

Mapping heavy metal pollution in Tehran air using *Morus alba* tree leaves

Maryam Mollashahi^{a*}, Habib Alimohammadian^b, Seyed Mohsen Hosseini^c, Vahid Feizi^d,
Alireza, Riahi Bakhtiari^e

^a Department of forestry, Semnan University, Semnan, IRAN

^b Department of Geology and Mineral Explorer of IRAN, environmental magnetic laboratory, Tehran, IRAN

^c Department of forestry, Tarbiat Modares University, Tehran, IRAN

^d Young Researchers club, Central Tehran Branch, Islamic Azad University, Tehran, IRAN

^e Department of environment, Tarbiat Modares University, Tehran, IRAN

Received 15 June 2013

Accepted 26 November 2013

1. Introduction

Pollution can be defined as an undesirable change in the physical, chemical or biological characteristics of the air, water or land that can affect health, survival or activities of humans or other organisms. Air pollution is the biggest environmental problem in whole of the world that industrialization and increasing in number of city cause to increasing of its intensity. Tehran, one of the heavily-populated capitals and air pollution is known one of the environment problems for Tehran citizens during past recent century so this city today's is known one the pollutant city in the world. Some factors such as Tehran topography and climatology, population growth (more than 10 million person), increase in the number of motor vehicles (more than two million vehicles) as well as industrial expansion, cause to intensify of air pollution in this city. Also this city is a greatest industrial city in Iran and there are some Power plant, Refinery and chemical plants in it. In fact the important reason for Tehran air pollution is irregular consumption fuel fossil particular gasoline.

Particulate matter is considered one of the main sources of air pollution problems in Tehran. The emitted particles in the air for a while and then slowly deposited on exposed surfaces such as tree leaves. Heavy metal studies are necessary to evaluate air contamination. The problem of environmental pollution due to toxic metals has begun to cause concern now in most major metropolitan cities. The toxic heavy metals entering the ecosystem may lead to geo-accumulation, bio-accumulation and bio-magnifications. Heavy metals like Fe, Cu, Zn, Ni and other trace elements are important for proper functioning of biological systems and their deficiency or excess could lead to a number of disorders.

The road side tree leaves accumulate more particulate matter. Tree leaves are capable to absorption air pollution, so using plant for air pollution monitoring is known as an effective method.

Biomonitoring is one of inexpensive and simple method to concentration of heavy metals and air quality investigation. In this method living organism can be used to obtain environmental

* Corresponding author: Maryam Mollashahi. Tel: 00989112717355

E-mail: maryam.mollashahi@gmail.com

Archive of SID
data and its quality. *Morus alba* has large and flatten leaves surface that can accumulate large amount of precipitated atmospheric particles and have monotonous distribution in Tehran city, so this species are used to air pollution studies. Therefore trees have natural Bio filter role in pollutant cities. Traffic pollution has toxic material such as Pb, Cu, Cd that are so harmful for health of peoples.

The aim of this investigation is the ability of *Morus alba* leavesto deposition of pollution such as heavy metals As, Al, Cr, Co, Fe, Cu, Hg, Mn, Ni, Zn. At final will deal with to mapping air pollution using pollutant elements that deposited on *Morus alba* leaves.

2. Study Area

The metropolis of Tehran is the capital city of the province and of Iran also it is the biggest city of Iran. The northern parts which are adjacent to Alborz Mountains are clearly colder and more moderate than southern parts. The prevailing wind in western part of the city is generally from the west. It covers on area of 18,909 square kilometers and is located to the north of the central plateau of Iran. Tehran city has been divided in to 22 sectors and each sector has online digital air pollution monitoring display. The concentration of air pollution is mapped daily and the sampling sites were chosen on the base of these maps. The number of sampling sites in a sector is determined on the bases of the degree of air pollution in that sector, i.e. more pollution sector, more number of sampling sites in it.

3. Material and Methods

In this research for air measurement *Morus alba* that has a homogeneous spread in the Tehran city were chosen. Then heavy metals such as Al, As, Fe, Co, Cr, Cu, Mn, Ni, Pb, Zn were measured in the all of the 22 regions of Tehran. For this aim Sampling was carried out during a fifteen-day period. The highest pollution in Tehran city occur in autumn, sampling was done in September 2010. First of all, using Tehran's controlling air quality administration maps, high, low and medium air pollution regions was recognized. For this idea 100 sample points were selected in whole of the Tehran region.

As far as possible the sampling sites were distributed over an area in and around the of Tehran city. The *Morus alba* leaves species were chosen for this research. This species is distributed evenly across the whole of this city. Then tree leaves of the aforesaid species were collected from the Tehran and from around of highways and streets. Sampling was confined to branches, facing road.

Sampling were done in shiny days and at a height of 1–1.5 m above ground. In order to ensure the leaves were of similar-sized, leaves with 10–15 cm length were collected. Samples were put in pocket-size sealable plastic bags and all leaf samples were refrigerated at 5°C. The totals of 100 sampling sites were selected in urban administration of Tehran city. Three packages of leaves sample were collected at each sampling site, and total samples were 300.

Specimen preparation include: room temperature drying at closed system and powdering before measurement.

After sample preparation include: room temperature drying and powdering, sample were digested, then using ICP set amount of heavy metals were measured in leaves.

4. Heavy metals were measurements

Destruction procedures based on the use of a combination of HNO_3 and H_2O_2 are also commonly used for leaf plant analysis. Samples (1g) were weighed into 100 ml Pyrex beakers and treated with 10 ml concentrated HNO_3 (ultrapure 65%). The beaker was covered with a watch-glass and the suspension was heated up to 130°C for 1 h. A total amount of 4ml 20% H_2O_2 was added in aliquots of 1 ml. After cooling, the suspension was filtered in a 50-ml volumetric flask and diluted to the mark (Laing *et al.*, 2003). Then heavy metal concentrations were determinate by ICP method at geological survey of Iran.

Finally using GIS software, all of results were put to mapping air pollution. One of the systems which have appeared lately is Geospatial Information System (GIS). GIS is not only a system for creating, managing and analyzing graphic and attribute data, but also is a decision supporting system.

5. Results and Discussion

Results showed that most amount of the heavy metal centralized at central, south and east south of Tehran that include regions such as 9, 10, 11, 12, 14, 15, 16 and 17. Because of high traffic of vehicles, industrial workshops, international airport of Mehrabad and several military center in region 9 there is a high pollution than other regions. Region 12 is in the center of Tehran. Great market of Tehran is in this region and cause to high traffic. Also, Shoush and Enghelab square have high pollution.

Results of this research showed that high concentration of Cu in *Morus alba* was 123.162 mg/kg and for Ni is 12.85mg/kg. Because of nickel gasoline abrasion in motor vehicle this element product and then disperse in air.

Also, between different elements, Al and Fe had maximum pollution, so minimum value in Fe was seen in district 3 but it was higher than standard value. Either, there is a high correlation between some elements such as Al, Cu, Fe, Ni and Zn. This correlation index is refer to how the presence of an element can be used for estimation of another elements. This means that high correlation confirm significant relation between two or more elements. It can be so useful because only one element measurement can show presence of another elements percentage.

High concentration of elements (Al, Cu, Fe, Ni and Zn) is a serious problem for human health in this city. Tree leaves can be effective to measure amount of air pollution in pollutant cities, also some plant such as *Morus alba* with expanded leave seem to be suitable for air pollution monitoring because of high surface area in tree leaves are capable to deposited more amount of air pollution materials.

6. Conclusion

This paper pay to investigation of heavy metal concentration on 22 Tehran's sectors using *Morus alba* tree leaves. For this aim *Morus alba* tree with flat leaves were chosen. Results showed that the heavy mineral analysis of deposited particles on *Morus alba* leaves, has high concentration of Fe, Cu, Al, Ni, Zn, Mn, Pb). Leaves with large surface areas per unit of weight such as *Morus alba* leaves, have favorable surface properties for pollutant materials deposition. Between different elements, Fe and Al has highest pollution.

Archive of SID

At the end, high pollution were seen in central, south and south east of Tehran and some factors such as Tehran's topography conditions, climate element such as wind, population and motor vehicles increasing, industrial concentration have important role in Tehran air pollution. Also, most of these elements are in severe pollution condition and in most cases measured concentration show higher amount of standard values that can be a serious threat for human health.

Key Words: Air pollution, Heavy Metal, *Morus alba*, Tehran

www.SID.ir