Frontiers in Life Sciences and Related Technologies 1(1) (2020) 35-41

Contents lists available at Dergipark

Frontiers in Life Sciences and Related Technologies

Journal homepage: http://www.dergipark.org.tr/tr/pub/flsrt

Research article

Deposition of heavy metals on coniferous tree leaves and soils near heavy urban traffic

Ozlem Turan[1], Huseyin Ozdemir[*2,3], Goksel Demir[4]

[1]Bahcesehir University, Institute of Pure and Applied Sciences, Department of Urban Systems and Transportation Management, Besiktas, Istanbul, Turkey
[2]Bahcesehir University, Faculty of Engineering and Natural Sciences, Department of Civil Engineering, Besiktas, Istanbul, Turkey
[3]Agriconsulting Europe S.A., Cankaya, Ankara, Turkey
[4]University of Health Sciences Turkey, Faculty of Hamidiye Health Sciences, Department of Occupational Health and Safety, Uskudar, Istanbul, Turkey

Abstract

In this study, the heavy metal pollution and its accumulation effects in soil is the major cause. The magnitude and distribution of heavy metal pollution in Istanbul has been investigated by taking soil and plant samples from urban intersections and refuges defined as passive green areas in Ataşehir, Beykoz, Kadıköy, Kartal, Maltepe and Pendik, Sancaktepe, Sultanbeyli, Ümraniye and Üsküdar districts of Anatolian Side of Istanbul Province. Within this scope, 205 leaf samples (3 needle-leaved) and 170 soil samples were collected from 2 different depths (0-20 cm and 40 cm) and samples taked from 17 different passively green area locations. Concentrations of heavy metals such as cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb) and zinc (Zn), which cause pollution in the samples were measured using the ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometer) instrument. The average Cd, Cr, Cu, Ni, Pb and Zn levels for 0-20 cm depth in soil samples were; 6.03, 55.72, 38.01, 48.59, 32.69, 90.30 mg kg^{-1}. For 20-40 cm deep soils, mean values were determined as 6.10, 55.66, 35.11, 49.75, 33.51, 83.85 mg kg^{-1}, respectively. Results show us more than one point samples in different depths and locations exceeded excepting limit values almost every heavy metal.

Keywords: *Soil pollution; roadside soils; roadside plants; Istanbul*

1. Introduction

Under the conditions of rapid urbanization and industrialization, heavy metals are being introduced into the soil environment via atmospheric and water pathways, which is causing an increase in soil heavy metal pollution (Agomuo and Amadi, 2017). Also, air pollution, one of the types of environmental pollution, is a serious problem all over the world threatening the health of all living things through the development of industrial activities. And from the 1900s onwards, heavy metal pollution especially from vehicle emissions seems to have increased significantly (Hawkins et al., 2020). In this context, air pollution can be defined as the presence of pollutants in various forms such as ash, dust, fog, soot, smoke, steam, gas and odor in quantities damaging all existences (Das et al., 2019; Karahan et al., 2020). Air, water and soil, there is a natural balance between them, are like rings of a chain intertwined with each other. For this reason air, water and soil pollution cannot be considered as independent phenomena. The pollution of any one of them means that a ring of the chain is broken which also affects others

[*] Corresponding author.
E-mail address: huseyin.ozdemir@cityair-tr.eu (H. Ozdemir).

Received in 15 August 2020; Accepted 24 September 2020
Available online 29 September 2020

seriously, causing the ecosystem to deteriorate. The acid rains resulting from air pollution and the polluted water reaching the soil and causing soil pollution are examples that can be given in this respect. The pollution of soils, which is very difficult or even impossible to recover when they are lost, appears in a very long time compared to other types of pollution. For this reason, in order not to be late about soil pollution, it is firstly necessary to determine whether the soil in the vicinity is searched for dirt and pollution, if necessary, to take necessary preventive measures and to coordinate with related institutions and organizations (Keshavarzi et al., 2019). Moreover, related institutions should act in coordination with this issue.

The most important agent of air and soil pollution is heavy metals. The term of heavy metal is used for metals with a specific weight greater than 5 g cm^{-3} or for elements with a relatively large atomic number (Hogan, 2010; Ozdemir, 2019). Heavy metals include transition metals from elements that show metallic properties in the periodic system and some elements including a number of nonmetals, lanthanides and actinides (Bediako et al., 2015). Heavy metals are natural components of the environment. However, they have been mixed in soil, water and air as a result of rapid population growth, increased urbanization, industrial facilities, expansion of power plants, local heating systems and motor vehicles. The risk of these metals subjected to human health is very high because these metals have a tendency to be adsorbed, accumulated and biomagnified in the body that can be responsible for various diseases (Herojeet et al., 2015). This type of pollutions has adversely affected all the elements and the continuity of the ecosystem, causing environmental problems to be felt at a significant level (Karaca et al., 2005; Uyar et al., 2009; Dhakal and Kattel, 2019).

Heavy metals tend to accumulate in the soil. Unlike other toxic elements, they cannot be created or destroyed by living organisms (Ozyigit et al., 2019). The accumulation of metal quantities in the soil depends on the previous metal content of the soil, the emission levels, and the transport of metals gathered in the source of pollution to the relevant areas (Ronchi et al., 2019). Heavy metals are kept in the soil in consequence of the adsorption of the soil, chemical reactions and ion exchange (Li et al., 2020). Deposition of heavy metals depends on the amount of organic matter in the soil and on the type of clay minerals (Yin et al., 2020). Most of the metals, along with heavy and trace elements, are necessary for plant growth, but when they are present in high concentrations in the soil, they become harmful and toxic to living things (Ozyigit et al., 2018; Karahan et al., 2020). Especially in plants, the presence of excess amounts of Cd, Hg and Pb metals is seen as a sign of contamination (Hoang et al., 2020).

Plants are important ecosystem components that enable the transfer of substances within the ecosystem between biotic and abiotic environments (Martínez-López et al., 2014). The main source of trace elements in plants is the growth environment. Also, when we scope another harmful effects about heavy metals are, they has been found that there are positive relationships between atmospheric heavy metal accumulation and heavy metal concentrations in plants (Ugulu et al., 2012). Many plant species can accumulate potentially toxic substances in significant amounts (Piczak et al., 2003). *Pinus* sp., *Cedrus* sp. and *Juniperus* sp. were selected for this study because they meet most of the requirements of good bioindicators (Mingorance et al., 2007). The pine has needles with a thick epicutical wax layer that makes the most suitable biodegraders, especially those that are sensitive to environmental pollution (Mingorance et al., 2007; Serbula et al., 2012). Urban trees and shrubs are often used to provide biological isolation in industrial and urban areas, as they play an important role in filtering ambient air by absorbing particulate matter and removing heavy metals (McDonald et al., 2007; Dzierzanowski et al., 2011). To give information about short-term and long-term toxicity levels, plants with higher biological impressions, especially those plants that are green every season, are preferred.

In recent years, many studies have been carried out on determining the type, concentration and sources of heavy metals in roadside dust. For example, heavy metals such as Cd, Cu, Mn, Ni, Pb and Zn have been found to be an important contaminant on roadsides in Istanbul (Sezgin et al., 2004). In a study in Antalya, Cd, Cr, Cu, Pb and Zn and were investigated in coastal areas where marine and motor vehicles affected soil, soil samples taken from relatives of industrial zones and clean areas. Concentrations in the city were found to be quite high compared to clean areas (Guvenc et al., 2003).

Concentrations of Cd, Cu, Mn, Ni, Pb and Zn were investigated in Dhaka city of Bangladesh to determine heavy metal pollution in soil and plants. As a result, it has been understood that industrial solid wastes, wastewater and emissions cause heavy metal pollution around the city of Dhaka (Kashem and Singh, 1999). In Birmingham, UK, roadside heavy metal pollution has been identified in connection with intersections controlled by traffic lights that are likely to regularly stop vehicles (Charlesworth et al., 2003).

In Hong Kong and Jordan, a study has been conducted on some roadside parks and gardens in order to determine the heavy metal pollution in the soil. It is stated that the density of the metals is higher in the samples taken from the parks near the roadside, and there is a significant relation between traffic density and metal concentrations of leaves, soil and dust (Lee et al., 2006). In another study of heavy metal concentrations in plant, soil and air found at the roadside of Jordan, concentrations of Cu, Pb, Cd and Zn heavy metals were investigated. It has been found that automobiles make a great source of these elements around the roadside, so that roadside has a high content of heavy metals in the soil and plants (Jaradat and Momani, 1999).

Herewith, in this study, we aimed to use leaf samples from needle-leaved trees and various soil samples in different depths from passive green areas which may simply entail being open space in urban areas and not usually use for peoples to determine the current concentration of heavy metals in Anatolian Side of Istanbul Province.

2. Material and methods

2.1. Study area

Istanbul has a very important position between the Asia and Europe continents (Ozdemir et al., 2014). Its population is close to 15 million, the number of traffic-driven vehicles is 3 million 651 thousand 166, and this value is increasing day by day. For this reason, one of the biggest causes of environmental pollution in Istanbul is definitely traffic (Unal et al., 2020).

In this study, it is aimed to investigate the size and distribution of the pollution situation in the passive green areas of Istanbul Anatolian side. For this aim, 3 different kinds of plant leaf and 2 different depth soil samples were collected from 17 different locations in Istanbul Anatolia. The representation of these points on the map is given in Figure 1. Leaf samples were determined using available plants in the study areas. Also, soil samples were collected from the environment of all plant species.

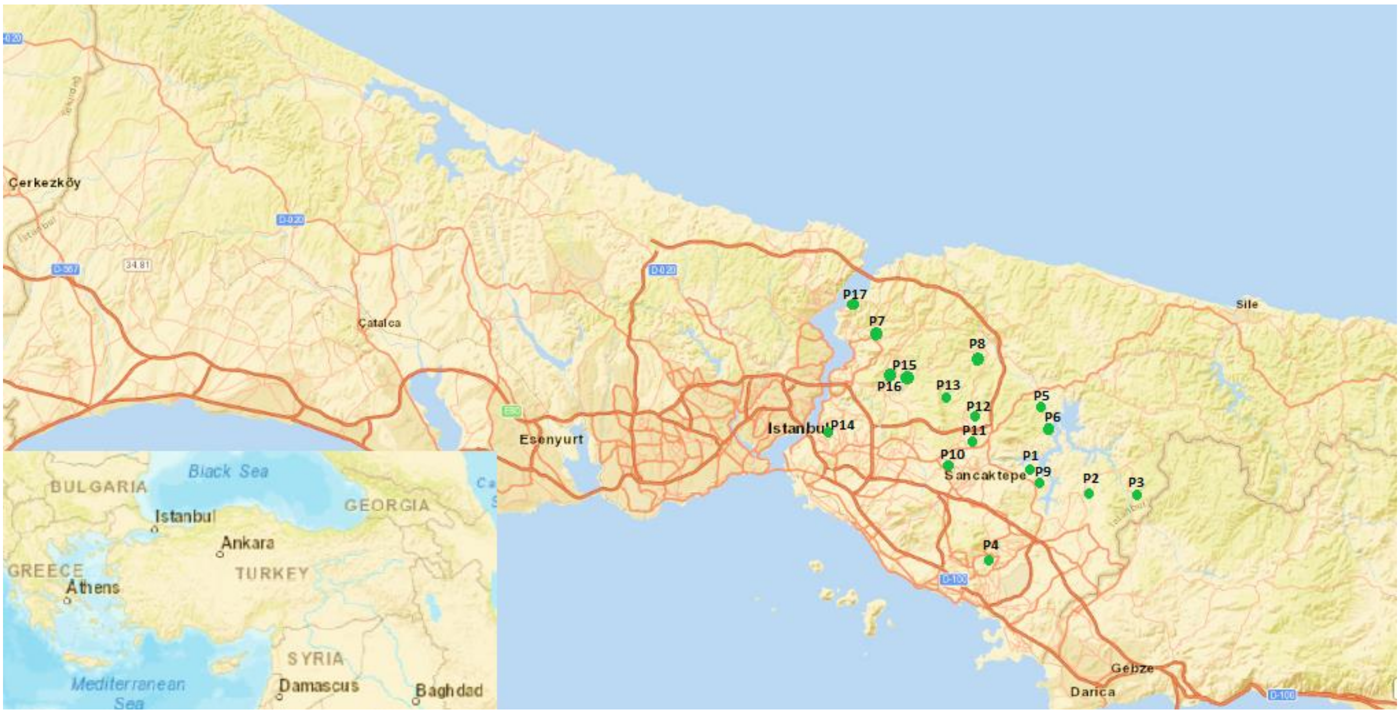

Fig. 1. Location of study areas in Istanbul Anatolian province (ESRİ, Arcgis).

2.2. Experimental study

A total of 28 soil samples were taken from 2 different depths, 0-20 cm and 20-40 cm by using drill tools. The soil study areas are divided into parcels by paying attention to differences such as soil color, area gradient, soil structure and at least one kilogram soil sample is taken to represent each parcel. A total of 51 leaf samples were taken from 3 different plants representing different layers of trees. Leaf samples were determined using available plants in the study areas. Plant species from which leaf samples are taken are as follows: Cedar (*Cedrus* sp.), Pine (*Pinus* sp.) and Juniper (*Juniperus* sp.). The coordinates of the study areas were given in Table 1.

Table 1
The coordinates of the study areas.

Location Code	Latitude	Longitude
P1	40.910219	29.183229
P2	40.924211	29.311629
P3	40.947897	29.310706
P4	40.861408	29.273036
P5	40.919180	29.278118
P6	40.942186	29.302335
P7	40.999386	29.073590
P8	40.979635	29.218200
P9	40.943105	29.216145
P10	40.940880	29.127078
P11	40.951061	29.161613
P12	40.968180	29.139885
P13	40.992566	29.127265
P14	40.987301	29.033883
P15	40.980263	29.077338
P16	41.005469	29.072423
P17	41.106940	29.084599

Taking of samples from the specified regions was carried out in April 2015. Concentrations of Cd, Cr, Cu, Ni, Pb, and Zn causing pollution were determined using ICP-OES instrument within the scope of heavy metal pollution in all samples.

The soil samples were subjected to an oven drying process at an average temperature of 35-40°C by laying them on a non-evaporating and non-hygroscopic tray with a thickness of not more than 15 mm. The soil samples to be analyzed were prepared by grinding with wooden and porcelain mortars and knurls in a such manner that they can pass through the sieve of 2 mm thickness to prevent metal contamination.

0.2-0.3 g of soil samples which are prepared for heavy metal analysis were weighed and transferred to pressure pots with Teflon material and 10 ml of aqua regia (1/3 HNO_3 / HCl) was added. Then, in the temperature-pressure controlled microwave device (BERGHOF Microwave Sting Unit) where the low temperature and high pressure disintegration processes can be performed, the disintegration process was carried out within the compass of the program that lasts one hour and provides gradual temperature increase. Then, the obtained solution was diluted with distilled water at the desired ratio, and the solution was ready for measurement. The solution obtained after the incineration process, after the method works in ICP-OES (Perkin Elmer Optima 2100 DV) instrument, was subjected to heavy metal detection by the method selected by choosing the wave lengths with low background (for Cd: 226.502, for Cr: 267.716, for Cu: 324.752, for Ni: 341.476, for Pb: 220.353 and for Zn: 213.857), low interference and least vibration. Leaf samples were washed with pure water and then dried in a fan-drying oven at a temperature of 65-70°C so that they can be passed through a 0.2 mm sieve. The heavy metal analysis method carried out in the soil samples was exactly applied to the prepared plant samples.

3. Results and discussion

In this study, it has been observed that the highest concentration of heavy metal was Zn (82.06 mg kg^{-1}) at the 10^{th} point, the lowest concentration of heavy metal was Pb (0 mg kg^{-1}) at 10^{th} point and Cd 0 mg kg^{-1}) at 8^{th} point. The highest value was found at the 8^{th} point for Zn (36.43 mg kg^{-1}) and the lowest value was found at the point P8/9 for Cd (0 mg kg^{-1}) and at the point of P8 for Cr (0 mg kg^{-1}) in the leaves of the pine plants. The

Table 2
The heavy metal concentrations of plant leaf samples (mg kg^{-1}).

		Cd	Cr	Cu	Ni	Pb	Zn
	Avg.	0.16±0.07	16.38±19.57	18.35±10.09	10.49±15.92	5.75±6.89	44.60±22.00
***Cedrus* sp.**	**Min.**	0.00 (P8)	3.00(P16)	8.95(P10)	1.73 (P3)	NA (P10)	21.80 (P10)
	Max.	0.38 (P6)	52.78 (P11)	38.88 (P6)	39.27 (P11)	19.33 (P6)	82.06 (P6)
	Avg.	0.11±0.06	9.17±8.21	8.41±3.97	4.06±6.34	2.14±1.40	26.25±6.13
***Pinus* sp.**	**Min.**	0.00 (P8&P9)	0.00 (P8&P9)	2.11(P10)	0.09 (P9)	0.68 (P15)	20.58 (P15)
	Max.	0.22 (P17)	25.71 (P14)	2.80(P9)	16.78 (P14)	4.06 (P29)	36.43 (P8)
	Avg.	0.10±0.06	11.05±6.91	11.89±4.94	8.88±6.62	8.70±13.55	32.03±18.50
***Juniperus* sp.**	**Min.**	0.00(P10)	2.11(P10)	5.79(P10)	1.55 (P1)	NA (P10)	13.69 (P10)
	Max.	0.14 (P4)	18.88 (P13)	18.12 (P15)	14.32 (P13)	29.70 (P5)	61.10 (P5)

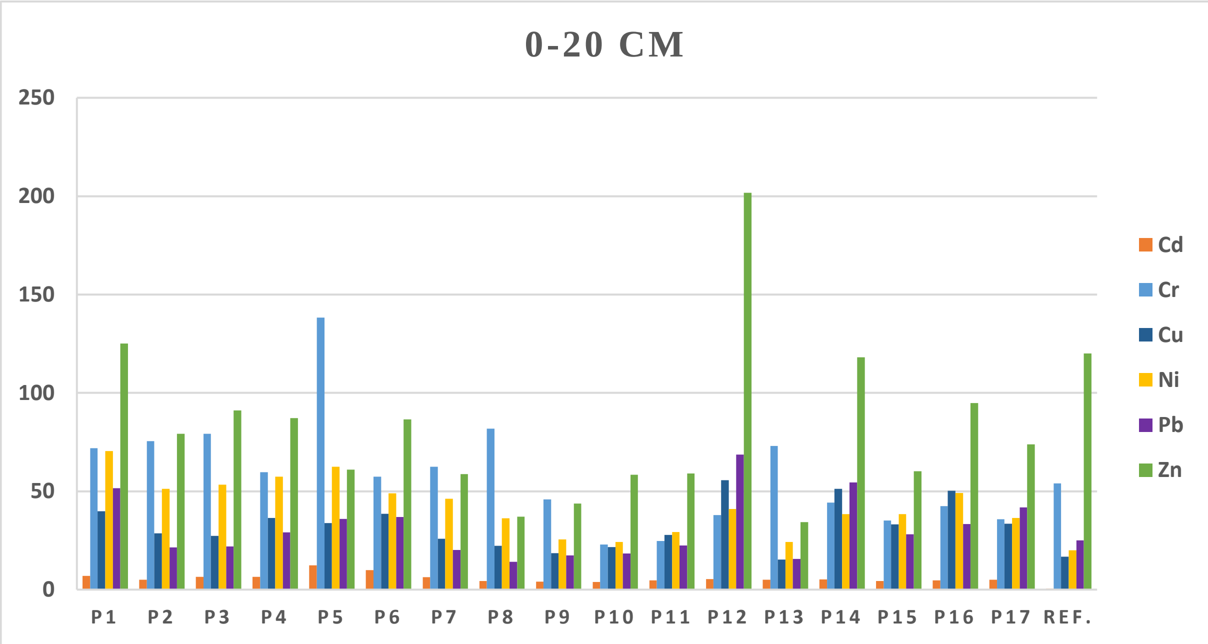

Fig. 2. The heavy metal concentrations of soil samples in the depth range of 0-20 cm (mg kg^{-1}) and compares according to references (Yalcin et al., 2020) values from previous studies.

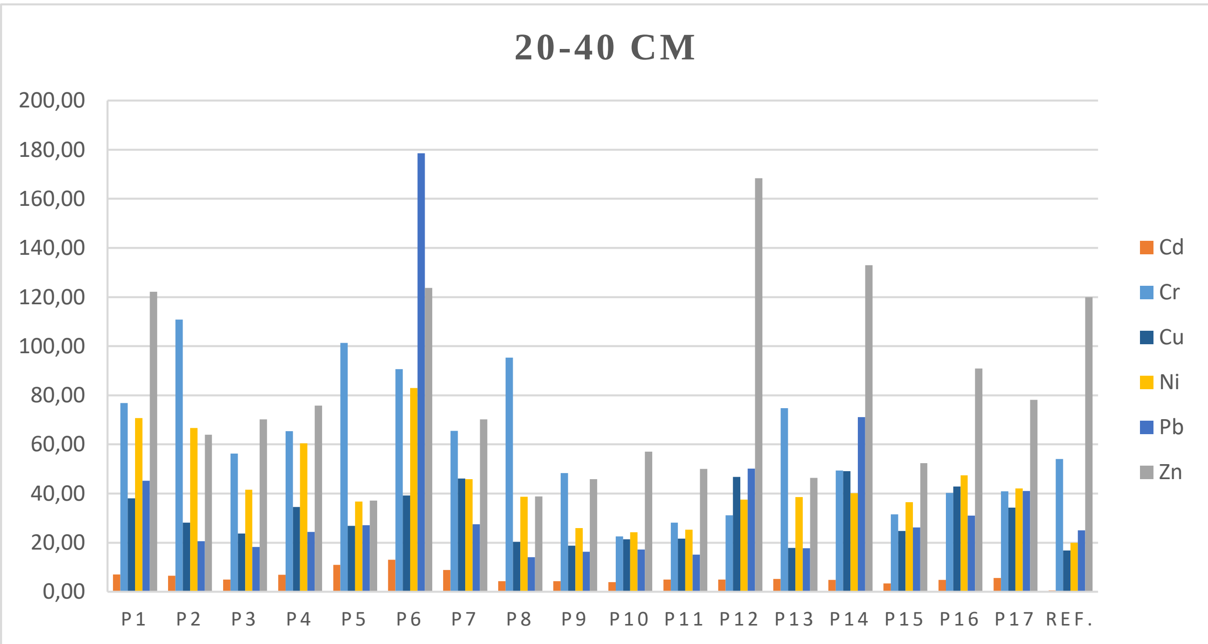

Fig. 3. The heavy metal concentrations of soil samples in the depth range of 20-40 cm (mg kg^{-1}) and compares according to references (Yalcin et al., 2020) values from previous studies.

Table 3
The heavy metal concentrations of soil samples in the depth range of 0-20 cm and 20-40 cm (mg kg^{-1}).

	Cd	Cr	Cu	Ni	Pb	Zn	Cd	Cr	Cu	Ni	Pb	Zn
Notation	**0-20 cm**	**20-40 cm**	**0-20 cm**	**20-40 cm**	**0-20 cm**	**20-40 cm**	**0-20 cm**	**20-40 cm**	**0-20 cm**	**20-40 cm**	**0-20 cm**	**20-40 cm**
P1	6.99±0.6	7.00±1.0	71.82±15.9	76.84±17.9	39.86±6.0	38.05±9.0	70.45±7.6	70.71±8.1	51.52±30.0	45.22±25.0	125.08±20.7	122.15±19.1
P2	5.00±0.2	6.56±2.0	75.41±13.1	110.81±63.6	28.65±6.20	28.09±6.9	51.19±3.6	66.64±23.0	21.49±3.3	20.62±6.5	79.24±28.7	63.93±24.7
P3	6.50±2.2	4.99±1.0	79.22±17.9	56.27±18.5	27.33±6.8	23.75±11.9	53.27±11.0	41.50±14.9	21.99±2.4	18.28±5.5	91.08±5.5	70.24±37.2
P4	6.48±1.4	6.89±1.7	59.68±16.8	65.44±27.4	36.46±6.6	34.58±2.7	57.49±9.9	60.39±19.3	29.07±7.2	24.38±7.0	87.16±9.8	75.78±8.9
P5	12.32±6.4	10.92±2.8	138.30±98.6	101.28±26.7	33.75±8.3	26.80±8.3	62.48±25.2	36.75±10.1	35.88±7.11	27.04±3.5	60.96±9.4	37.11±4.8
P6	9.90±2.5	13.04±1.8	57.49±5.4	90.68±8.9	38.53±1.4	39.24±2.1	49.00±3.6	83.01±6.3	36.98±2.4	178.60±12.3	86.59±7.6	123.70±14.2
P7	6.35±1.2	8.91±2.8	62.53±14.2	65.50±26.5	25.86±12.0	46.15±8.5	46.15±13.4	45.80±21.6	20.23±3.3	27.46±5.6	58.65±29.3	70.26±51.3
P8	4.38±1.0	4.31±1.4	81.78±28.0	95.29±23.2	22.35±7.9	20.38±6.0	36.31±21.4	38.73±18.8	14.14±4.4	14.12±3.6	37.09±18.8	38.81±21.3
P9	3.99±1.4	4.29±1.3	45.80±14.3	48.27±9.5	18.59±10.7	18.77±11.9	25.53±11.4	25.89±15.1	17.31±7.1	16.27±7.2	43.71±24.3	45.82±40.4
P10	3.92±0.7	3.97±0.5	22.95±3.7	22.48±2.9	21.59±0.2	21.37±3.5	24.24±2.1	24.28±2.9	18.34±0.7	17.22±4.2	58.36±3.1	57.08±11.9
P11	4.76±0.1	5.00±0.5	24.73±1.5	28.18±8.9	27.77±1.4	21.59±7.7	29.27±1.0	25.23±5.6	22.40±6.3	15.08±3.3	59.11±0.2	50.02±11.12
P12	5.40±0.6	4.95±1.3	37.96±9.3	31.15±6.0	55.66±14.2	46.81±12.1	40.91±13.4	37.49±10.5	68.64±36.2	50.19±23.5	201.63±88.4	168.43±60.2
P13	4.98±1.1	5.20±1.0	72.99±46.1	74.72±54.8	15.20±3.1	17.80±5.4	24.28±14.8	38.61±24.7	15.67±2.9	17.76±3.6	34.31±2.5	46.43±14.1
P14	5.26±0.9	4.87±1.1	44.29±4.9	49.38±8.5	51.21±25.4	49.12±18.6	38.40±12.6	40.08±9.3	54.55±51.8	71.05±71.2	118.15±104.7	132.94±93.4
P15	4.42±0.8	3.35±0.3	35.14±3.2	31.51±2.0	33.15±3.0	24.75±0.9	38.38±8.8	36.52±4.7	28.10±12.6	26.13±9.2	60.12±10.5	52.40±14.9
P16	4.73±0.6	4.89±0.3	42.52±10.6	40.22±0.8	50.27±7.4	42.85±7.6	49.10±12.0	47.37±13.4	33.34±6.8	31.04±7.7	94.89±14.7	90.86±33.7
P17	5.10±0.3	5.59±0.3	35.74±3.1	40.85±9.6	33.47±3.8	34.27±2.2	36.43±4.3	42.01±13.0	41.72±3.3	40.98±3.8	73.81±4.2	78.09±8.5
Avg.	5.91±2.19	6.16±2.59	58.14±27.99	60.52±27.52	32.92±11.54	31.43±10.67	43.11±13.53	44.77±16.44	31.26±15.44	37.73±39.35	80.58±40.40	77.89±37.78
Min.	3.92	3.35	22.95	22.48	15.20	17.80	24.24	24.28	14.14	14.12	34.31	37.11
Max.	12.32	13.04	138.30	110.81	55.66	49.12	70.45	83.01	68.64	178.60	201.63	168.43

highest values of Zn (61.10 mg kg^{-1}) at the P5 point and the Pb and Cd values (0 mg kg^{-1}) at the P10 and P4 points, respectively, are the lowest values in the leaves of the juniper plants of the selected point. The result of leaf analysis of various plants collected from the study areas is shown in Table 2.

The normal worldwide distributions of the studied heavy metals in mg kg^{-1} in soils are 0.5 global average for Cd; 54 (global average) for Cr (Kabata-Pendias and Mukherjee, 2007; Yalcin et al., 2020). Ni is one of the micronutrients and also a heavy metal (Ozyigit et al., 2018), and it occurs in soils (in mg kg^{-1}) in the range of 0.2-450 with the average between 19-22. The natural Pb concentrations (in mg kg^{-1}) originated from the main rocks in regions between 10 and 40, with a grand average of 25 (Kabata-Pendias and Mukherjee, 2007; Yalcin et al., 2020). According to the literature, the normal limits for Cu (in mg kg^{-1} DW) the Cu contents (in mg kg^{-1} DW) in soils are found to be in ranges of 25-75 (Kabata-Pendias and Pendias, 2001; Dimitrijević et al., 2016).

In researches previously performed in Istanbul, the Zn concentrations (in mg kg^{-1} DW) in co-located soil samples for *Alcea pallida* (Yener and Yarci, 2010), *Hibiscus syriacus* (Yener, 2007), and *Celtis australis* (Ozturk et al., 2017) were found to be as 79.90, 62.53, and between 39.63-122.64, respectively.

In other studies done earlier in our country and abroad, the Zn levels (in mg kg^{-1} DW) in UW leaves and soils were reported as 7.42-19.53 and 35.55-217.00 for *Phoenix dactylifera* in Antalya-Turkey (Aksoy and Ozturk, 1996); 22.08-231.26 and 66.12-1215.25 for *Elaeagnus angustifolia* in Kayseri-Turkey (Aksoya and Sahin, 1999); 13.02-139.0 and 10.67-506.43 for *Robinia pseudoacacia* in Denizli-Turkey (Celik et al., 2005); and 50-151 and 173-576 for *Poa annua* in Bradford-England (Aksoy et al., 1999). According to the literature, the normal limits for Zn (in mg kg^{-1} DW) in plants are reported as 20-150 75 (Kabata-Pendias and Pendias, 2001; Dimitrijević et al., 2016) and the Zn contents (in mg kg^{-1} DW) in soils are found to be in ranges of 3-300 with a grand average of 65 (Kabata-Pendias and Pendias, 2001; Barker and Pilbeam, 2015; Yalcin et al., 2020).

As shown in Table 3, the highest concentrations of pollutants were found to be Zn (201.63 mg kg^{-1}) at the point P12 and Cd (3.92 mg kg^{-1}) at the point P10 when the concentrations of heavy metals in the 0-20 cm depth soil of the selected points were compared. For the depths of 20-40 cm, the highest concentration of heavy metal was found as Pb (178.6 mg kg^{-1}) at the point P6 and the lowest concentration of heavy metal was found as the Cd at the point P15 (3.35 mg kg^{-1}).

Cr, Cu, Ni, Pb, Zn heavy metal analyzes of 0-20 cm and 20-40 cm depth profiles of soil samples taken from 17 different points selected as research areas are shown in Table 3.

In terms of quantity, the heavy metals in the soil taken from the study areas are as follows; Zn> Cr> Ni> Cu> Pb> Cd (Table 3). According to the previous researches determined shown in Figure 2, soil measures shown us there is some important exceed values in the study. For 0-20 cm depth; For Cd, every study points exceed the reference (Barker and Pilbeam, 2015; Yalcin et al., 2020) value which is 0.5 mg kg^{-1}, the highest value was found at the point 5 for Cd (12.32±6.4 mg kg^{-1}) and the lowest value was found at the point 9 for Cd (3.92±0.7 mg kg^{-1}) and an average value for Cd is 5.91±2.19 mg kg^{-1}.

For measures of Cr, 9 study points exceed the reference (Kabata-Pendias and Mukherjee, 2007; Yalcin et al., 2020) value (P1, P2, P3, P4, P5, P6, P7, P8, P13), the highest value was found at the point 5 for Cr (138.30±98.6 mg kg^{-1}) and the lowest value was found at the point 10 for Cr (22.95±3.7 mg kg-

$^{-1}$) and average of Cr value is 58.14±27.99 mg kg^{-1}. For measures of Cu, all study points exceed the reference (Kabata-Pendias and Pendias, 2001; Dimitrijević et al., 2016) value except P13, the reference value for Cu is 16.78 mg kg^{-1} and the highest value was found at the point 12 for Cu (1 55.66±14.2 mg kg^{-1}) and the lowest value was found at the point 13 for Cu (15.20±3.1 mg kg^{-1}) and average of Cu value is 32.92±11.54 mg kg^{-1}. For Ni every study point exceeds the reference (Barker and Pilbeam, 2015; Yalcin et al., 2020) value which is 20 mg kg^{-1}, the highest value was found at point 1 for Ni (70.45±7.6 mg kg^{-1}) and the lowest value was found at the point 10 for Ni (24.24±2.1 mg kg^{-1}) and an average value for Ni is 43.11±13.53 mg kg^{-1}.

For Pb over half of the study points are exceed the reference (Kabata-Pendias and Mukherjee, 2007; Yalcin et al., 2020) value which is 25 mg kg^{-1} (P1, P4, P5, P6, P12, P14, P15, P16 and P17), the highest value was found at the point 12 for Pb (68.64±36.2 mg kg^{-1}) and the lowest value was found at the point 8 (14.14±4.4 mg kg^{-1}) and an average of Pb value is 31.26±15.44 mg kg^{-1}. For measures of Zn, only 2 points exceed the reference (Yener and Yarci, 2010) value which is 120.0 mg kg^{-1} (P1 and P12), the highest values was found at the point 12 for Zn (201.63±88.4 mg kg^{-1}) and the lowest value was found at the point 13 for Zn (34.31±2.5 mg kg^{-1}) and an average value for Zn is 80.58±40.40 mg kg^{-1}.

As shown in Figure 3, soil measures have shown us there is some important exceed values in the study. For 20-40 cm depth; For Cd, every study points exceed the reference (Kabata-Pendias and Mukherjee, 2007; Yalcin et al., 2020) value which is 0.5 mg kg^{-1}, the highest value was found at the point 6 for Cd (13.04±1.8 mg kg^{-1}) and the lowest value was found at the point 15 for Cd (3.35±0.3 mg kg^{-1}) and an average value for Cd is 6.16±2.59 mg kg^{-1}. For measures of Cr, 9 study points exceed the reference value (Barker and Pilbeam, 2015; Yalcin et al., 2020). The highest value was found at the point 2 for Cr (110.81±63.6 mg kg^{-1}) and the lowest value was found at the point 10 for Cr (22.48±2.9 mg kg^{-1}) and the average of Cr value is 60.52±27.52 mg kg^{-1}. For measures of Cu, all study points exceed the reference (Kabata-Pendias and Pendias, 2001; Dimitrijević et al., 2016) value, the reference value for Cu is 16.78 mg kg^{-1} and the highest value was found at the point 14 for Cu (49.12±18.6 mg kg^{-1}) and the lowest value was found at the point 13 for Cu (17.80±5.4 mg kg^{-1}) and average of Cu value is 31.43±10.67 mg kg^{-1}. For Ni every study point exceeds the reference (Barker and Pilbeam, 2015; Yalcin et al., 2020) value which is 20 mg kg^{-1}, the highest value was found at point 6 for Ni (83.01±6.3 mg kg^{-1}) and the lowest value was found at the point 10 for Ni (24.28±2.9 mg kg^{-1}) and an average value for Ni is 44.77±16.44 mg kg^{-1}. For Pb, over half of the study points exceed the reference (Kabata-Pendias and Mukherjee, 2007; Yalcin et al., 2020) value which is 25 mg kg^{-1}, the highest value was found at the point 6 for Pb (178.60±12.3 mg kg^{-1}) which is high values.

4. Conclusion

The intersections and the refuges where we are conducting our work are passively green and not actively used by people. Therefore, it is not possible to be directly affected by the pollution that occurs in such areas. However, the soil results show us that there is a very important and dangerous situation that may arise from time to time. The heavy metal values found at the study points are much higher than the exception we selected and at some points already affect heavy metals and some metals have already found all points such as Cd 10 times higher than the reference (Yalcin et al., 2020).

The important thing is that we have passive green areas, especially in cities such as Istanbul, due to the analyzes that have shown us that trees affected, urban life and increasing population every day. As previous studies have shown us that urban life is returning, like cars and factories and they increase the concentration of heavy metals over time.

This study is particularly important for some high heavy metal concentrations (such as P6 for Pb at 20-40 cm or P1 for Ni at 0-20 cm), considerations for subsequent studies. Anyway, as we know, soil deposits could be a thing of the past and could stabilize now, to be sure the analysis should continue at the same points with the methods.

Heavy metals accumulate in the soil causing irreversible soil pollution and affecting the health of all living things. For this reason, necessary precautions should be taken and such studies should be repeated at certain intervals to prevent and control soil pollution.

As a result, it is seen that heavy metal pollution is not in dangerous levels due to the heavy metal concentrations in the general soil of the Anatolian side of Istanbul except Southwest, North and northwest parts for now but the results of soils are threatening and must repeat and improve studies under future technologies and knowledge.

References

Agomuo, E. N., & Amadi, P. U. (2017). Accumulation and toxicological risk assessments of heavy metals of top soils from markets in Owerri, Imo state, Nigeria. *Environmental Nanotechnology, Monitoring & Management, 8*, 121-126.

Aksoy, A., & Ozturk, M. (1996). *Phoenix dactylifera* L. as a biomonitor of heavy metal pollution in Turkey. *Journal of Trace and Microprobe Techniques*, *14*(3), 605-614.

Aksoy, A., & Sahin, U. (1999). *Elaeagnus angustifolia* L. as a biomonitor of heavy metal pollution. *Turkish Journal of Botany*, *23*(2), 83-88.

Aksoy, A., Hale, W. H., & Dixon, J. M. (1999). *Capsella bursa-pastoris* (L.) Medic. as a biomonitor of heavy metals. *Science of the Total Environment*, *226*(2-3), 177-186.

Barker, A. V., & Pilbeam, D. J. (2015). *Handbook of plant nutrition*. (pp. 1-773). CRC press.

Bediako, J. K., Wei, W., Kim, S., & Yun, Y. S. (2015). Removal of heavy metals from aqueous phases using chemically modified waste Lyocell fiber. *Journal of Hazardous Materials*, *299*, 550-561.

Celik, A., Kartal, A. A., Akdogan, A., & Kaska, Y. (2005). Determining the heavy metal pollution in Denizli (Turkey) by using *Robinio pseudoacacia* L. *Environment International*, *31*(1), 105-112.

Charlesworth, S., Everett, M., McCarthy, R., Ordonez, A., & De Miguel, E. (2003). A comparative study of heavy metal concentration and distribution in deposited street dusts in a large and a small urban area: Birmingham and Coventry, West Midlands, UK. *Environment International*, *29*(5), 563-573.

Das, S., Lee, S. H., Kumar, P., Kim, K. H., Lee, S. S., & Bhattacharya, S. S. (2019). Solid waste management: scope and the challenge of sustainability. *Journal of Cleaner Production*, *228*, 658-678.

Dhakal, B., & Kattel, R. R. (2019). Effects of global changes on ecosystems services of multiple natural resources in mountain agricultural landscapes. *Science of the Total Environment*, *676*, 665-682.

Dimitrijević, M. D., Nujkić, M. M., Alagić, S. Č., Milić, S. M., & Tošić, S. B. (2016). Heavy metal contamination of topsoil and parts of peach-tree growing at different distances from a smelting complex. *International Journal of Environmental Science and Technology*, *13*(2), 615-630.

Dzierzanowski, K., Popek, R., Gawrońska, H., Sæbø, A., & Gawroński, S. W. (2011). Deposition of particulate matter of different size fractions on leaf surfaces and in waxes of urban forest species. *International*

Journal of Phytoremediation, *13*(10), 1037-1046.

Guvenc, N., Alagha, O., & Tuncel, G. (2003). Investigation of soil multi-element composition in Antalya, Turkey. *Environment International*, *29*(5), 631-640.

Hawkins, S. J., O'Shaughnessy, K. A., Adams, L. A., Langston, W. J., Bray, S., Allen, J. R., & Firth, L. B. (2020). Recovery of an urbanised estuary: Clean-up, de-industrialisation and restoration of redundant dock-basins in the Mersey. *Marine Pollution Bulletin*, *156*, 111150.

Herojeet, R., Rishi, M. S., & Kishore, N. (2015). Integrated approach of heavy metal pollution indices and complexity quantification using chemometric models in the Sirsa Basin, Nalagarh valley, Himachal Pradesh, India. *Chinese Journal of Geochemistry*, *34*(4), 620-633.

Hoang, H. G., Lin, C., Tran, H. T., Chiang, C. F., Bui, X. T., Cheruiyot, N. K., & Lee, C. W. (2020). Heavy metal contamination trends in surface water and sediments of a river in a highly-industrialized region. *Environmental Technology & Innovation*, 101043.

Hogan, C. M. (2010). Heavy metal. Encyclopedia of Earth. National Council for Science and the Environment. Eds E. Monosson & C. Cleveland, Washington DC. https://editors.eol.org/eoearth/index.php?title=Special%3ASearch&profile=default&search=heavy+metal&fulltext=Search, Last accessed on September 2020.

Jaradat, Q. M., & Momani, K. A. (1999). Contamination of roadside soil, plants, and air with heavy metals in Jordan, a comparative study. *Turkish Journal of Chemistry*, *23*(2), 209-220.

Kabata-Pendias, A. & Pendias, H. (2001). *Trace elements in soils and plants*. 3rd ed., (pp. 1-432). CRC Press, Boca Raton New York, Washington, D.C.

Kabata-Pendias, A. & Mukherjee, A. B. (2007). *Trace elements from soil to human*. (pp. 1-550). Springer, Berlin Heidelberg, New York.

Karaca, F., Alagha, O., & Erturk, F. (2005). Statistical characterization of atmospheric PM_{10} and $PM_{2.5}$ concentrations at a non-impacted suburban site of Istanbul, Turkey. *Chemosphere*, *59*(8), 1183-1190.

Karahan, F., Ozyigit, I. I., Saracoglu, I. A., Yalcin, I. E., Hocaoglu-Ozyigit, A., & Ilcim, A. (2020). Heavy metal levels and mineral nutrient status in different parts of various medicinal plants collected from eastern Mediterranean region of Turkey. *Biological Trace Element Research*, *197*, 316-329.

Kashem, M. A., & Singh, B. R. (1999). Heavy metal contamination of soil and vegetation in the vicinity of industries in Bangladesh. *Water, Air, and Soil Pollution*, *115*(1-4), 347-361.

Keshavarzi, B., Najmeddin, A., Moore, F., & Moghaddam, P. A. (2019). Risk-based assessment of soil pollution by potentially toxic elements in the industrialized urban and peri-urban areas of Ahvaz metropolis, southwest of Iran. *Ecotoxicology and Environmental Safety*, *167*, 365-375.

Lee, C. S. L., Li, X., Shi, W., Cheung, S. C. N., & Thornton, I. (2006). Metal contamination in urban, suburban, and country park soils of Hong Kong: a study based on GIS and multivariate statistics. *Science of the Total Environment*, *356*(1-3), 45-61.

Li, B., Huang, H., Sun, Z., Zhao, N., Munir, T., Yu, W., & Young, B. (2020). Minimizing heavy metals in recovered struvite from swine wastewater after anaerobic biochemical treatment: reaction mechanisms and pilot test. *Journal of Cleaner Production*, 122649.

Martínez-López, J., Carreño, M. F., Palazón-Ferrando, J. A., Martínez-Fernández, J., & Esteve, M. A. (2014). Remote sensing of plant communities as a tool for assessing the condition of semiarid Mediterranean saline wetlands in agricultural catchments. *International Journal of Applied Earth Observation and Geoinformation*, *26*, 193-204.

McDonald, A. G., Bealey, W. J., Fowler, D., Dragosits, U., Skiba, U., Smith, R. I., & Nemitz, E. (2007). Quantifying the effect of urban tree planting on concentrations and depositions of PM_{10} in two UK conurbations. *Atmospheric Environment*, *41*(38), 8455-8467.

Mingorance, M. D., Valdes, B., & Oliva, S. R. (2007). Strategies of heavy metal uptake by plants growing under industrial emissions. *Environment International*, *33*(4), 514-520.

Ozdemir, H. (2019). Mitigation impact of roadside trees on fine particle pollution. *Science of the Total Environment*, *659*, 1176-1185.

Ozdemir, H., Pozzoli, L., Kindap, T., Demir, G., Mertoglu, B., Mihalopoulos, N., & Unal, A. (2014). Spatial and temporal analysis of black carbon aerosols in Istanbul megacity. *Science of the Total Environment*, *473*, 451-458.

Ozturk, A., Yarci, C., & Ozyigit, I. I. (2017). Assessment of heavy metal pollution in Istanbul using plant (*Celtis australis* L.) and soil assays. *Biotechnology & Biotechnological Equipment*, *31*(5), 948-954.

Ozyigit, I. I., Uras, M. E., Yalcin, I. E., Severoglu, Z., Demir, G., Borkoev, B., ... & Solak, A. O. (2019). Heavy metal levels and mineral nutrient status of natural walnut (*Juglans regia* L.) populations in Kyrgyzstan: nutritional values of kernels. *Biological Trace Element Research*, *189*(1), 277-290.

Ozyigit, I. I., Yalcin, B., Turan, S., Saracoglu, I. A., Karadeniz, S., Yalcin, I. E., & Demir, G. (2018). Investigation of heavy metal level and mineral nutrient status in widely used medicinal plants' leaves in Turkey: Insights into health implications. *Biological Trace Element Research*, *182*(2), 387-406.

Piczak, K., Leśniewicz, A., & Żyrnicki, W. (2003). Metal concentrations in deciduous tree leaves from urban areas in Poland. *Environmental Monitoring and Assessment*, *86*(3), 273-287.

Ronchi, S., Salata, S., Arcidiacono, A., Piroli, E., & Montanarella, L. (2019). Policy instruments for soil protection among the EU member states: A comparative analysis. *Land Use Policy*, *82*, 763-780.

Serbula, S. M., Kalinovic, T. S., Ilic, A. A., Kalinovic, J. V., & Steharnik, M. M. (2012). Assessment of airborne heavy metal pollution using *Pinus* spp. and *Tilia* spp. *Aerosol and Air Quality Research*, *13*(2), 563-573.

Sezgin, N., Ozcan, H. K., Demir, G., Nemlioglu, S., & Bayat, C. (2004). Determination of heavy metal concentrations in street dusts in Istanbul E-5 highway. *Environment International*, *29*(7), 979-985.

Ugulu, I., Dogan, Y., Baslar, S., & Varol, O. (2012). Biomonitoring of trace element accumulation in plants growing at Murat Mountain. *International Journal of Environmental Science and Technology*, *9*(3), 527-534.

Unal, Y. S., Sonuc, C. Y., Incecik, S., Topcu, H. S., Diren-Ustun, D. H., & Temizoz, H. P. (2020). Investigating urban heat island intensity in Istanbul. *Theoretical and Applied Climatology*, *139*(1-2), 175-190.

Uyar, G., Avcil, E., Oren, M., Karaca, F., & Oncel, M. S. (2009). Determination of heavy metal pollution in Zonguldak (Turkey) by moss analysis (*Hypnum cupressiforme*). *Environmental Engineering Science*, *26*(1), 183-194.

Yalcin, I. E., Ozyigit, I. I., Dogan, I., Demir, G., & Yarci, C. (2020). Using the Turkish red pine tree to monitor heavy metal pollution. *Polish Journal of Environmental Studies*, *29*(5), 3881-3889.

Yener, S. H. (2007). The biomonitor characteristics of *Alcea pallida* Waldst. et Kit and *Hibiscus syriacus* L. (Malvaceae), Ph.D. Dissertation. Marmara University, Institute of Sciences, Istanbul-Turkey.

Yener, S. H., & Yarci, C. (2010). *Alcea pallida* Waldst. & Kit.(Malvaceae) as a heavy metal biomonitor in Istanbul (Turkey). *Fresenius Environmental Bulletin*, *19*(5a), 1024-1030.

Yin, X., Zhang, L., Harigai, M., Wang, X., Ning, S., Nakase, M., & Takeshita, K. (2020). Hydrothermal-treatment desorption of cesium from clay minerals: the roles of organic acids and implications for soil decontamination. *Water Research*, 115804.

Cite as: Turan, O., Ozdemir, H., & Demir, G. (2020). Deposition of heavy metals on coniferous tree leaves and soils near heavy urban traffic. *Front Life Sci RT*, *1*(1), 35-41.