GoldenGate Journal of Science & Technology 2017, 3: 27 - 29 ©GJST
ISSN 2505-0656 (Print)

Environmental Science

ASSESMENT OF AIR POLLUTION TOLERANCE INDEX OF TREE SPECIES (A CASE STUDY ON KATHMANDU RINGROAD TREES)

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Abstract

Air pollution tolerance index (APTI) determination is very important for the selection of tree species plantation in the polluted area because of the increasing industrialization, traffic due to air pollution threatening the environment. APTI was calculated for selected plant species growing in road sides of Ring road in Kathmandu. The leaf samples were collected from different five trees species of most abundant species. The determination of APTI by calculating the four parameters i.e. ascorbic acid content, total chlorophyll, pH and relative water content of leaf extract. The APTI was high with Bougainvillea glabara (7.56) followed by Albezia saman (6.48), Ficus benjamina (6.33), and Psidium gaujava (5.86) and least with Grevillea robusta (1.78). The selected tree species were found to be sensitive to pollution. Species with lower APTI value are considered sensitive species, which can be used as a biological indicator for further monitoring of air quality. Species with higher APTI value are tolerant species and thus, can be planted for pollution abatement in order to control and reduce air pollution.

Key words: *APTI, roadside trees, tolerance species*

Introduction

Air pollution has become a major problem arising mainly from industrialization and urbanization during last few decades and is one of the major factors deteriorating the quality of life in cities, making people more vulnerable to diseases. Particulate matter is of great concern in relation to their adverse impact on human health and vegetation (Rai, 2013). The degradation of air quality is major environment problem that affects many urban and industrial sites and the surrounding region worldwide (Kuddus et al., 2011). There have been significant development activities in terms of industrialization and urbanization in almost all cities. The major contribution to the air pollution is vehicular emission from combustion of fuel, due to increasing use of private transportation (Liu & Ding, 2008.).

Air pollution can directly affect plants through leaves. Air pollution leads to the acid rain which limits the nutrient availability to the plants result the damage of leaves. Most plants experience physiological change when exposed to airborne pollutant before exhibiting visible damage to leaves (Dohman et al., 1990). Therefore, new threat calls for new approach in the selection process of urban plantation. The idea that selected species will be resistant and tolerant to the high level of air pollution witnessed currently urban center. The response of the plants towards air pollution is assessed by the air pollution tolerance index.

Materials and Methods

Study Area

The location selected for present study was ring road of Chabahil Chowk to Om Medical Hospital which is one of the busiest roads of the Kathmandu with heavy traffic.

Sampling and Sample size

Leaves were collected from those species which are more abundant plant species along road from Chabahil Chowk to Om Medical Hospital during the month of March, 2017. The samples were brought to laboratory and kept in refrigerator for further analysis of biochemical parameters. Fresh leaf weight was immediately taken.

Laboratory Method

The APTI value is calculated by the formula given as (Singh and Rao 1983),

APTI= A (T + P) + R] / 10 …… (1)

Where,

A= Ascorbic acid content (mg/g)

T= Total chlorophyll content (mg/g)

P= pH of leaf extract

R= Relative water content (%)

The APTI values were categorized by three groups (Lakshmi, 2009).

APTI Value	Response
30 to100	Tolerant
29 to17	Intermediate
16 to 1	Sensitive
< 1	Very sensitive

Biochemical Parameters

Relative water content (RWC)

Fresh weight was obtained by weighing the leaves. The leaf samples were then immersed in water over night blotted dry and then weighed to get the turgid weight. The leaf were then dried in a hot air oven at 105°c and reweighed to obtain the dry weight. RWC was determined by using the formula given as,

RWC= [(FW-DW) / (TW-DW)] ×100

Where: FW = fresh weight, DW = dry weight, TW = turgid weight.

Leaf extract pH

5 g of fresh leaves was washed and homogenized with 25 ml of distilled water and the pH of leaf was measured with pH meter.

Total chlorophyll

1 g of fresh air leaf tissue was grounded in pestle and mortar with 5ml of 80% acetone and content transferred to big sized tube, made the volume 20ml and were left for 15 min. the liquid portion was decanted into another test tube and then centrifuged at 2500 rpm for 10 min. and leave to settle down. The supernatant was then be collected and the absorbance were taken at 645nm and 663nm using uv-spectrophotometer. Then the chlorophyll content was calculated by the following formula;

Total Chlorophyll = (20.2 X OD645 + 8.02 X OD663) V

10000W

Where,

OD = Optical Density

V = Total volume of chlorophyll solution, ml

W = weight of the tissue extracted, g

Ascorbic Test Content

5 g of leaf sample was taken in a test tube and 5ml oxalic acid+EDTA (2.5gm oxalic acid+ 0.37gmEDTA+500ml distilled water) extracting solution was added. 1ml of orthophosphoric acid followed by 1ml of 5% sulphuric acid, 2ml ammonium molybdate and 3ml of water were added respectively and left to react for 15min. Absorbance was measured at 760nm using UV-Visible spectrophotometer. The ascorbic acid concentration was then obtained from a standard ascorbic acid curve.

Results & Discussion

Air pollution tolerance index (APTI) was calculated for the five plant species planted in Chabahil- road section was taken for biochemical analysis. *Grevillea robusta* is highly dominated in numbers followed by the *Albezia saman* and *Psidium gaujava* and a least in number is *Bougainvillea glabara.* The results obtained from the analysis of biochemical parameters that were analyzed for APTI listed in below table 1.

Table no.1 Air pollution tolerance index of studied plant

S. N	Scientific Name	Relative Water Content (%)	pH	Total Chlorophyll (mg / g)	Ascorbic Acid (mg / g)	APTI
1	*Albezia saman*	61.92	5.06	0.06	0.5	6.48
2	*Grevillea robusta*	17.15	5.94	0.72	0.1	1.78
3	*Psidium guajava*	57.83	6.31	0.27	0.13	5.86
4	*Ficus benjamina*	62.51	6.17	0.28	0.13	6.33
5	*Bougainvillea glabara*	73.88	6.45	0.73	0.25	7.56

pH

The pH observed for all the plant ranges from 5 to 6 which might be due to SOx, NOx pollutants from the vehicular emission.

Relative water content

Relative water content of *the Bougainvillea glabara* is found higher with 73.88% *and Grevillea robusta* has least water content with 17.15%. High water content within a plant body will help to maintain its physiological balance under stress condition such as exposure to air pollution.

Total Chlorophyll

The chlorophyll content of selected plant/tree species ranges between 0.06-0.73 mg/g among the roadside. The highest total chlorophyll content among the species was recorded *in Bougainvillea glabara* (0.73) followed by *Grevillea robusta* (0.72) and *Ficus benjamina* (0.28) and the lowest value were obtained in *Psidium guajava* (0.27) and *Albeza saman* (0.06) have least total chlorophyll contain among all.

Absorbic Acid

The collected sample trees were found under sensitive in nature ranges between 0.1 to 0.5 mg/g (Lakshmi *et al*., 2009). Ascorbic acid content as trees reducing factor is generally higher in tolerant tree species. High level of pollution in air increases the phytotoxicity of plants by impinging a decrease in the ascorbic acid content which results in increased susceptibility of plants to pollution (Singh & Verma 2007).

APTI

The APTI values for each tree/plant species at polluted site were calculated and the value obtained of *Albezia saman, Grevillea robusta, Psidium gaujava, Ficus benjamina, and Bougainvillea glabara* were 6.48, 1.78, 5.86, 6.33, and 7.56 respectively. The highest APTI value was obtained in the *Bougainvillea glabara* and the least value was obtained in the *Grevillea robusta* among all of the selected tree species. The decrease value of APTI may be due to decreased chlorophyll in the plant in respond to air pollution due to reason of damage.

Conclusion

APTI determination is very important for the selection of tree species plantation in the polluted area because of the increasing industrialization, traffic due to air pollution threatening the environment. The tolerant species on the basis of APTI can be used to plant in urban forestry. Plants used as sink leads to accumulation of pollution which alters the nature of leaf and make them more sensitive. Sensitivity and response of plants to air pollution is variable. However, all the selected plant/tree species are sensitive, *Grevillea robusta* found more sensitive than others. So, the species which are more sensitive can be preferred for the biological indicators of air pollution and the tolerant one can be used as sink to pollution. Therefore, the results of such studies are handy of future planning. It is worth noting that combining a variety of parameters gave a more reliable result than when based on a single biochemical parameter. Plants have the potential to serve as excellent quantitative and qualitative indices of pollution.

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