-20 cm depth was 0.83 ppm while the average at the depth of 20-40 cm was 0.16 ppm and found to be 0.49 ppm on average (Table 3). Özkan (2017) reported similar results in the identification of the heavy metal pollution of agricultural land in the vicinity of the Antakya-Cilvegözü international road, which he had made in the territory of the region, and of the plants growing in these lands.

Nickel: The total amount of changeable Ni content of the research soil was the lowest of 0.00 ppm, while the highest was 20.00 ppm. The average changeable Ni content of the samples at depths of 0-20 cm of soil was 5.00 ppm while it was 3.00 ppm at 20-40 cm depth and average of 4.00 ppm was found at both depths (Table 3). Tolunay and Bayçu (2009), have shown similar results in the study of urban regions of Istanbul in different regions in order to determine the contents of Cd, Pb, Zn and Ni. Urease, β-glycosidase, acid and alkaline phosphatase enzyme activities were determined in the soil where hazelnut cultivation was carried out in Terme-Ünye region and these activities aimed to determine the relationship between some important features of the soil and trace elements and heavy metal contents (Karaca et al., 1998), have shown similar results in the study of a region land.

Lead: The Pb content of soil was 3.00 ppm at the lowest, while the highest Pb content was determined as 67.00 ppm. The average Pb content of the samples at 0-20 cm depth of the soil was 30.00 ppm while it was 24.00 ppm at the depth of 20-40 cm and 27.00 ppm at two depths (Table 3). Dartan and Toröz (2013), found similar results in a study conducted in a different region for the investigation of heavy metals in agricultural soils in the southern Marmara region. Yağmur and Okur (2011), found similar results in their study of different regions in order to reveal the nutritional status and the pollution levels of heavy metals in the cherry garden in Kemalpaşa district of İzmir province of Aegean region.

Relations Between Available Molybdenum Content and Some Other Soil Heavy Metal Properties

The relationship between the heavy metal content of the soil and the available Mo is given in Table 4. As can be understood from the examination of the table, the soil is composed of Co (r: 0.34***; Figure 2), Ni (r: 0.52***; Figure 3), Pb (r: 0.45***; 0.23*; Figure 5) and Fe (r: 0.44***; Figure 6). Furthermore, significant positive relationships were determined between Cd contents of soils and Co content (r: 0.57***). A positive correlation was found between the Co content of the soil and Ni (r: 0.52***), Pb (r: 0.24*) and Fe (r: 0.34***). In the study that Costa et al. (2017) investigated the natural content of heavy metals in South Amozon region in Brazil, Co and Cd, Pb and Fe contents were found to be positively correlated. At the same time, significant positive correlations were found between the Ni contents of the soils and Pb (r: 0.31***) and Fe (r: 0.40***) contents. In the study that Liu et al. (2016) investigated the variability of heavy metal contents in the soil of typical Tibetan pastures, Ni and Pb were fount to be positively correlated. A significant positive correlation was also found between Pb content and Cu (r: 0.61***) and Fe (r: 0.44***) contents. However, a significant positive correlation was found between Cu content and Fe (r: 0.56***) content.

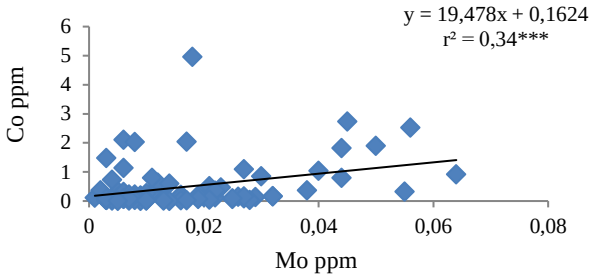

Figure 2 Relationship between useful Mo and Co contents of soil samples

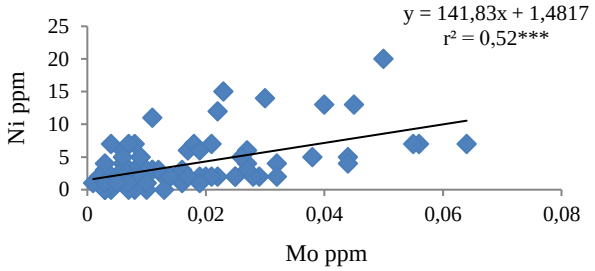

Figure 3 The effect of soil samples on Ni relationship between content

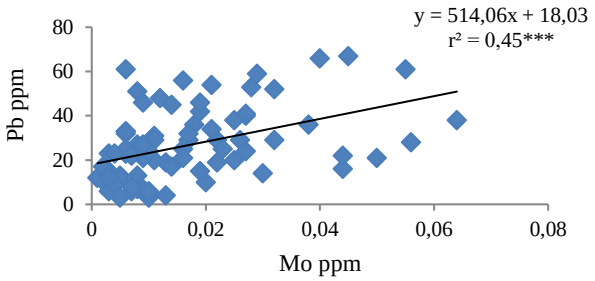

Figure 4 Relationship between useful Mo and Pb contents of soil samples

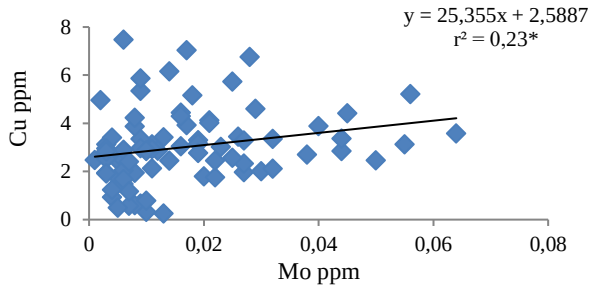

Figure 5 Relationship between useful Mo and Cu contents of soil samples

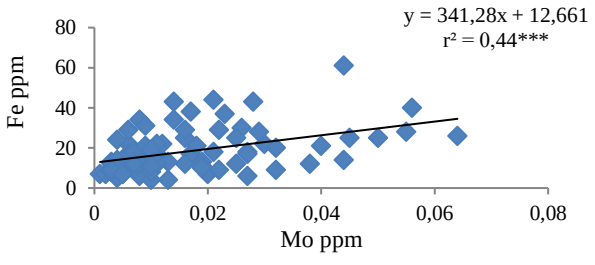

Figure 6 Relationship between useful Mo and Fe Contents of soil samples

Result

The useful Mo status of meadow-pasture land in Kırıkhan-Reyhanlı region of Hatay province was investigated and tried to determine the relation with some heavy metal contents in the soil. The content of Mo is generally reduced, depending on the depth. The available Mo contents of 95% of the sampled pasture soils were found to be under the critical level (>0.05 ppm) according to Bhattachariyya et al (1998). Considering the limit values reported by Linsay and Norvell (1978), for the copper Cu content of the soil samples, it was seen that the whole of the soil was sufficient (>2 ppm) in terms of the available Cu content. Soil samples showing clearly iron Fe deficiency (<2.5 ppm) could not be determined. Soils that are likely to show critical Fe deficiency (2.5-4.5 ppm) are 2.50% whereas 97.50% are good (>4.5 ppm) in terms of available Fe. The average Cd content of the samples at 0-20 cm depth of the soil was 0.06 ppm while it was 0.04 ppm at the depth of 20-40 cm and 0.05 ppm on both sides. The average Co content of the soil at 0-20 cm depth was 0.83 ppm while the average at the depth of 20-40 cm was 0.16 ppm and found to be 0.49 ppm on average. The average changeable Ni content of the samples at depths of 0-20 cm of soil was 5.00 ppm while it was 3.00 ppm at 20-40 cm depth and average of 4.00 ppm was found at both depths. The average Pb content of the samples at 0-20 cm depth of the soil was 30.00 ppm while it was 24.00 ppm at the depth of 20-40 cm and 27.00 ppm at two depths. It was determined that there are significant positive relationships between Co, Ni, Pb, Cu and Fe contents of Mo in the soil. It was also determined that there are significant positive significant relationships between Cd and Co; Co with Ni, Pb, Fe and Pb and Cu, Fe and Cu and Fe.

When the Mo contents of the meadow-pasture soil samples are compared with the permissible limit values of heavy metals (Anonymous, 2017); No heavy metal pollution or lack of Mo was found in the soil. In addition, significant positive relationships were found between the available Mo contents of the soil and Co, Ni, Pb, Cu and Fe.

Acknowledgement

We would like to thank Mustafa Kemal University Scientific Research Projects Coordinator (BAP-16807) for their support in the conduct of the work.

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