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Phytochemical Monitoring of Some Plants Exposed to Vehicular Pollution at Badarpur Ashram Road, New Delhi, India

Shailendra Arora
Dept of Environmental Science
Maharaja Ganga Singh
University, Bikaner

Rajaram Choyal
Dept of Environmental Science
Maharaja Ganga Singh
University, Bikaner

Abstract

The present study evaluates the relationship between air pollution stress and biochemical characteristics of selected plants such as *Azadirachtaindica A.jus*s, *Polyalthialongifoliachinensis*Benth. & *Hook.* , *DelonixregiaBoj.ex Hook*., *FicusreligosaLinn. Alstoniascholaris Linnconducted* at Badarpur Ashram Road, New Delhi in which main traffic site was identified for the collection of leaf sample. An attempt was made to estimated biochemical changes like Ascorbic Acid, Total Chlorophyll content, pH of leaf extract, Relative water content in selected plants and air pollution tolerance index (APTI) of plants also calculated by using these four biochemical parameters. It reveals that selected plants are having impact and it can be used as a bio indicator of air pollution. It was observed that vegetation at road side with heavy traffic was much affected by vehicular pollution at compare to away from road side. Significant decrease in total chlorophyll pH etc. was observed with reduced leaf area. It was concluded that plants can be used as indicator for urban air pollution and there is need to protect the roadside plants from air pollution.

Keywords : Biochemical, Ascorbic, Industrialization,Urbanization

Introduction

However, increase in industrialization, unplanned urbanization, alarming increase in vehicles fleet; population growth and underestimated future plan of city development are the major triggers for the increases in the air pollution level in the city (Jayanthi, V. and R. Krishnamoorthy2006). Exposure assessment studies carried out in the developing world on several air pollutantsare reviewed (Agrawal et al., 2003; Oliva and Mingorance, 2006; Han and Naeher, 2006) and it is known that pollutants in the outdoor and indoor environments are associated with acute adverse effects on health of human and plants (Lebowitz, 1995; Tripathi et al., 2008; Dwivedi et al., 2008).Plants developed characteristic response and symptoms in response to particular types and level of air pollution. Such information can be used in the field surveys of air pollution and the concept of plants as indicators of air pollution was firstly developed by elements. Vegetation naturally cleans the atmosphere by absorbing gases and particulate matter through leaves as plant leaf may act as a persistent absorber when exposed to the polluted environment. Sensitive plant species are suggested as bio-indicators (Tripathi et al., 1999; Raina and Sharma, 2006). Bio-indicators may be very useful due totheir high sensitivity towards a broad (DeTemmerman et al. 2004). Different plant species showed a different behavior for different pollutants and any plant part could be indifferently usedas bio monitors (Mingorance et al., 2007). Atmospheric metal may be accumulating by lichen(Baptista, M.S., M.T.S.D. Vasconcelos, J.P. Cabral, M.C. Freitas and A.M.G. Pacheco- 2008). Pollen quality is also as a potential indicator of pollution(Calzoni, G.L., F. Antognoni, E. Pari, P. Fonti, A. Gnes and A. Speranza 2007). Ascorbic acid play a role in detoxification of O3 in soya been(Cheng, F.Y., K.O. Burkey, J.M. Robinson and F.L. Booker 2007). Woody species are more tolerant to pollution and therefore should to be broadly used in a humid urban industrial environment with heavy duty vehicle emissions.(Hong Xia, C., J. Geo Ming, N. Shu Li, J. Chang Dao, L. Mei Zhen, Y. ShunLi and G. Lei Ming 2006).Particulate matter concentrations are higher in seasons with prevailing winds (Wang, X.K. and W.Z. Lu 2006).In young mutant chlproplast are with irregular in shape and they contained large vesicles but no normal lamellae or grana (Maclachlan, S. and S. Zalik 1963). (According to Singh and Rao (1983) a formulae has been adopted to determine the air pollution tolerance index (APTI) of various plant

species considering upon the four biochemical parameters i.e. total chlorophyll, ascorbic acid, leaf extract pH and relative water content. Thus the present work designed to evaluate the air pollution tolerance index (APTI) of different plant species growing at Badarpur Ashram Road, New Delhi.

Materials and Methods

Delhi is positioned with the Great Indian Desert (Thar Desert) of Rajasthan in the west and southwest, central hot plains in the south and genetic plains of Uttar Pradesh/Uttaranchal in the east while cooler hilly regions in the north. Delhi is situated at latitude 28º24'17" and 28º53'00" North; Longitude 76º45'30" and 77º21'30" (East) at elevation of 216 m above the mean sea level (MSL).Delhi's climate is very hot in summer (April - July) and cold in winter (December - January). The average temperature can vary from 25º C to 45º C during the summer and 22º C to 5º C during the winter respectively.The topography of the city is manly urban plain having two main features - the Ridge and the river Yamuna. The Ridge refers to an area inhabited by extraordinary plants and fierce animals.The Yamuna river plains are very fertile as they are flooded by the river and are rich in alluvial soil. The soil in the hilly region of Delhi is loam placed above the slightly compact soil of light grey color.The rainy season in Delhi begins in June and continues almost till October. Delhi receives most of its rain during this period from the Northwesterly winds. Most of the precipitation occurs in the month of July. The weather condition of Delhi remains pleasant during the rainy season, but humidity level remains high.

The present study is carried out in January 2013 regular and periodically visits to Badarpur Ashram RoadNew Delhi.

Commonly found tree species in Delhi include, *Eucalyptus* sp., *Ficusbenghalensis, Ficusreligiosa, Mangiferaindica, Syzygiumjambolanum, Alstoniascholaris, Azadirachtaindica, Cassia fistula, Polyalthialongifolia, Delonixregia etc.*

The effect of air pollution on the plants can be quantified using a parameter, air pollution tolerance index (APTI) (Singh and Rao, 1983). The APTI is a function of total chlorophyll content of the leaf, pH, relative water content and the ascorbic acid content. The APTI for a particular tree species is given in following Equation.

APTI = [A (T+ P) + R]/10

Where A= Ascorbic acid content in mg/g dry weight,
T= Total Chlorophyll content in mg/g dry weight,
P= pH of the Leaf extract,
R = Relative water content (%)

The following five plants were choose for study the effect of pollution from various sampling sites.

1. *AzadirachtaindicaA.juss*
2. *PolyalthialongifoliachinensisBenth. & Hook.*
3. *DelonixregiaBoj.ex Hook.*
4. *Ficusreligosa Linn.*
5. *Alstoniascholaris Linn.*

For present study sample leaves collected from road side and away from road side of same plant in same trip.

Ascorbic Acid (AA) Content Analysis

Ascorbic acid content was measured by using spectrophotometric method. 1 g of the fresh foliage was put in a test-tube, 4 ml oxalic acid - EDTA extracting solution was added, then 1 ml of orthophosphoric acid and then 1 ml 5% tetraoxosulphonic (VI) acid added to this mixture, 2 ml of ammonium molybdate was added and then 3 ml of water. The solution was then allowed to stand for 15 minutes. Then the absorbance was measured at 760nm with a spectrophotometer.

Total Chlorophyll Content Analysis

Total Chlorophyll content was analyzed by the method given by Lichtenthaler and Buschmann, 2001; Boyer, 1990; Tam and Soderstrom 1989.

For Total Chlorophyll analysis, 0.5 g fresh leaves material wasgrounded and diluted to 10 ml in distilled water. Asubsample of 2.5 ml was mixed with 10 ml acetoneand filtered. Optical density was read at 645 nm(D645) and 663 nm (D663). Optical density of Total Chlorophyll(CT) is the sum of chlorophyll a (D645) density andchlorophyll b (D663) density as follows:

CT = 20.2 (D645) + 8.02 (D663)

Total Chlorophyll (mg/g DW) was calculated as follows:

Total Chlorophyll = 0.1CT x (leaf DW/leaf fresh weight)

Ph of The Leaf Extract Analysis

pH of the Leaf extract was analyzed by **pH meter**.

For the pH estimation 0.5g of leaf material was ground to paste and dissolved in 50 ml. ofdistilled water and this extract was measured by using calibrateddigital pH meter.

Relative Water Content Analysis

Relative water content was analyzed by RWC % i.e.

RWC% = [(FW-DW)/ (TW-DW)] x 100

Here is:

RWC = Relative water content
FW = Fresh weight of leaves
DW = Dry weight of leaves
TW = Turgid weight of leaves

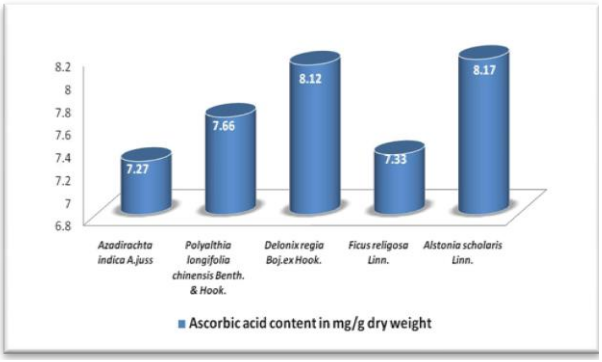
FW, which is fresh weight, was gained by weighing the fresh leaf pieces on a 4-digit balance. Then, these leaf pieces were weighed after immersing in water overnight to get TW, which is turgid weight. Next, leaf pieces were blotted to dryness and placed in a dryer at 105_ (2 hrs.) and reweigh to get dry weight (DW).

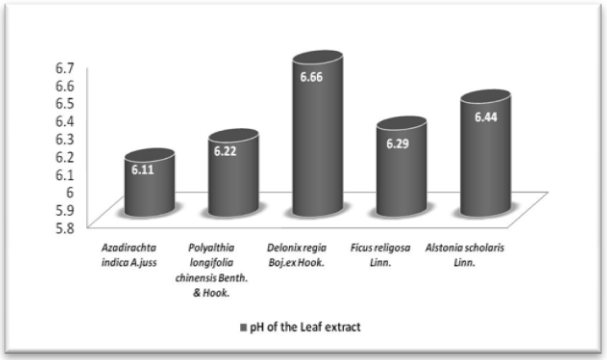
Results and Discussion

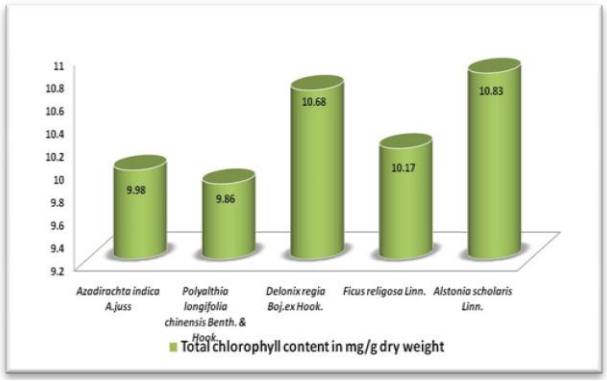
Results for location at Road Side

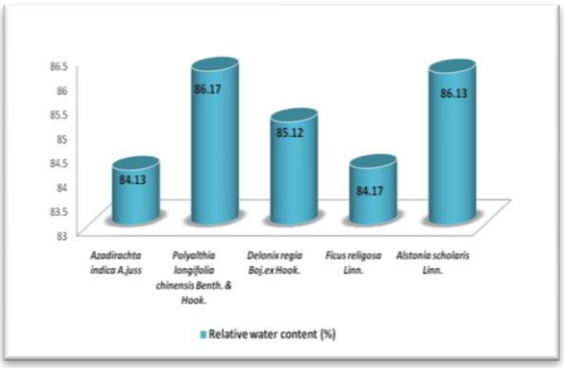
Name of plants	Ascorbic acid content in mg/g dry weight	Total chlorophyll content in mg/g dry weight	pH of the Leaf extract	Relative water content (%)	APTI
Azadirachta indica A.juss	**7.27**	**9.98**	**6.11**	**84.13**	**20.11**
Polyalthia longifolia chinensis Benth. & Hook.	**7.66**	**9.86**	**6.22**	**86.17**	**20.93**
Delonix regia Boj.ex Hook.	**8.12**	**10.68**	**6.66**	**85.12**	**22.59**
Ficus religosa Linn.	**7.33**	**10.17**	**6.29**	**84.17**	**20.48**
Alstonia scholaris Linn.	**8.17**	**10.83**	**6.44**	**86.13**	**22.72**

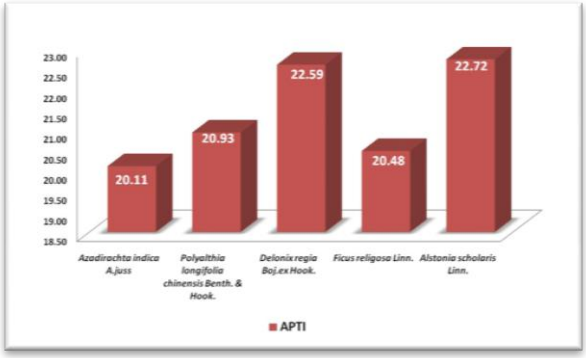
Month - January 2013. Time - Afternoon Hours.
Site - Badarpur Ashram Road, New Delhi Location - Road Side











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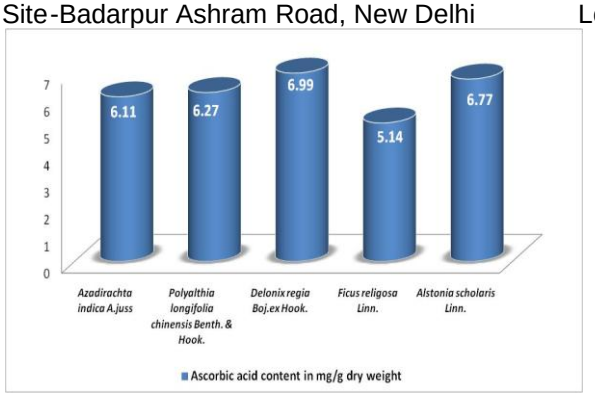
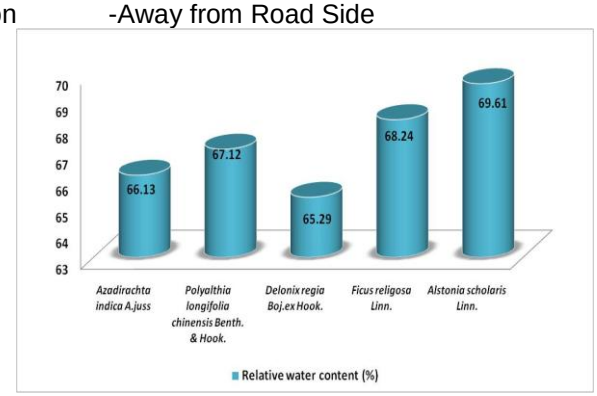
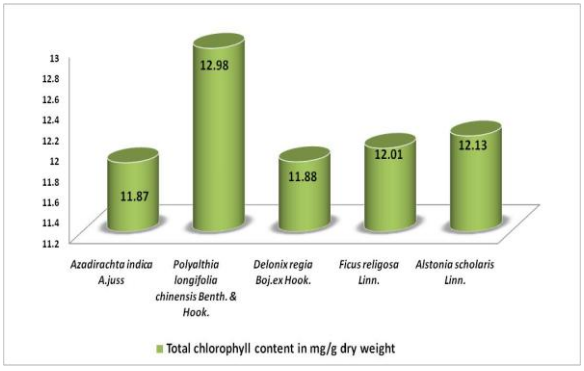
Results for location at Away from Road Side

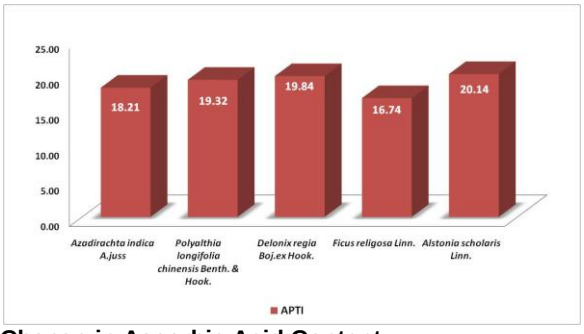
Name of plants	Ascorbic acid content in mg/g dry weight	Total chlorophyll content in mg/g dry weight	pH of the Leaf extract	Relative water content (%)	APTI
Azadirachta indica A.juss	**6.11**	**11.87**	**7.11**	**66.13**	**18.21**
Polyalthia longifolia chinensis Benth. & Hook.	**6.27**	**12.98**	**7.13**	**67.12**	**19.32**
Delonix regia Boj.ex Hook.	**6.99**	**11.88**	**7.17**	**65.29**	**19.84**
Ficus religosa Linn.	**5.14**	**12.01**	**7.29**	**68.24**	**16.74**
Alstonia scholaris Linn.	**6.77**	**12.13**	**7.34**	**69.61**	**20.14**

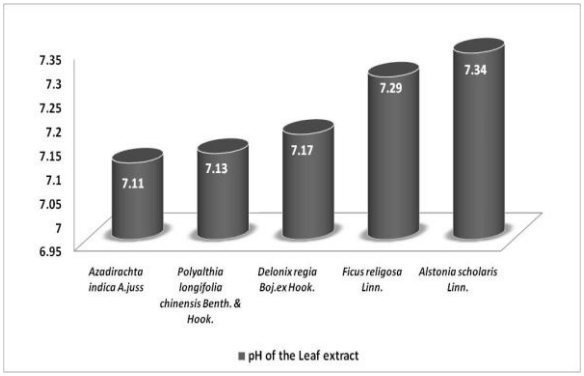
Month -January 2013. Time -Afternoon Hours.
Site-Badarpur Ashram Road, New Delhi Location -Away from Road Side











Change in Ascorbic Acid Content

Ascorbic acid is very important metabolite in plants and it activates the resistance mechanism in plants under pollution stress. The present study shows the increased level of ascorbic acid in all plants species and increasing level depends on pollution stress.

Highest ascorbic acid was found at road side location in *Alstoniascholaris Linn.*.i.e. 8.17mg/g dry weight and away from road side in *DelonixregiaBoj.ex Hook*.i.e.6.99 mg/g dry weight. The lowest ascorbic acid was found at roadside location in *AzadirachtaindicaA.jussi*.e.7.27 mg/g dry weight and away from road side in *Ficusreligosa Linn* i.e. 5.14 mg/g dry weight.

Change in Total Chlorophyll Content A Considerable loss in total **chlorophyll** was noted

because the chloroplast is the primary site of attack by air pollutants.

Highest chlorophyll was found at roadside location in *AlstoniascholarisLinni i*.e.10.83 mg/g dry weight and away from road side in *PolyalthialongifoliachinensisBenth&Hook* i.e.12.98 mg/g dry weight. The lowest chlorophyll content was found at road side location in *PolyalthialongifoliachinensisBenth&Hook* i.e.9.86 mg/g dry weight and away from road side in *AzadirachtaindicaA.juss* i.e.11.87 mg/g dry weight.

Change in PH of Leaf Extract

The **pH** is an indication of the development of detoxification mechanism in plants necessary for tolerance. In the present study pH of leaves became more acidic in the plants of polluted environment.

Highest pH of leaf extract was found at road side location in *DelonixregiaBoj.exHook* i.e.6.66 and away from road side in *Alstoniascholaris Linn*.i.e.7.34. The lowest pH of leaf extract was found at road side location in *AzadirachtaindicaA.juss* i.e. 6.11 and away from road side in also in *AzadirachtaindicaA.juss* 7.11.

Change in Relative Water Content

The observed result shows that **RWC** was marginally increased at all the sites based on pollution load so pollution would be a one of the factor for change in RWC.

Highest RWC was found at road side location in *PolyalthialongifoliachinensisBenth. & Hook* i.e. 86.17 and away from road side in *Alstoniascholaris Linn*.i.e. 69.61.The lowest RWC was found at roadside location in *AzadirachtaindicaA.juss* i.e.84.13 and away from road side also in *DelonixregiaBoj.ex Hook*. i.e. 65.29.

Change in Air Pollution Tolerance Index (APTI)

In this study **APTI** values of plants were significantly increased in all more polluted sites as compare to less polluted sites. Singh and Rao 1983 states that APTI is an index which determines capability of a plant fight against air pollution. Plant which have higher APTI are tolerant to air pollution and can be used as sink to mitigate pollution while plants having low APTI shows less tolerance and can be used to bio indicator of air pollution.

Highest Apti was Found At Road Side Location In *Alstoniascholaris Linn* i.e.22.72 And Away From Road Side Also In *Alstoniascholaris Linn i*.e.20.14. The Lowest APTI Was Found At Road Side Location In *Azadirachtaindicaa.Juss* i.e. 20.11 and Away From Road Side Also In *Ficusreligosa Linn* i.e. 16.74.

Conclusion

Bio monitoring of plants is an important tool to find out the impact of air pollution on plants. The present study suggests that plants have the potential to serve as excellent quantitative and qualitative indices of pollution level. Present study with all the selected plants showed reduction in concentration in chlorophyll. The rapid urbanization impart more stress on the vehicular use, which release toxic air pollutants in the urban atmosphere in the developing countries. Monitoring of air pollution, bio monitoring of plants is an important tool to find out the impact of air pollution on plants.

The plant species can be conveniently grouped based on the APTI values.

S No.	APTI	Response
1	30-100	Tolerant
2	29-17	Intermediate
3	16-1	Sensitive
4	<1	Very Sensitive

Our results show that all plants located on both i.e. road side and away from road side have APTI value >16 and <29. So all plants are categorized as intermediate.

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