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Assessment of Air Pollution Tolerance Index of Selected Plants Unveil To Traffic Roads of Noida, Uttar Pradesh

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ABSTRACT: In today scenario Air pollution has become one of the major and complex challenges of Environment as no one can yield fresh ambient air. Plants are most important species as they balance the ecological system of an environment. Additionally, they are the prime and immobile acceptors of air pollution. In present work 5 different plant species i.e. Ficus Religiosa, Delonix regia, Polyalthia longifolia, Plumeria sp. And Azadirachta indica were considered from the highly polluted roadside of Noida sector 78.For evaluation of its tolerant limit four physiological and biochemical parameters namely Relative water content, leaf extract pH, Ascorbic acid, and chlorophyll content were analyzed. And on these parameters APTI i.e. Air pollution tolerance index has been framed. The individual importance of planting these species are also analyzed to enhance the importance of planting these species on the road side of the heavily polluted zone.The result signifies that all the above species comes under sensitive zone.

Keywords: APTI, Ascorbic Acid, Relative Water Content, Leaf Extract pH, Chlorophyll Content.

I. INTRODUCTION

Bio-monitoring of environmental state in temporal and spatial scales is considered important for optimizing the existence sustaining system of the Earth. Among all organisms vegetation are extra appropriate in bio-monitoring programs considering that they are greater touchy especially to air pollutants and being stationary they are able to hold diaries of age-lengthy environmental experience (A Mukherjee, 1993).

Plants play most significant and important role as they produce oxygen in the air for our respiratory as well as sequester carbon dioxide through assimilation system. They provide ecological advantages; create an economic, aesthetic and undertaking price for humans and its surrounding regions (Roy S et al., 2012). Plants perform the characteristic of air filtration via aerial elements particularly from the leaves, stems, and twigs (Beckett KP et al 2000).The plant species as soon as planted at one vicinity are constant there and so constantly possibly to be uncovered to numerous chemicals and emissions from the one-of-a-kind land use activities of surrounding regions. Due to change in our lifestyle and consistent urbanization area required for greenery is being replaced by buildings, roads, shopping complexes etc.

Even though many protocols has being published for preservation our environment but still it is very less in practice. A major problem which we suffer in our daily life is through contamination of air,soil, and water due to anthropogenic activities.Visualization of plants in response to particular types and level of air pollution is easy and practical.Plants obviously clean the environment via soaking up gasses and particulate count through leaves as plant leaf might also act as a persistent absorber whilst exposed to the polluted surroundings.

According to Singh and Rao (1983), Air Pollution Tolerance index is a type of grading index based on major Bio-chemical parameters like Relative water content, leaf extract pH, Ascorbic acid, Chlorophyll content, and carotenoid. Based on Air Pollution tolerance index values we categorize the plants under Tolerant, Intermediate, Sensitive and most sensitive species. Such statistics may be used in a proper plantation of trees at different sites to withstand air pollutants. In my study, I have calculated the air pollution tolerance index (APTI) of different plant species growing near road side of Noida sector 78 (residential area) to check its tolerance limit.

II. MATERIAL AND METHOD

A. Sample collection

Fresh leaves were collected during November 2016 from the road side of Noida, sector 78 (residential area) keeping in mind precautionary measures and brought to the laboratory for an experimental process.

B. Biochemical measurements

Ascorbic acid contents in (mg/g of fresh weight), total chlorophyll (mg/g fresh weight), pH of leaf extract and relative water content are the parameters that are essential for the determination of APTI, an associated index to evaluate the impedance and susceptibleness of plant species to pollution.

In plant system ascorbic acid (vitamin c) is very important and planned functions in chemical change as an associate in nursingproteincompound and to speed up cell growth. Additionally, high ascorbate enzyme activity within thecytomembrane is related to areas of speedy cell growth whereas pH acts as an associate indicator for sensitivity to pollution (F. Scholz, S. Reck, 1977). Chlorophyll, which is present in chloroplasts of plants is an essential green pigment and helps plants to convert water and co_2 into glucose and oxygen in the presence of sunlight. It also helps in the production of vitamin c in plants.

a. ***Relative water content.*** Fresh weight (FW) was received by means of weighing the fresh leaves. The samples have been then hydrated to full turgidity underneath normal room temperature overnight. After hydration, the samples had been taken out of the water and were properly dried fast and lightly with tissue paper and straight away weighed to achieve absolutely turgid weight (TW). Samples had been then oven dried at 80 ^{0}C for 24h and weighed (after being cooled down in a desiccator) to decide dry weight (DW) (Barrs and Weatherley, 1962).

$$Relative\ water\ content\ (RWC) = [(FW - DW)/(TW - DW)] \times 100$$

Where:

FW = fresh weight,

DW= dry weight, and

TW= turgid weight.

b. LEAF EXTRACT Ph. 1 gram of washed leaves was homogenized in10 ml de-ionized water and centrifuged at 2,500 rpm for 3 mins. The pH of filtered leaf extract was measured with the help of digital pH-meter with a glass electrode dip in a homogenized solution of leaf filtrate. The glass electrode was calibrated using the buffer solutions of pH4 and pH 9. (Singh and Rao,1983)

c. Total Chlorophyll Content (Photosynthetic Pigment). According to Arnon (1949), chlorophyll concentration was calculated.1 gram of fresh leaves were taken and cut into small pieces (about 1 mm wide) with scissors, leaves were grinded in 20 ml of 80 % acetone. After grinding the sample was transferred to another test tube and centrifuged at 2,500 rpm for 3 minutes.

Measure the optical density (absorbance) of the extract with the help of spectrophotometer. Measure optical density at 480 nm, 510 nm, 645 nm and 663 nm. These are positions in the spectrum where maximum absorption by chlorophyll *a* and *b* occur. The concentration of chlorophyll *a* and *b*, in mg/g of tissue, and carotenoids in mg/g is calculated by the following formula as given by Mac Kinney (1941):

$$Chlorophyll\ a(\frac{mg}{g}) = \frac{12.7 \times O.D645 - 2.69 \times O.D663}{1000 \times W} \times V$$

$$Chlorophyll\ b(\frac{mg}{g}) = \frac{22.9 \times O.D645 - 4.68 \times O.D663}{1000 \times W} \times V$$

$$Carotenoids\ (\frac{mg}{g}) = \frac{7.6 \times O.D480 - 1.49 \times O.D510}{1000 \times W} \times V$$

Total chlorophyll content (Tch) = Chlorophyll a + Chlorophyll b (mg/g)

V = Total volume of the chlorophyll solution (ml)

W = Weight of the tissue extracted (g)

O.D=Optical density

d. Ascorbic Acid. Take 5 ml of working standard in 100 ml of a conical flask and add 10 ml of 4% oxalic acid. Titrate against the dye and note the point in the appearance of pink color, which persists for a few minutes (V_1 ml). Extract 1 gm of sample in 10 ml of 40% oxalic acid and filter, collect the filtrate and make the volume up to 100 ml by adding 4% oxalic acid. Pipette out 5 ml of the extract, add 10 ml of 4% oxalic acid and titrate against dye, by (Sadasivam and Manikam, 1991).

$$Ascorbic\ acid\ \frac{mg}{100}\ gm\ sample = (0.5mg \times V1ml) \times \left(\frac{V2ml}{5ml}\right) \times \left(\frac{100ml}{wt}.of\ sample\right) \times 100$$

Where:
V_1= Reading with standard
V_2= Reading with extract

III. AIR POLLUTION TOLERANCE INDEX

APTI of tree species has been calculated by the following formula proposed by Singh and Rao (1983).

$$APTI = \frac{A(T+P)+R}{10}$$

Where:
A= ascorbic acid contents in mg/g of leaves
T = total chlorophyll in mg/g fresh weight
P = pH of leaf extract
R = relative water content (%)

Based on the APTI values the plants were conveniently grouped into categories as mentioned in the following (Kalyani and Singaracharya, 1995):
APTI values Response are -
30 to100= Tolerant
29 to17= Intermediate
16 to 1 =Sensitive
<1 =Very sensitive

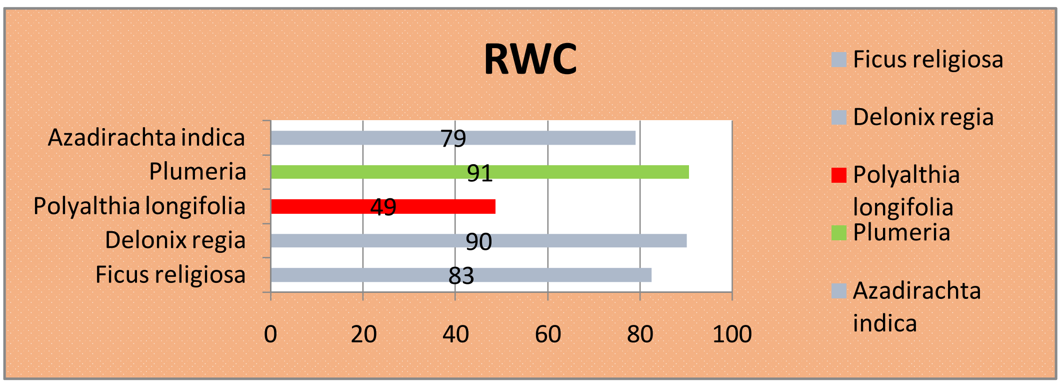
IV. RESULT ANALYSIS

After performing and analyzing all the bio-chemical parameters of plant leaves and resultant APTI, following result has been concluded.

Relative Water Content: -Relative water content of each species has been calculated based on Fresh weight, turgid weight and dry weight of leaves. As per the formulae, the Relative water content is calculated. As per the result RWC of Plumeria sp. Is highest and Polyalthia longifolia is lowest (Table 1 and graph 1).

Table 1: Relative water content.

S.No.	Name of species	FW	TW	DW	RWC
1	Ficus Religiosa	3.83	4.34	1.42	83
2	Delonix regia	0.56	0.61	0.1	90
3	Polyalthia longifolia	0.86	1.25	0.49	49
4	Plumeria	6.15	6.64	1.44	91
5	Azadirachta indica	1.41	1.67	0.43	79



GRAPH 1: RELATIVE WATER CONTENT

Ph. The pH of leaf extract was scaled.While we are planning to plant trees it is essential to understand which plant should be planted as per our requirement. The pH of leaf reflects the acidic and alkaline nature as a response to a sensitivity of air pollution (Singh and Rao, 1983).The result shows that Ficus Religiosa is most acidic among all and Azadirachta indica is most acidic among all (Table 2 & Graph 2).

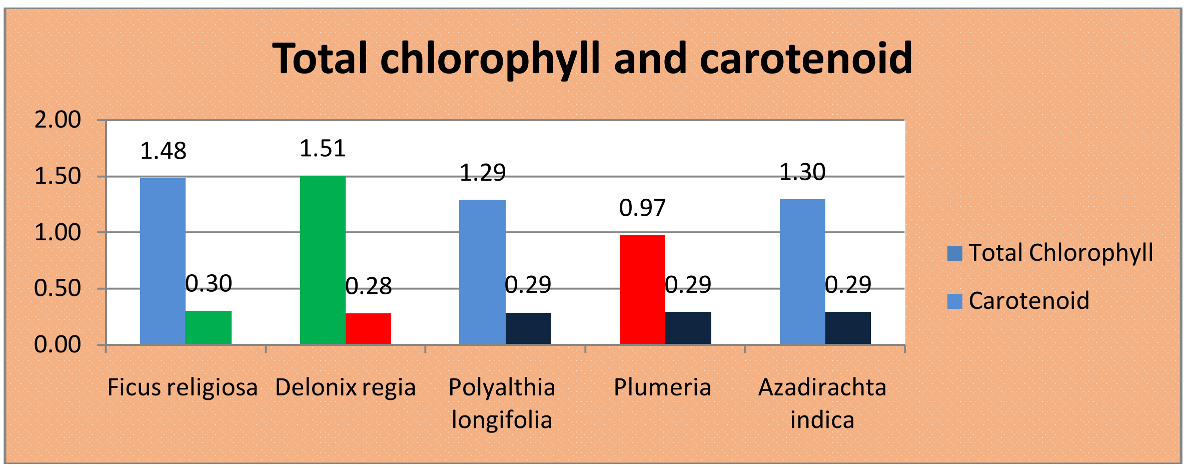
Table 2 : pH of plant species.

S No.	Name of species	pH	Temp
1	Ficus Religiosa	7.54	23.2
2	Delonix regia	7.04	23.1
3	Polyalthia longifolia	6.62	23
4	Plumeria	6.5	24.4
5	Azadirachta indica	6.61	22.5

Total Chlorophyll Content (Photosynthetic Pigment) With an increase in the level of pollutant each year, the photosynthetic mechanism of plants has started deteriorating.Additionally, it was reported a reduction in pigment content brought by acidic pollutants like SO2 that causes pheophytin formation by the action of chlorophyll (Chauhan A, Joshi PC, 2008).The carotenoid content of Ficus Religiosa was found to be high and it had been low forDelonix regia. Carotenoids area unita category of natural fat-soluble pigments found in the main in plants, algae, and photosynthetic microorganism, wherever they play a critical role in photosynthesis Process (Ong ASH, Tee ES, 1992). Carotenoids protect chlorophyll from photooxidative destruction (Sifermann Harms D, 1987). The chlorophyll content of Delonix regia was found to be high and Plumeria sp. low. The values are calculated in mg/g fresh leaves (Table 3 & Graph 3).

Table 3: Chlorophyll and carotenoid content of plant leaves.

S No.	Name Of Species	Chlorophyl 1 A	Chlorophyll B	Total Chlorophyll	Carotenoid
1	Ficus Religiosa	0.49	1.00	1.48	0.30
2	Delonix regia	0.52	0.98	1.51	0.28
3	Polyalthia longifolia	0.48	0.81	1.29	0.29
4	Plumeria	0.48	0.49	0.97	0.29
5	Azadirachta indica	0.43	0.86	1.30	0.29

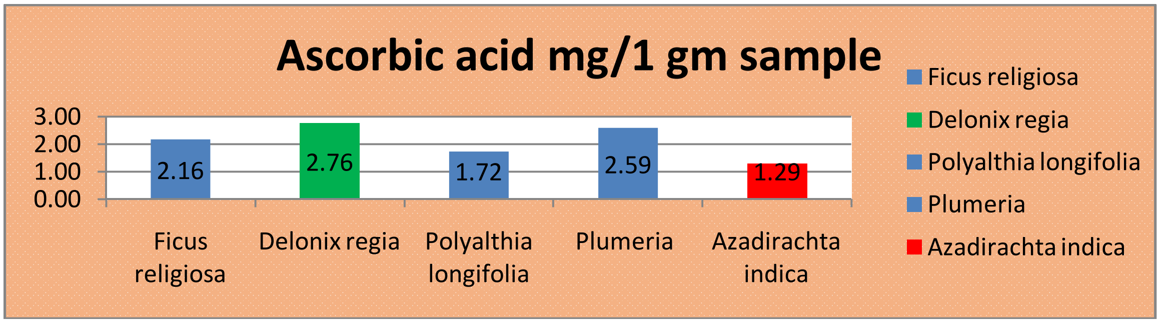


GRAPH 3: TOTAL CHLOROPHYLL AND CAROTENOID

Ascorbic Acid. As per the studies it states that plants having high ascorbic acid are more tolerant to air pollutants.The result shows Delonix regia has highest ascorbic acid content and Azadirachta indica has lowest ascorbic acid content among all five species (Table 4 and Graph 4).

Table 4 : Ascorbic acid of plant species.

S No.	**Name of species**	**Volume of extract(V1)**	**Ascorbic acid mg/1 gm sample**
1	Ficus religiosa	2.5	2.16
2	Delonix regia	3.2	2.76
3	Polyalthia longifolia	2	1.72
4	Plumeria	3	2.59
5	Azadirachta indica	1.5	1.29



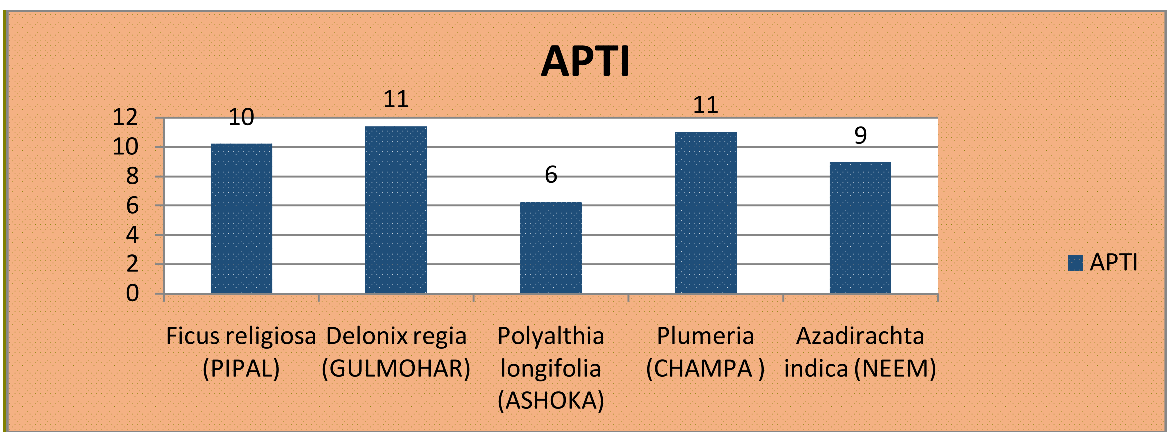
GRAPH 4: ASCORBIC ACID OF PLANT SPECIES

V. AIR POLLUTION TOLERANCE INDEX

Air pollution tolerance index is an index which species sensitivity of different category of plant species under the effect of pollutants based on bio-chemical parameters.In this study, all the plants's species are falling under sensitive zone. In which Polyalthia longifolia is very sensitive to pollution and Plumeria and Delonix regia are comparatively less sensitive to air pollutants (Table 5 & Graph 5).

Table 5 : Air Pollution Tolerance Index of Plant Species.

ANALYSIS OF APTI OF SELECTED PLANT AT NOIDA SECTOR 78,(SOCIETY GATE)							
S NO.	NAME OF SPECIES	RELATIVE WATER CONTENT	PH	ASCORBIC ACID MG/1 GM SAMPLE	TOTAL CHLOROPHYLL	APTI	APTI VALUE RESPONSE
1	Ficus Religiosa (PIPAL)	83	7.54	2.16	1.48	10	S
2	Delonix Regia (GULMOHAR)	90	7.04	2.76	1.51	11	S
3	Polyalthia Longifolia (ASHOKA)	49	6.62	1.72	1.29	6	S
4	Plumeria sp. (CHAMPA)	91	6.5	2.59	0.97	11	S
5	Azadirachta Indica (NEEM)	79	6.61	1.29	1.30	9	S



GRAPH 5: AIR POLLUTION TOLERANCE INDEX OF PLANT SPECIES

VI. CONCLUSION

Human beings are directly dependent on plants in form of vegetables, fruits, construction materials etc. In all forms, we need purity of substance which could be only achieved if Plants grow in better conditions. With an increase in industrialization, maximum use of private vehicles, a danger of deforestation etc. The concentration of air pollutants is increasing on a vast scale. Noida being one among the planned city, still, it lacks in the proper plantation of plants. Since it is one among the Nation Capital Region we need to focus on its beauty and sustainability. As per my study, all five species are coming under sensitive zone. APTI is one of the important tools which may help in a healthy plantation of trees. According to circumstances, we can plant trees around us which should be highly tolerant to air pollution. Further, I will continue my work and make a comparative study of plant species at different sites of National Capital Region.

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