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Investigation of Ahwaz's Air ContaminationbyNickel Using ConoacarpusPollution Burden Index

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Abstract: Developments of industry, increased of urban traffic and the pollutions caused byindustries in the developed countries as well as Iran have all resulted in soil, air and watercontamination. Given the matter of environmental pollution, it is necessary to consider a permanent biomonitoring for pollutions of air, soil and water in highly contaminatedareas. In many parts of the world, the plants and animals are used as the biomonitoring for environmental pollution. In this research, the leaf of Conoacarpus species was used as a biomonitoring for heavy metal, the nickel, in Ahwaz. The concentration of the tracer (Ni) in soil and the samples of both rinsed and unwashedleaf takenfromfoursites (Weiss andMlasany (control)Pasdaran boulevard (with adequategreenbeltandlesstraffic), Naderi boulevard (the trafficof the city) steelindustry(industrial area)) were collected and after extracting were measuredbyatomic absorption device.The results of analysis of soil samples showed that the mean amount of Ni in the soil depth of 0 to 10 cm at all the sites was 46.125 mg/kg and was lower than allowable limit. Then the pollution burden index in unwashed leaf was calculated for nickel which in all the sites their mean was 0.71 and for washed ones it was 0.84. It means that there is a significant difference. In general, the results indicated that using the pollution burden index at the Ahwaz's industrial and high urban traffic areas is higher than any other areas and the Conoacarpus species can be used as a reliable biomonitoring for studying the air and water pollution in this area.

Key words: Environmentalmonitoring، Conoacarpus، Nickel، PollutionBurden Index، Air Pollution

INTRODUCTION

The pollution is one of the harmful factors which mostlyaffect the environmentthrough exploiting the natural resources and using fossil fuels. By industrializing and modernizing of communities, this problem has been intensified more than ever. The environmental pollution means producing undesirable changes in physical, chemical and biological characteristics of vital resources i.e. water ,air and soil to the extent that endangers the human beings health and viability of other creatures or restricts their activities (Market 1993). Since the pollutants threaten the living creatures' life, it is very important to obtain adequate information of types as well as the amounts of each pollutant. One of the most reliable ways to determine the amount and the type of these pollutants is that a natural biomonitoring to be used. Although, in the past, the naturalbiomonitoring has been mainly employed for estimating the air pollution, today it is rarely used for estimating and measuring the water and soil contamination (Soylak and Dogan 2000, Mulgew and Williams 2004). Since many plants are able to uptake and store a number of pollutants via their aerial organs, especially leaves, using the plants as a biomonitoring is a useful way in estimating the pollutants. Biomonitoring by plants is a low- cost and valuable method for examining the effect of various pollutants and the environment as a whole (Celik and Aslihan 2000, MonaciandBargali 2004). The concentration of air pollutants and gathering information in this case is a practical method which could help us to find feasible solution toward inhibition of air pollution (AkosyandSahin 2003, Adel, 2000). Generally, the biomonitorings have been classified in to active and passive biomonitoring. In the latter, the plants naturally grown at the study areas are used such as indigenous, garden, corps and ornamental plants. Of those passive biomonitoring plants used in the literature can be mentioned as poplar trees, pine, palm,jujube fruit, figs, ash, apple, birch, juniper, elderberry, oak and acacia. In these plants, the leaf and in some cases the bark and wood are used for monitoring the pollutants(Madegon and Robinson, 2004). In the former, the plants that genetically react to air pollutants are detected in the studyarea or those plants from otherareasthatare notaffected by pollution are collected andreleasedinto the environment, such as mossesand lichens (Djingova and Kuleff 1993). Pollutantsby themselves disturb the ecosystem from which theheavy metalsare considered asharmful because ofnon-biodegradableandphysiologicaleffectsonliving organismseven atlowconcentrations. Becausethe heavy metals are usedinindustry and necessity of some of themdue toinvolvinginsomephysiologicalactivities in plants and animals, it is necessary to gain information of which as much as possible (Diatta and Grazebisz 2003). In our country, Iran, asthe industrial development occurred in the second half of past century and forthcoming planning and also increasing the number of gas-burning vehicles,

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theynecessitate more and more study on pollutants and their effects on environmental cycles. Since a large part of Ahwaz are occupied by pollution-generating plants and having heavy traffic, they have exposed this city to air and soil contamination. For this reason, the studies related to determining the type and amount of pollutants caused by both industries and urban traffics existing in the air and soil can open a window to introduce practical solutions toward creating a healthy environment. One of the newest reliable ways for determining the type and amount of various pollutants is that a natural biomonitoring to be employed and because the physical methods can be replaced by chemical ones, they may be used for indicating the air pollutions where the chemical methods are faced with restrictions. Thus it seemed very important to conduct an experiment in order to determine both air and soil pollutions in some industrial and non-industrial areas in Ahwaz. The purpose of this paper is to examine the intensity of air and soil polluted by nickel in both high urban traffic and industrialized areas using Conoacarpus species as a passive biomonitor plant.

METHODS AND METERIALS

Position and site:

This research was carried out in four sites located inside Ahwaz and out strikes in order to examine the type and concentration of air and soil pollutants. They are as follows:

Site1: having sufficient greenbelt and less traffic (Pasdaran boulevard)
Site 2: the highest urban traffic in the city (Naderi street)
Site 3: industrial area (Khuzestan Steel Complex)
Site 4: a site with partial traffic as a control (Wiess and Molasany)

Sampling, Preparation and Soil Analysis:

A total of 20soil samplesfrom 0 to10 cmsoildepth,surfacesoilsamples weretakenin four areas by using sampling auger andthey were moved to the laboratoryin plastic bags. In thelaboratory, soil samples wereair-dried, crushedandpassed through a2 mmsieve. Acidity(pH)of saturationextract of soil samples was measuredbypH meter,OhmModel262and organiccarbon was measured byWalckyandBlack technique(Nelson and Sommers, 1982). To determine theconcentrationofheavy metalsin thesoil, the soil was poured in to 100ml beaker10 ml ofconcentratednitric acid was added to it andheatedfor an houron awater bath. To determine theconcentration ofheavy metalsin thesoil, the soil inawarm,humanand100 mlwas pouredinto10 ml ofconcentratednitric acidadded andheatedfor one hourinto awater bath. Aftercoolingthesoil, the hydrogen peroxide was addedtobleachthe samples. AfterfiltrationwithWhatman42filter paper, it broughttovolume inside a 100ml balloontheconcentration of nickelwere measured by usingatomic absorption. (Pydtt, 1999., Soon and Abboud, 1993).

Sampling, Preparation and Plant Analysis:

Conoacarpus species was selected as apassivebiomonitoringandsampling ofleaves was conducted by following method.Ateachsite,five trees were selectedrandomly. Leafsamples were picked froma height of aboutonemeterabove thegroundinfour sides of a tree. Thesamplesfrom thefoursidesof eachtreeweremixed anddivided intotwo equal parts. One partwas rinsed with distilled watertoremovedustanddepositson theleavesandotherpartsremained intact. Thesesamples were put aside forlaboratoryanalysis. Therefore,the total number ofplant samples was preparedfor analysis of32 samples, and then they were divided in to 16washed samplesand 16 unwashedsamples. Plantsamples werefirstair-driedona cleansheetof apaperand thenmovedto thepaperpackets.The packets were dried in an electricovenuntil they reached aconstant weightat 60° C and then they were powdered by a Wileymilland prepared for analysis. To determine the nickel concentration, the extracting was conducted by nitric acid and the reading was performed by atomic absorption. To determine thesignificant differencesbetweenthesites of interest for concentration, an unbalancedcomplete randomized designwas used. Todetermine the importance ofwashing theleaves,LSDtest was applied to compare theheavy metalcontent ofwashed andunwashedplants for eachsite. In order to analyze and data processing, the SAS, MINITAB program was used.

The amount of nickel contaminationinsamplesof leaveswascalculated byusingPLIpollutionburden index.

This indexis based ontheconcentrationfactor(CF)of eachelement in thesample.

Contaminationfactorconcentration ratioof theconcentration ofanelementis the concentration ratioof an elementto the concentration of the same element in the control samples.

CF= Csampe/Crefrence

Having calculated the amount of concentrationfactor forallsamples, their products and ultimately,theirsquare root can be used for estimating the pollutionburdenindex. This index was computed foreach element inthe site of interestby following formula.

$$PLI = \sqrt{CF_1 \times CF_2 \ldots\ldots \times CF_n}$$

This indexallows evaluating the severityofcontamination. The pollution burden closeto 1indicates that thepollutionloadofheavy metalspollutionisaround thebaseline pollution. However, the value greater than 1 is an indication of contamination.

RESULTS AND DISCUSSION

Soilanalysis:

The concentration ofnickeland some chemical characteristicsof varioussitesinthis studyareindicatedin Table 1. Asthetableshows theaveragePHofthe soilsitesarenot of highdifference. However,all the studysoilsare in thealkaline limit. The different forms of heavy metal species have different patterns in trend of absorption even in transporting to aerial organs and accumulation in these organs especially in leaf due to having differentsolubility of in differentspeciesdifferentpH.

Table 1: the nickel concentration mean existing in soil associated with chemical soil properties (mg/kg)

Soil	Ni	pH	OC%
Pasdaran boulevard	46.75	7.3	0.98
Naderi street	44.75	7.4	1.1
Wiess and Molasany	41.5	7.4	0.19
Khuzestan Steel Complex	51.5	7.5	0.36

Plant Analysis:

The analysis results of conoacarpusleafsamplesobtained to determine theamount ofheavyelements, Ni andvariance analysis tableof theelements in theleaves ofthefoursites respectively are shown in the table 2.

Table 2: comparison of nickel concentration means in Conoacarpus leaf samples at the study areas(mg/kg).

Ni	Site
0.2212 [c]	Pasdaran boulevard
0.260 [b]	Naderi street
0.296 [a]	Khuzestan Steel Complex
0.301 [a]	Wiess and Molasany

The sites having the same characters are not significantly different.

Nickelis not an essentialelementforplants and animalsandplantswhenitsconcentrationexceedsthe allowable limitleads tothetoxicityoftheplant(Kabata - Pendias and Pendias, 1992). The highestconcentrationofnickelin was seen inthesteel complexthatonaverage was0.301 which followed by WeissandMlasany with0.296 that there is no significant difference between them but numerically they have differencedue tothe highnickel concentration insteel complex.

Table 3: analysis of nickel concentration variance measured in Conoacaprus leaf

Ni	Degrees of freedom	Sourcesof variation
**0/001	3	Area
*0/011	3	Repeat
*0/011	1	Washing/notwashing
**0/000	3	Interaction
**0/001	21	Error

*,** and ns, are significant and non-significant different in levels 1% and 5%respectivily

Pollution Burden index Calculation:

This index for Conocarpusleavesrelated tonickel at 4sites in washed samplerangedfrom0.50to 1, whicthe highest amount measured is related to the site ofthe steelcomplex.it can be attributed to high pollution due to existing factories in this site. Also in unwashed leaf this index ranged from 0.85 to 1.12. The largest amount of nickel adsorption in site of steel complex is related to air. Therefore,due tohigh concentrations ofheavy metalsintheatmosphereintheregion it has beenableto absorbmore andpollution burden index has high number.

Diagram. 1: pollution burden index related to nickel in Conoacaprus's washed leaf samples

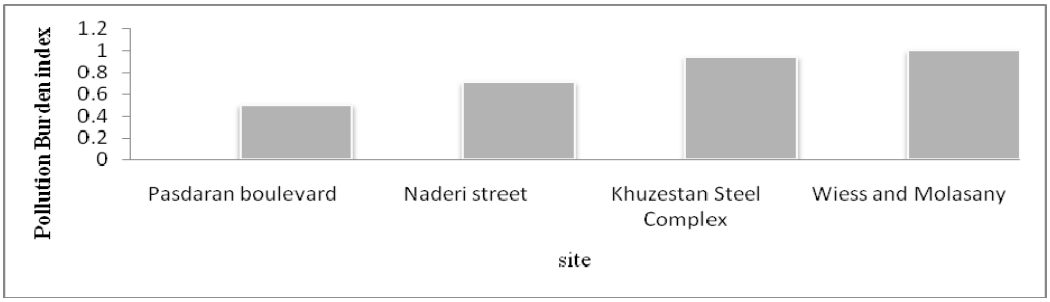

Diagram. 2: pollution burden index related to nickel in Conoacaprus's unwashed leaf samples

The resultsshowed the Conoacarpus has a good potentialfor theaccumulation ofheavy metals. Calculationshowedthat the highest amount for washed samples was in steel complex site which is an indication of capability of this plant in absorption of nickel. The traffic of vehicles and the factories are the main source pollution. Use of Conoacarpus leaf as a boimonitoring for air pollution in the site lacking of the measuring devices can be useful because of simplicity and low-cost.

Conclusions:

The resultsshowed thatconocarpusleavescan be used a abiomonitoring for airpollutioninareascontaminatedby heavy metalssuch asNi and can distinguishes the polluted from non-polluted areas. Theleavescan be considered asabiologicalindicatorfor theevaluation ofairborneheavy metals.Conocarpustrees(evergreen plants) could be considered asapassivebiomonitoringinenvironmental studies.

The pollution burden index of this plant is different in different sites and is extremely depended on pollution condition in the sites. The species with high pollution burden index can be used in polluted areas.The bushes have a higher tolerance to pollution than trees. By determining the pollution burden index in a polluted area the effects of pollution in that area can be recognized.

REFERENCES

Abedi, Mohammad Javad& Naser, Honarjoo, 1993. microelement , reference book.

Adel, Manzala, A., 2003. Heavy metal pollution and biomonitoring plants in lake Manala, Egypt. Pakistan. Biological Science, 6(13): 1108-1170.

Aksoy, A. and u. Sahin, 2000. Robinia pseudo – acacia L. as a possible biomonitor of heavy metal pollution.In : Kayseri. Sci. Total Environ, 24: 279-284.

Brady, N.C., 1990. The nature and properties of soils, 10 th edition. MacmilanPublisbing CompanyNew York. pp: 621.

Celik, A., A. Aslihan, 2004. Determining the heavy metal pollution in Denizli (Turkey) by using Robinia pseudo acacia L. 31(1): 105-112.

Cook, C.M., S.P. Sgardelis, 1994. Concentration of Pb, Zn and Cu in TaraxacumSpp in relation to urban pollution. Bull. Environ. Contan.Toxical., 53: 204-210.

Diatta, J.B.W. Grzebisz, 2003. A study of soil pollution by heavy metals in the city of Poland using Taraxacumofficinale as a bioindicator., 6(2): 1-12.

Djingova, R., I. Kuleff, 1993. Monitoring of heavy metal pollution by Taraxacumofficinale. Plants as biomonitors / Indicator for heavy metals inthe Terrestrial Environment

Handreek, K.A., 1994 .Effect ofpH on the uptake of Cd, Cu and Zn from soilless media containing sewage sludge. Soil and Plant, (25): 1913-1927.

Harrison, R.M., M.B. chirawi, 1989. The assessment of air and soil as contributors of some trace metals to vegetable plants. I.use of a filtered air ,growth cabinet. Science of the Total Environment, 83:13-34.

Markert, B., 1993. Plant as biomonitors/Indicators for heavy metals in the terrestrial environment.Weinheim VCH. Press: 670.

Monaci, F., R. Bargagli, 2000. Biomonitoring of airborne metals in urban environments: New trace of vehicle emission in place of lead, Environ. Pollut, (107): 321-327.

Mulgrew, A., P. Williams, 2004. Biomonitoring of air quality using plants. Air Hygiene report., (10): 1-100.

Rahmani, H.R., M. Kalbasi, Sh, Haj Rasooliha, 2000. Soil pollution by lead result fromvehicles in highways of Iran. Journal of Agriculture science,4(4): 31-42.