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A 25-year Monitoring of the Air Pollution Depicted by Plane Tree Species in Tehran

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***Abstract*—**Tehran, one of the heavily-populated capitals, is severely suffering from increasing air pollution. To show a documented trend of such pollutants during last years, plane tree species (Platanus orientalis) were suited to be studied as indicators, for the species have been planted throughout the city many years ago. Two areas (Saadatabad and Narmak districts) allotting different contents of crowed and highly-traffic routs but the same ecological characteristics were selected. Twelve sample individuals were cored twice perpendicularly in each area. Tree-rings of each core were measured by a binocular microscope and separated annually for the last 25 years. Two heavy metals including Cd and Pb accompanied by a mineral element (Ca) were analyzed using Hatch method. Tree-rings analysis of the two areas showed different groups in term of physiologically ability as the growths were plunged during the last 10 years in Saadatabad district and showed a slight decrease in the same period for another studying area. In direct contrast to decreasing growth trend in Saadatabad, all three mentioned elements increased sharply during last 25 years in the same area. When it came to Narmak district, the trend was completely different with Saadatabad. There were some fluctuations in absorbing trace elements like tree-rings widths were, yet calcium showed an upward trend all the last 25 years. The results of the study proved the possibility of using tree species of each region to monitor its air pollution trends of the past, hence to depict a pollution assessment of a populated city for last years and then to make appropriate decisions for the future as it is well-known what the trend is. On the other hand, risen values of calcium (as the stress-indicator element) accompanied by increased trace elements suggests non-sustainable state of the trees.

***Keywords*—**Air pollution, *Platanus orientalis*, Tehran, Trace elements, Tree rings.

I. INTRODUCTION

RECENTLY expanding of the area of the capital and its suburbs, and a large proportion of migration to Tehran together with increased vehicles and other pollution-maker units made the air pollution of the city a profound challenge. In this situation urban trees act as biofilters and help filtering the polluted air. The only internal study on P. orientalis done by khorasani [12] was to make a comparison between tree-ring growths and the amount of air pollutants in which he found a partial conformity. However, recent studies in different areas of the world showed the effective role of dendrochronology in determining the air pollutant absorption then to explore the historical events. Trees reacting to the natural and manmade turbulences and existing long lively have been agreeably important for environmental monitoring [23]-[18]-[13[16]- [21]-[3].

Reducing the ambient temperature, removal of the air pollutants and increasing the air moisture are some of the effective roles of trees modifying the air [15]. Dendrochronology data are aimed at time series recovering [8]-[14]-[6]-[9]-[7]-[5], determining the relationship between tree-ring growth and air pollutant or acid rain [4]. The effectiveness of tree ring is also proved in recording the fire history [9], radioactive pollution [11]-[2], volcanic eruption [17] and earthquake [10]-[23].

We are following whether plane tree species planted all over Tehran capable of uptaking the air pollutants then to enrich the areas with the more pollution-resistant individuals. Cadmium and lead as the two major monitored heavy metals in EPA, for they are virulent to the mankind immune system [19], together with calcium as a stress-indexed element are analyzed in this study.

II. MATERIALS AND METHODS

Twenty four relatively young plane trees in two districts of Saadatabad and Narmak (with different inhibitual and the same ecological conditions) were selected and cored by using a 0.5 cm borer twice perpendicularly at dbh[1]. Tree-ring widths of the past 25 years were measured and separated annually yielding the years 1984 to 2008. Dried matters were not adequate to run the common digestion methods; thus, Hatch digestion was located best.

III. RESULTS

Tree-ring growths of Saadatabad district showed a sudden

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[1] diameter at breast height

plunge during the last 25 years (with the best average growth of 9 mm in 1989 to the least of 1mm in 2008). The same, however, is not true when it comes to Narmak district as there was mild increase in ring widths from 1985 to 1998 and then a moderate decrease till 2008 (with an average of 2 mm in 1985 to the most of around 4 mm in 1998 and then to less than 2 mm in the last year) (Fig. 1-2).

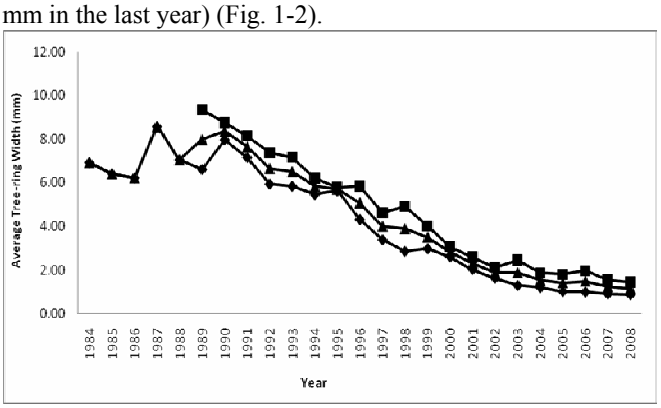

Fig. 1 Tree-ring width in Saadatabad

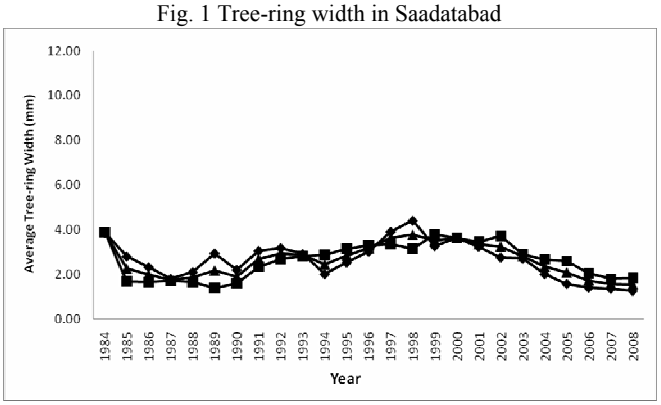

Fig. 2 Tree-ring width in Narmak

As the data show, the amount of cadmium fluctuated in Saadatabad from 1984-1994 then followed an increasing trend till 2008. The amount of lead, however, reached a pick in 1988 and thenafter a four-year decrease then has gradually risen until 2006 (Fig. 3-4). Following two mentioned heavy metals, calcium was also showed an upward trend all the time.

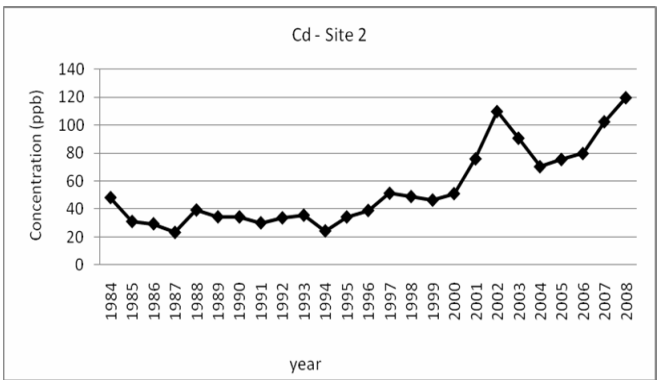

Fig. 3. Cadmium concentrations in Saadatabd

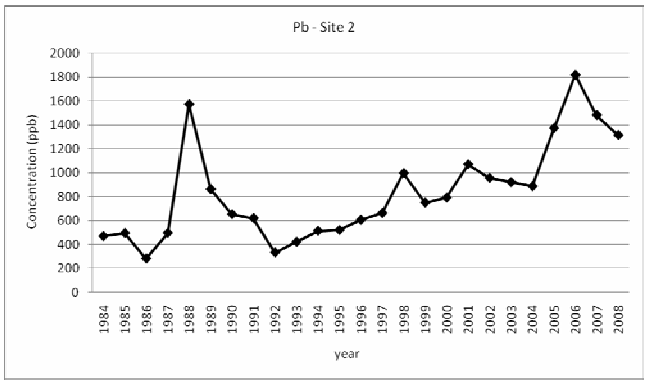

Fig. 4. Cadmium concentrations in Narmak

In Narmak district the situation was to large extent different. There was no characteristic rise or fall both in cadmium and lead absorbed except for the last 5 years in which cadmium was sharply increased and lead moderately decreased (Fig. 5-6). Nonetheless, there was a sharp rising in the amount of calcium in recent years confirming cadmium trend (Fig. 7-8).

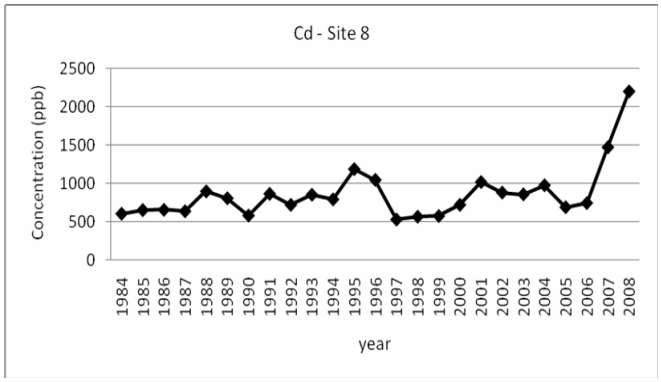

Fig. 5. Cadmium concentrations in Narmak

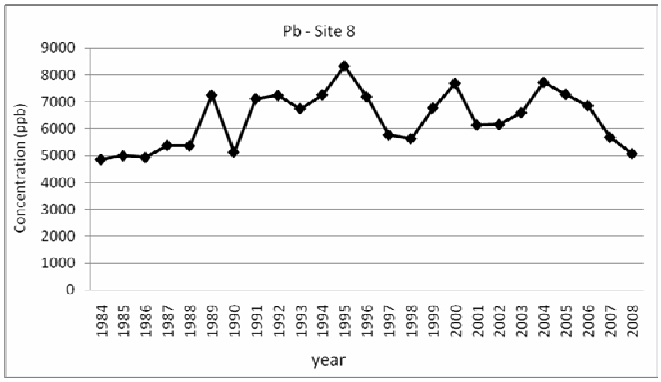

Fig. 6. Cadmium concentrations in Narmak

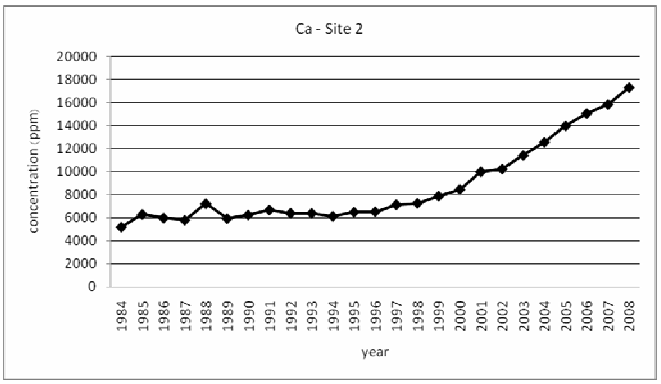

Fig. 7. Calcium concentrations in Saadatabd

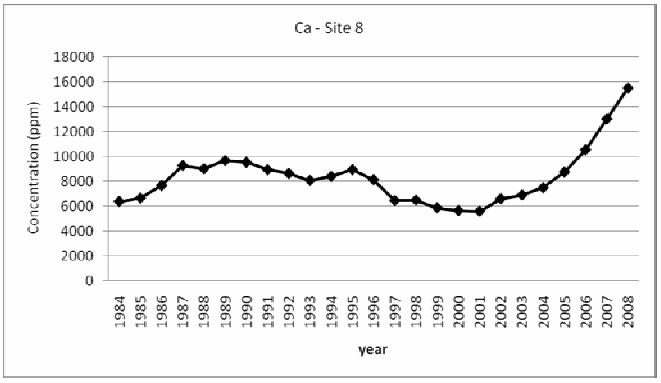

Fig. 8. Calcium concentrations in Narmak

As a whole, the results suggest that there are significant differences between the amount of the heavy metals absorbed by the trees early and lately in the last 25 years.

IV. Discussion and Conclusion

The results on many literatures suggested that accumulation of some heavy metals including lead and cadmium in leaves will rise to chloroplast deterioration particularly in young leaves then to a decrease in photosynthesis [1]. Plants try to simultaneously decrease their growths as they are stressed by the pollution. In this study, as the graphs showed, there was a strong confirmation of this problem. That is, trees in Sadadatabad district with a sudden fall in ring widths represented a sharp increase in Cd and Pb uptaken during the last years. On the other hand, there were fluctuations in tree-ring widths of Narmak district and the fluctuations in the amount of heavy metals absorbed as well.

There might be some other factors affecting tree-ring growths, though. Precipitation is the most important ecological factors influencing tree growth. As the data of Annual Weather Report Processing Centre suggest, there was a same amount of precipitation during 20 years ago and even an increase in last 5-year period. By selecting trees from the same altitudes and aspects, this scenario likes to promote the decreased tree-ring width due to the pollution, for they were in stress. Having the population of the capital grown several times, also support the amount of pollution as the number of cars, caraways, and indoor and industrial sewages increased subsequently.

V. Conclusion

Plane trees are of the prevailing biotic elements of the capital, then they obviously reacted against the air pollutants and the decreased tree growth trend is showing such a close correlation. It is also expectable that all the biotic components existing in Tehran ecosystem should have been physiologically deteriorated, and currently bird migration from Tehran is of an obvious example of the fact. The results of this study proved that trees are the reserves and biological history of the regions and tend to reveal the long-time ambient changes.

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