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Detection of landscape species as a low-cost biomonitoring study: Cr, Mn, and Zn pollution in an urban air quality

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Abstract Urban air pollution in cities, among the world's most critical problems, has escalated to such an extent that it threatens human health in many urban centers and causes the death of millions every year. Trace metals are significant among the components of air pollution. Trace metals can endure long without undergoing biodegradation and bioaccumulation in living organisms. Moreover, their concentration in the air increases gradually. Therefore, monitoring metal concentration is extremely important for reliable indicators of environmental pollution. Biomonitoring is an effective method for describing metal concentrations in urban areas. Chromium, manganese, and zinc, selected within the present study, have various adverse effects on plants in high concentrations. Their identification is highly critical for monitoring the pollution level in their regions. This study aimed to determine the Cr, Mn, and Zn concentration changes according to organ, and age in *Elaeagnus angustifolia* L., *Platanus orientalis* L., *Koelreuteria paniculata* Laxm, *Ailanthus altissima* (Mill.) Swingle, and *Cedrus atlantica* (Endl.) Manetti ex Carr is 30 years old. The accumulation of metals in the outer bark can be found as follows Zn > Mn > Cr in all species, although *Ailanthus altissima* (Mill.) Swingle and *Platanus orientalis* L. can be suitable for biomonitoring tools because concentrations change significantly depending on the airborne metal.

Keywords Air pollution · Biomonitor · Trace metals · Landscape trees

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Introduction

The environmental index argues that urban air quality is deteriorating with increased anthropogenic pollutants (Lin & Zhu, 2018). In some cities, the damage is caused by severe environmental pressure, densely populated, and constantly consuming fossil fuels, including mechanical movements. They seriously affect humans and various living things due to increased urbanization rate can improve air quality. The plants face severe urban air pollution, so the amount of metal accumulation comes with their location (Amato-Lourenco et al., 2017). Landscape trees that accumulate trace metals in their bodies are used as biomonitors in urban environments (Markert et al., 1999; Yilmaz & Isinkaralar, 2021). However, it has not yet been precisely determined which living organisms are the most suitable biomonitors (Weinstein & Davison, 2003). It could be said that trees are likely suitable biomonitors. However, the major problem is easy sampling, as effective biomonitors. Also, it cannot be approximated how long these living things have been exposed to metal pollution (Isinkaralar et al., 2022). Therefore, it will not be possible to know accurately how long the trace metal concentration obtained through research has been accumulated, and it casts doubt on the reliability of the data about different pathways (Aboal et al., 2010). Urban areas have been claimed as sources of trace metal due to atmospheric dry and wet deposition (Kuang et al., 2007; Turkyilmaz et al., 2019; Türtscher et al., 2017).

Several species must possess certain qualities to be a biomonitor for air pollution (Marié et al., 2016). These biomonitor types, which should not be affected by exposure to air pollution, are requested not to be sensitive. Moreover, it should easily withstand stress or harsh conditions (Isinkaralar, 2022a; Turkyilmaz et al., 2018). Perhaps the first condition for biomonitoring is to be a durable and spreading species (Wannaz et al., 2012). It is also necessary to grow in the same conditions in the same region for many years and have been exposed to pollutants (Mahapatra et al., 2019). Due to the accumulation in its organs, its direction and texture are examined to easily detect environmental pollutants (Bajpai et al., 2009; Paoli et al., 2019; Turkyilmaz et al., 2020). The most important reason for using trees extensively is that they tend to contain various elements in amounts that are much more than their own needs. For example, it is stated that trees readily absorb more toxic metals than other plants (Salemaa et al., 2004). They have also extensively used biomonitoring the change of other metal pollution over time (Torres et al., 2008). Researchers have been using biomonitors since the 1970s (Lehndorff & Schwark, 2009; Stanković et al., 2018). First, it cannot be determined how long these plants have been exposed to the pollution factor. When this situation is evaluated, the time interval when the determined values of a metal concentration accumulated cannot be precisely known. This situation causes the reliability of the obtained data to be questionable. The accumulation in the organs shows the direction and amount of the pollutants and gives information about the pollutant sources (Bonanno & Orlando-Bonaca, 2017; González et al., 1996). In developed countries, trace metal emissions are less than in developing countries due to the low emissions from traffic or industry (reducing or cutting anthropogenic sources). Following trace metal emissions in developing countries is essential due to the lack of environmental practices and regulations. Since it is a complicated multi-sensor system and costly to monitor instantly, regional accumulation is followed with the help of various species (Al Barakeh et al., 2017; Gualtieri et al., 2017). Although monitoring environmental pollutants is booming locally, studies have stated that it is complex and challenging globally (Suchara et al., 2017). Success has been achieved by the more effective use of the data obtained against the different adsorbing abilities of other species growing in the natural environment (in the same conditions, the same climate, and stress) and the inclusion of these species in the studies. Thanks to the species' success in adsorbing different metals, it aims to reduce emissions from traffic or industry (Moreno et al., 2003).

Among metals related to traffic (Cr and Zn) and industrial activities (Mn) are mentioned by many scholars (Kabir et al., 2012; Kumar et al., 2020; Zhou et al., 2014). Brake wear, tire wear, fossil fuel, petrochemical products, engine oil throwing away, and traffic-related have been reported in the literature (Huang et al., 2021; Mayer, 1999; Panko et al., 2019). Several metals can be present in urban environments as airborne particulates, sediments, road dust, soils, etc. Urban plants have been accumulated as nature magnets to help provide information on the local environmental pollution and atmospheric trace deposition (King et al., 2014; Xing & Brimblecombe, 2019). In some cases, the growth of other plants to be taken from the same region in the same soil structure under the same climatic conditions for many years helps to increase the trace metal concentration it can adsorb (Kularatne & De Freitas, 2013; Shanker et al., 2005). For many reasons, the importance of biological monitoring is rising. It is vital for local governments and institutions looking at an environment-climate change to use perennial plants used in landscape planting as biomonitors. This passive biomonitoring study aims to assess the organs of *Elaeagnus angustifolia* L., *Platanus orientalis* L., *Koelreuteria paniculata* Laxm, *Ailanthus altissima* (Mill.) Swingle, and *Cedrus atlantica* (Endl.) Manetti ex Carr. They will have a significant role in determining metal concentrations in the recent past. This study aimed to determine the trace metal concentrations of the recent history in the trees grown in Ankara at different locations and ages. Thus, it was attempted to determine whether the species had the potential to be used in monitoring trace metal concentrations that might occur due to air pollution in the recent past.

Materials and methods

Sampling area

The study has been carried out in high traffic areas (urban transportation and private cars) from the roadside of Etlik street, Keçiören, located in Ankara, Türkiye. Tree samples were collected during October 2020, when the vegetation period was over and the geographic coordinates from 39°57′ N–32°50′ E to 39°59′ N–32°49′ E. It was taken from the parts facing the traffic from the landscape area (2.5 m to roads) at the intersection of Etlik streets and the connection point to the main roads of Ankara. Due to the region's residential and commercial centers' density, vehicle traffic activity is relatively high. Long queues of vehicles, especially during business entry and exit times, increase emissions. Different types of landscape plant samples collected from the parks, some commercial and residential landscapes in the middle median on this street, along the roadsides, were divided into four districts for distribution of traffic (low or high intensity) and species.

Selected species and sampling

Performing the biomonitor study area should be determined first as the target area due to the target pollutants. The pollutant was monitored and tracked, and the target pollutant mass was estimated in this area. In this context, determine the species that best retain the target metals. Then, considering the wind direction and intensity of the oscillating sources (to which region the dominant wind carries pollutants more frequently), the study was started with the help of factors such as spot detection. A total of 63 samples were obtained for five different species planted simultaneously and grown in the same soil structure and climatic conditions collected as landscape plants in Table 1. They are extensively used for landscaping highways in city centers, parks, gardens, etc. These selected landscape trees were taken from a landscaped area (road) on the side of the main road with high traffic. The species were treated in the laboratory and classified according to their names and range of age (all species as 30 years).

Table 1 The sample ID number for Cr, Mn, and Zn analysis in selected landscape species

Selected species	Sample ID
Elaeagnus angustifolia L	S1
Platanus orientalis L	S2
Koelreuteria paniculata Laxm	S3
Ailanthus altissima (Mill.) Swingle	S4
Cedrus atlantica (Endl.) Manetti ex Carr	S5

The samples of all trees taken from the road interior side brought to the laboratory were and were not washed. The samples were kept at room temperature for 15 days until they dried. Then, the samples were ground into powder, weighed 0.5 g, and placed in special tubes designed for microwave use. Ten milliliter of 65% HNO_3 (65%, Merck) was added to the samples and burned in a microwave at 280 PSI and 180 °C for 20 min. After the tubes cooled down following their removal from the microwave (Ethos One, Milestone GmbH, Germany), distilled water was added to fill up to 50 mL according to US EPA 3052 Method (United States Environmental Protection Agency (USEPA) 1996). Then, the element concentrations in the samples filtered through the filter paper were read at the appropriate wavelengths in the inductively coupled plasma optical emission spectrometry (ICP-OES, SpectroBlue, Spectro, Analytical Instruments GmbH, Germany). Analysis of metal concentrations was determined in axial viewing mode after multiplying the obtained values with the dilution factor by the EPA Method 6020B (United States Environmental Protection Agency (USEPA) 2013). All measurements were done in three concentrations obtained at the two wavelengths that, for all analytes (differed by less than 5%). The repeatability of the whole method calculated as relative standard deviation (RSD %) of three independent analyses of the same sample was less than 10%.

Statistical analyses

The data obtained from the analysis results were evaluated concerning 1991–2020 by using the SPSS (version 22.0) packaged software for Windows. The F value, error rate, and thus the difference of the factors were determined at the 95% confidence level by applying variance analysis of one-way ANOVA to the data, followed by Duncan's test for the factors with statistically significant differences at the 95% confidence level. The obtained results were interpreted after simplifying and tabulating.

Table 2 The accumulation of the Cr (ppb) concentration in landscape plants

Organ	S1	S2	S3	S4	S5	*F* value
Outer bark	2483.3 B	4176.1 Dc	1899.8 Ac	3937.6 Cb	3914.7 Cc	8819.2***
Inner bark	964.8 A	1162 Cb	1045.1 Bb	1180.5 Ca	1029.6 Bb	181.7***
Wood	1405.4 B	986.8 Aa	893.6 Aa	1004.2 Aa	911.6 Aa	8.6***
***F* value**	3.3 ns	1399.1***	965.4***	276.6***	6602.9***	

ns not significance; and the letters a, b, c, etc., according to Duncan's test results, show that the group is located. It is statistically different from the values in other groups; starting with the letter, a numerical value grows

*** indicate $p < 0.001$

Results

The ANOVA results of the change of Cr, Mn, and Zn concentrations in the species are examined that it is statistically significant at a 99.9% confidence level in all the areas.

Adsorbed Cr concentrations in several species

The mean Cr concentration in the organ was measured as seen in Table 2 which shows the accumulation of Cr concentration by several species.

In all four species, the lowest concentrations were obtained in wood, the highest in the outer bark. When the values are examined, it is seen that there is a fourfold difference between the Cr concentrations in the wood and outer bark in S2, S4, and S5. When the Duncan test results are examined, it is seen that the lowest value in outer bark is in S3, the highest in S2. In the inner bark, the lowest values are in S1 and the highest values in S2 and S4. Two groups were formed as a result of Duncan's test in wood, type 1 with the lowest value was in the second group, and all other species were in the first group in Table 3.

It is statistically different from the values in other groups; starting with the letter, a numerical value grows.

As a result of the analysis of variance, it was determined that the changes in the Cr concentration were statistically significant ($p < 0.001$) in all species and based on species in all years. When the values are examined that the value of 3702.4 ppb was obtained only in the woods formed in 1991–1993. The Cr concentration changed in a narrow range (855.9–1771.4 ppb). There is no significant change in species either year or year. However, in general, it is seen that the highest values are obtained in S1.

Adsorbed Mn concentrations in several species

The concentrations of Mn in the organ and its deposition level are given in Table 4. It shows the accumulation of Mn concentration in different species by year intervals in Table 5.

It is statistically different from the values in other groups; starting with the letter, a numerical value grows.

Table 3 Variation of the Cr (ppb) concentration in the landscape plants for years

Years	S1	S2	S3	S4	S5	*F* value
2018–2020	1562.5 Df	997.1 Cd	944.8 Ab	859.4 Aab	949.9 Bf	4780.9***
2015–2017	1771.4 Dg	1016.4 Ce	906.7 Ab	894.5 Ab	956.5 Bf	1725.6***
2012–2014	1008.9 Cc	1003.2 Cde	911.1 Bb	1566.4 Df	874.8 Ab	3175.9***
2009–2011	889.9 Ba	917.1 Ca	866.2 Aa	1222.1 De	859.3 Aa	818.9***
2006–2008	960.1 Cb	907.2 Ba	857.2 Aa	966.7 Cc	903.8 Bd	70.9***
2003–2005	1050.6 Dd	944.1 Cb	913.3 ABb	892.2 Aab	924.5 BCe	81.4***
2000–2002	918.1 Ba	1276.1 Cf	858.1 Aa	855.9 Aa	877.2 Abc	727.1***
1997–1999	1057.2 Dd	924.5 Ca	891.9 Bb	868 Aab	889.8 Bc	131.4***
1994–1996	1132.7 Ee	907.1 Ca	856.8 Aa	892.4 Bab	1005 Dg	729.1***
1991–1993	3702.4 Ch	974.8 Bc	981 Bc	1024.4 Bd	874.8 Ab	3818.5***
***F* value**	5317.9***	335.2***	34.3***	406.1***	114.3***	

*** indicate $p < 0.001$, and the letters a, b, c, etc., according to Duncan's test results, show that the group is located

Table 4 The accumulation of the Mn (ppb) concentration in landscape plants

Organ	S1	S2	S3	S4	S5	*F* value
Outer bark	25079.2 Ac	32774.3 Bc	39166.7 Cc	49260.8 Dc	49797.9 Ec	33754.3***
Inner bark	11296 Cb	9878.2 Bb	13501.8 Db	7497.2 Ab	32127.1 Eb	196352.1***
Wood	4880.6 Ca	1959.6 Aa	3081.4 Ba	2770.6 Ba	2029.1 Aa	21.3***
***F* value**	1115.1***	25023.9***	1389.7***	494.8***	5329.5***	

*** indicate $p < 0.001$, and the letters a, b, c, etc., according to Duncan's test results, show that the group is located

The variation of Mn concentration on an organ basis in all species was listed as wood < inner bark < outer bark. When the values are examined, it is remarkable that there is a difference of more than 24.5 times between wood and outer bark in S5. When the changes based on species are examined, it is seen that the lowest values were obtained in S1 in the outer bark and in S4 in the inner bark, while the highest values were obtained in S5 in the woods. On the other hand, it is seen that the lowest values in wood are obtained in S5 and S2 and the highest values in S1.

It is statistically different from the values in other groups; starting with the letter, a numerical value grows.

The variance analysis of Mn concentration determined that the changes based on year and species in all species were statistically significant ($p < 0.001$). While the highest values were obtained in S4 (10,356.4 ppb) in 2012–2014, it is noteworthy that the highest values were obtained in S1 in all years except 2012–2014 and 2009–2011. Apart from this, although the concentrations obtained in S5 were high until 1999, it is seen that the lowest values were obtained in S2 and S5 in general after this date. Another remarkable point is that there is no significant difference between the concentrations obtained in S2 and S4 woods in different years. In other species, there is a considerable difference between the concentrations obtained in different years.

Adsorbed Zn concentrations in several species

In this research's rank of Zn concentration in the organ is given in Table 6. It shows the accumulation of Zn concentration by various species. The Zn values had the maximum, and the highest mean belonged to all species over the years in Table 7.

It is statistically different from the values in other groups; starting with the letter, a numerical value grows.

As in Mn, the variation of Zn concentration on an organ basis in all species is listed as wood < inner bark < outer bark. When the values are examined, it is remarkable that there is an 18-fold difference between wood and outer bark in S4. When the changes based on species are discussed, the lowest values were obtained in S1 in the outer bark and S4 in the inner bark. The highest values were obtained in S3 in the

Table 5 Variation of the Mn (ppb) concentration in the landscape plants for years

Years	S1	S2	S3	S4	S5	*F* value
2018–2020	4855 De	2427.7 Ci	3772.6 Ch	1606.8 Bc	1124.8 Aa	91962.8***
2015–2017	6468.2 Ej	1936.4 Bf	3693.5 Dh	2632 Ci	1188.4 Ab	131053.8***
2012–2014	4182.4 Dc	1935.9 Bf	3618.1 Cg	10,356.4 Ej	1806.1 Af	268140.4***
2009–2011	3882.3 Da	1682.9 Ab	6054.6 Ei	2569.2 Ch	2066.5 Bg	160279.7***
2006–2008	4985.1 Df	1859.2 Bc	2431.6 Cd	1693.7 Ad	1696.1 Ae	57636.2***
2003–2005	5487.6 Di	1875.8 Bd	1890.1 Ba	2247.2 Cg	1400.4 Ac	104508.4***
2000–2002	5243.2 Eg	2005.3 Cg	2125.2 Db	1534.4 Ab	1443.9 Bd	54810.8***
1997–1999	5364.9 Eh	1910.8 Be	2543.6 Ce	1861.5 Af	3665.2 Di	158393.5***
1994–1996	4115.5 Eb	1621.7 Ba	2338.1 Cc	1472.1 Aa	3812.4 Dj	24702.9***
1991–1993	4221.5 Ed	2340.8 Ch	3037.6 Df	1732.7 Ae	2087.2 Bh	20516.3***
***F* value**	10349.1***	5939.9***	48275.7***	139280.6***	48481.7***	

*** indicate $p < 0.001$, and the letters a, b, c, etc., according to Duncan's test results, show that the group is located

Table 6 Variation of the Zn (ppb) concentration in the needles

Organ	S1	S2	S3	S4	S5	*F* value
Outer bark	15784.4 Bc	14822.1 Ac	30200.3 Ec	27959.6 Dc	17019.2 Cc	21247.8***
Inner bark	6579.1 Db	11,409.8 Eb	6483.4 Cb	3360.1 Ab	5355.8 Bb	42476.9***
Wood	2912.4 Ba	2846.2 Ba	2828.2 Ba	1560.2 Aa	2597.6 Ba	6.4***
***F* value**	78.1***	128.5***	837.1***	8045.1***	2647.6***	

*** indicate $p < 0.001$, and the letters a, b, c, etc., according to Duncan's test results, show that the group is located

outer bark and S2 in the inner bark. As for wood, two groups were formed as a result of Duncan's test, S4, where the lowest value was obtained and was in the first group, and all other species were in the second group.

It is statistically different from the values in other groups; starting with the letter, a numerical value grows.

As a result of the analysis of variance, it was determined that the Zn concentration in all species was statistically significant ($p < 0.001$). When the variation of Zn concentrations based on species and year is examined, it is seen that the highest values were obtained in S1 until 1999. Mn concentration, which was at a very low level until 2012, increased rapidly after this date, and the highest values obtained after 2015 were obtained in S2. The values obtained in S3 seem to be quite variable. In addition to this, there is no major difference between Zn concentrations in S4 and S5. The Zn concentration ranges between 1091.9–2471.6 ppb in S4 and 1946.1–3011.6 ppb in S5. This shows that the displacement rate of Zn in the wood in S4 and S5 is quite high.

Discussion

Biomonitoring studies have been carried out on Cr, Mn, and Zn concentrations in several species, which correspond with those reported in the literature by some authors (Blake & Goulding, 2002; Senhou et al., 2002; Cetin et al., 2020). The concentrations of Cr, Mn, and Zn found in this study were significantly similar to values reported from Isinkaralar (2022b). In its research, *Cupressus arizonica*, *Platanus orientalis*, and *Robinia pseudoacacia* were selected as biomonitoring studies for Al, Cr, and Mn concentrations in İzmit, Turkiye. This location has some industrial activities and releases many trace metals into the air. A biomonitoring study showed that the most suitable species is *Robinia pseudoacacia* although *Platanus orientalis* is prone to deposited Cr and Mn concentrations for biomonitoring purposes. Key et al. (2022) studied Cd, Fe, and Al concentrations of the annual rings of a 180-year-old *Corylus colurna* L. in Müsellimler Village of Ağlı district in Kastamonu. They found almost no transfer between organs and cells of the

Table 7 Variation of the Zn (ppb) concentration in the landscape plants for years

Years	S1	S2	S3	S4	S5	*F* value
2018–2020	2250.4 Ae	5347.6 Di	4653.1 Ch	2471.6 Cg	2434.1 Bd	18422.5***
2015–2017	2233.8 Ce	6089.2 Ej	4573.8 Dh	1334.2 Ac	1946.1 Ba	81770.3***
2012–2014	2168.2 Bd	3092.9 Dh	3293.8 Ef	1527.2 Ad	2398.1 Cc	12173.3***
2009–2011	2059.2 Bc	2181.6 Cd	2184.6 Cd	1279.1 Ab	3010.5 Di	3880.6***
2006–2008	999.2 Aa	2640.9 Dg	4636.2 Ei	1091.9 Ba	2194.3 Cb	8903.8***
2003–2005	1133.1 Ab	2323 Df	1780.6 Cc	1583.2 Be	2852.3 Eg	7586.2***
2000–2002	2313.4 Cf	2261.1 Be	1587.7 Ab	1591.4 Ae	2951.4 Dh	6814.4***
1997–1999	4513.2 Eh	1582.7 Cc	1430.9 Aa	1539.6 Bd	2618.9 Df	14661.9***
1994–1996	4110.4 Eg	1445.2 Aa	3484.6 Dg	1824.1 Bf	2558.6 Ce	7863.8***
1991–1993	7343.1 Ei	1497.9 Bb	2482.1 Ce	1360.4 Ac	3011.6 Di	57711.6***
***F* value**	95281.4***	24655.1***	9202.4***	797.7***	3648.1***	

*** indicate $p < 0.001$, and the letters a, b, c, etc., according to Duncan's test results, show that the group is located

Corylus colurna, which has Cd concentration ranged within a narrow band in its organs. Madejón et al. (2004) selected *Populus alba* as a biomonitor of trace elements (As, Cd, Cu, Fe, Mn, Ni, Pb, and Zn) in the soil and atmosphere in south Spain. Some trace metals positively correlate with their accumulation in leaves and availability in deep soil, although Nickel has the lowest correlation. Mohiuddin et al. (2014) assessed selected trace metals (Ti, V, Cr, Mn, Fe, Co, Ni, Cu, and Zn) from iron and steel facilities zones in Australia (four sampling sites) via atmospheric particles. They found that trace metal concentrations were higher in iron and steelmaking industry sites and positively correlated with some metals. Koç (2021) studied Ni and Co concentrations by the annual rings of *Cedrus atlantica* in Kışla Park, Kastamonu. It found that *Cedrus atlantica* was a proper biomonitor tool for change of trace metal accumulation. Petrova et al. (2014) collected leaves of some trees (*Acer platanoides* L., *Aesculus hippocastanum* L., and *Betula pendula* Roth.) in Plovdiv, Bulgaria, to analyze Cd, Cr, Cu, Fe, Pb, and Zn concentration by ICP–MS. Vianna et al. (2011) investigated heavy metal concentration in the atmosphere in Brazilian urban areas with *Tillandsia usneoides*. When samples taken from various regions were examined, it was seen that heavy metals were absorbed because of human activities rather than any mining area. Because heavy metals spread to the environment then accumulation on species that comes with the particulate matter with trace metals are highly toxic to human health. Kardel et al. (2018) analyzed unwashed and washed leaves of three evergreen species as *Chamaecyparis lawsoniana*, *Ligustrum japonicum*, and *Pinus brutia* subsp. *eldarica* (Medw) Silba. They obtained chemical compositions of roadside tree leaves in different site data and applied a two-way analysis of variance and Tukey-HSD test. While the roadside species can hold more metal on them, it has been observed that the adhesion rate decreases as they move away from the road (Isinkaralar, 2022c). In many studies, biomonitoring investigations carried out on many species and found the correlation becomes more substantial with the increase in traffic (Ahmida Saleh & Işınkaralar, 2022; Bayraktar et al., 2022; Boamponsem & de Freitas, 2017; Savas et al., 2021). Concentrations of trace metals are usually very high in traffic areas, which is the interaction effect of sampling sites by landscape plants.

Conclusion

The increase in the income level of people has led to an ascend in their environmental standards. So governments to take some environmental policies for continuous monitoring of pollutants. In this context, the ordinariness of tree species planted in large parks has consciously shifted to species. At the beginning of these was the widespread use of species that can absorb environmental pollutants. Thus, various species used in landscaping studies are considered quite reasonable in areas where environmental pollution is observed, depending on their ability to absorb pollutants and re-release. The biomonitoring method's success is sustainable, monitoring atmospheric pollution derived from primary fossil fuel use, industrial activities, and unplanned urbanization. Atmospheric deposition leads to the accumulation of the plants grown in the same polluted environment. Thus, they have different trace metal accumulation levels in their bodies due to hetero the genetic structure, which is not reasonably possible. The potential of plants to accumulate metals is closely related to plant metabolism. Therefore, in addition to genetic structure and environmental factors that affect plant metabolism, cultural processes such as plant stress level, hormone applications, pruning, shading, and fertilization can also affect plants' metal accumulation process. Using annual rings of the same tree or other organs as in that study can prevent errors caused by the genetic structure. Consequently, plants' trace metal accumulation process results from a complex mechanism defined by the interaction of various factors, and this mechanism has not yet been entirely resolved. In this study, the Cr concentration of *Ailanthus altissima* (Mill.), whose organs can sustain many years, was determined according to the organ and other factors. All trace metal concentrations changed significantly depending on the factors examined. The study results evaluated that the magnitude factors can cause a change in the metal concentrations in the recent past. It is envisaged to determine how the metal concentration in the air changes over time and the environmental effects of this change in highways, factories, and similar places with heavy industrial activities that cause toxic metal release. This sustainable method does not cause any vital damage to the plant from which the samples were taken. In future studies, *Ailanthus altissima*

(Mill.) and *Platanus orientalis* L. will be applicable for more motivated investigations of the relationship between trace metal accumulation and urban air pollution because they quickly adapt to the change in the trace metal concentration.

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Author contribution Emine Emel Yayla: Raw material collection, processing analysis, interpretation. Hakan Sevik: Thesis supervisor, processing analysis, interpretation. Kaan Isinkaralar: Conceptualization, software, writing original draft, data curation, formal analysis, review and editing.

Data availability The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Availability of data and materials Not applicable.

Declarations

Ethics approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

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