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"A COMPARATIVE STUDY FOR AIR POLLUTION TOLERANCE INDEX OF SOME PLANTS"

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ABSTRACT :

Now a day's air pollution is one of the serious problems around the world. Plants can filter the air via-aerial elements particularly through twigs, stems, leaves, etc. Afforestation program is the best way to control the air pollution. Air pollution tolerance index (APTI) is an intrinsic quality of trees to control pollution problems, which is currently of major concern of urban localities. The trees having higher tolerance index rate are tolerant towards air pollution and can be used as a source to control air pollution, where as the trees having less tolerance index can be used as an indicator to know the rate of air pollution. By combining biochemical and aggregate factors the Anticipated Performance Index is prepared, which is also helpful in green belt development. The present study is based on the assessment of APTI of different plants for mitigating air pollution.

KEYWORDS : *APTI; Air pollutants; Biochemical Parameters; Pollution.*

INTRODUCTION

Air pollution is one of the severe problem world is facing today.The **Air Pollution Tolerance Index** (**APTI**) is a simple and generalized way to describe the air quality. It is calculated from several sets of air pollution data.It deteriorates ecological condition and can be defined as fluctuation in any atmospheric constituents from the value that would have existed without human activity. Over the years, there has been a continuous growth in human population, road transportation, vehicular traffic and industries which increases the concentration of gaseous and particulate pollutants. (Krishna *et al.* 2014)

In recent decades, air quality in major cities of developing countries has deteriorated sharply due to rapid increase in traffic, vehicular and industrial emission, and the reduction of urban vegetation cover (Kim *et al.* 2015; Santos *et al.* 2015). Vehicular emission is considered to be a major source of air pollutants viz particulates, CO, SO_2, NOx, heavy metals and polyaromatic hydrocarbons (PAHs) (Kulshreshthaand Sharma 2015; Kisku *et al.* 2013). Release of such pollutants into atmosphere not only deteriorates the ambient air quality, but also poses health risk to the people particularly those suffering from respiratory and cardiovascular illness (Jahan *et al.* 2016; Adress *et al.* 2016).

To indicate the susceptibility level of a plant, pollution – induced changes in individual parameters and usually quantification and correlated with the level of plant response. However, it has been observed that pollution induced changes in one parameter alone may not provide a clear picture of the situation. Therefore, after careful consideration of the contribution of ascorbic acid, chlorophyll, relative water contents, and leaf extract pH to pollution tolerance in plants, these parameters were computed together in a formulation to obtain an empirical value signifying the air pollution tolerance index (APTI) of species (Singh and Rao, 1983).

MATERIALS AND METHODS

A total 20 plant species were investigated with respect to their APTI value. For this purpose, samples of mature leaves from plants were collected from the experimental sites near roadside of power loom (location 1) and garden side (location 2). For each species, three individuals were identified and samples in triplicate were taken from each of them. The collected samples were analysed for ascorbic acid, chlorophyll, relative water contents, and leaf-extract pH. Mean value of different parameters were used for computing the index.

The ascorbic acid content (mg g^{-1} dry weight) was determined using the titration 2, 6 - dichlorophenol indophenol method described by Keller and Schwager (1977).

Total chlorophyll (mg g^{-1} dry weight) was estimated following the Arnon 1949. 1gm of fresh was homogenized in 10ml of 80% acetone and added a pinch of $MgCO_3$ while crushing and left for 15min. the liquid protein was decanted into another test tube and centrifuged at 2,500rpm for 3min. the supernatant was then collected and the absorbance was taken at 620nm (A1) and 660nm (A2) for chlorophyll a and b respectively. Calculation was done by using the formula given below:

Total chlorophyll content = (A1 + A2) x volume of acetone / 1000 x w

For leaf extract pH, 100mg of fresh leaves was homogenized in 10ml deionized water. This was filtered and pH of the leaf extract was determined after calibrating pH meter with buffer solution pH 4 and pH 9.

The 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 leaves were then dried over night in a hot air oven at 70°C and reweighed to obtain the dry weight. RWC was determined and calculated by the method as described by Singh 1977.

RWC = [(FW – DW) / (TW - DW)] x 100
Where,FW–fresh weight
DW – dry weight and
TW – turgid weight

The APTI of a species was determined by using the formula developed by Singh and Rao (1983).

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

Where, A is the ascorbic acid content of leaf in mg g-1 dry weight, T is the total chlorophyll of leaf in mg g-1 dry weight, P is the leaf extract pH and R is the per cent relative water content of the leaf tissue. The total sum is divided by 10 to obtain a manageable figure.

RESULT AND DISCUSSION

The results of each biochemical components and air pollution tolerance index are enumerated in fig.1 to fig.5.

pH:

The high pH may increase the efficiency of the conversion from hexose sugar to ascorbic acid (Escobedo et al. 2008) while low leaf pH extract showed good correlation with sensitivity to air pollution and also reduces photosynthesis in plants. The photosynthesis efficiency strongly is dependent on leaf pH (Yan ju and Hui ding, 2008). The photosynthesis was reduced in plants with low pH (Turk and Wirth, 1975). The leaf extract pH in plants increased due to basis pollutants present at the polluted site. The pH observed in Fig.1 was found to be different for all plant leaves studied at two selected locations.

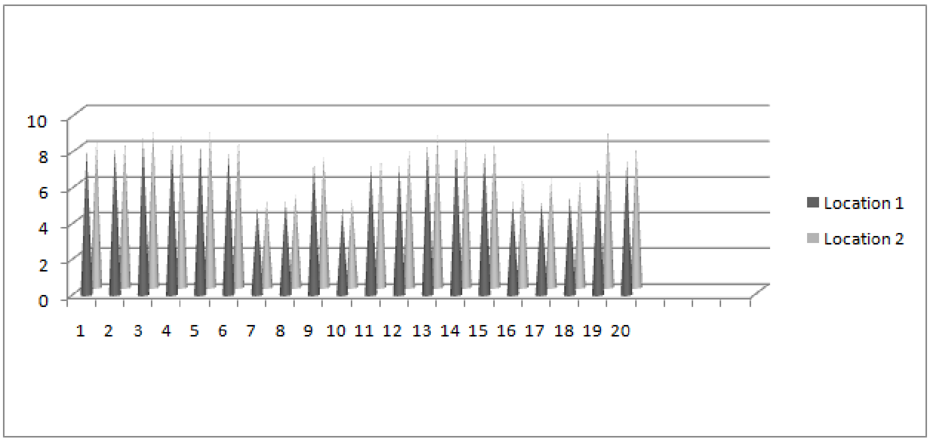

Figure 1: pH of plant

RELATIVE WATER CONTENT:

The relative water content (RWC) of leaves in an indicator of the plants water status with respect to physiological consequences of cellular water. RWC is useful indicator of the state of the water balance of the plant. The large quality of water in plant body helps in maintaining its physiological balance under stress conditions (Gohalez et al. 2001). The results of relative water content are shown in Fig.2. The relative water content was high with *Bougainvilleaspectabilis* while, it was low with *Ficusbenghalensis*. All the other plantsshowed relative water content in the range of 20.25% to 78.90%.

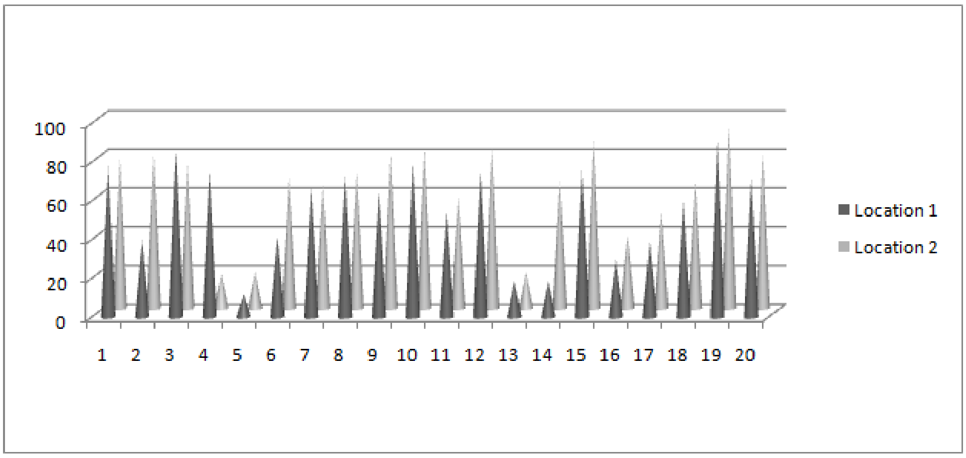

Figure 2: Relative water content

ASCORBIC ACID CONTENT:

The ascorbic acid content is shown in Fig.3. In location 1, the ascorbic acid content was high with *Azadirachtaindica* and very low with *Ziziphusjujuba*, most of the plants collected in location 1 found to contain ascorbic acid in the range of 0.25 to 8.5 mg/g ascorbic acid. In location 2, ascorbic acid content was high for *Bougainvilleaspectabilis* and very low with *Santalumalbum*, rest of the plants showed value of ascorbic acid content in the range of 0.31 to 8.0 mg/g ascorbic acid.

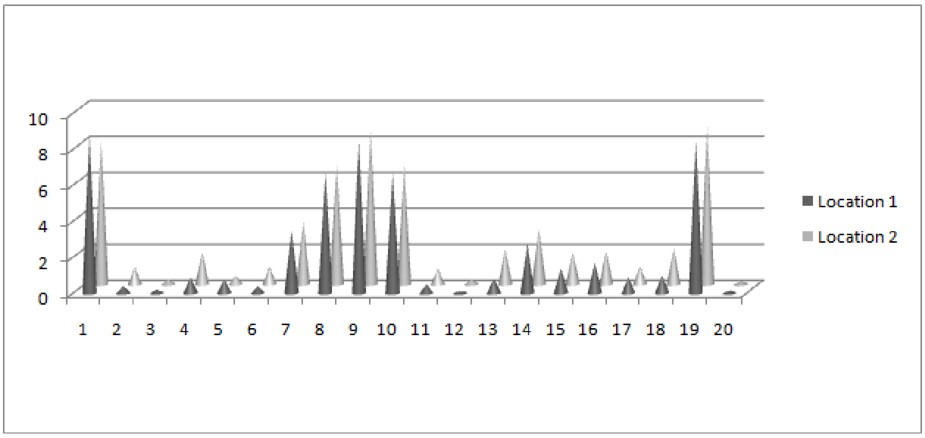

Figure 3: Ascorbic acid content

TOTAL CHLOROPHYLL CONTENT:

The results of total chlorophyll are shown in Fig.4. The chlorophyll level was higher with *Ficusbenghalensis*, and low with *Mangiferaindica* in location 1. All the other plants showed values in the range of 0.08 to 1.7mg/g chlorophyll. In location 2, chlorophyll level was high for *Bougainvilleaspectabilis* and very low with *Mangiferaindica*, rest of the plants showed values in the range of 0.08 to 1.75mg/g chlorophyll.

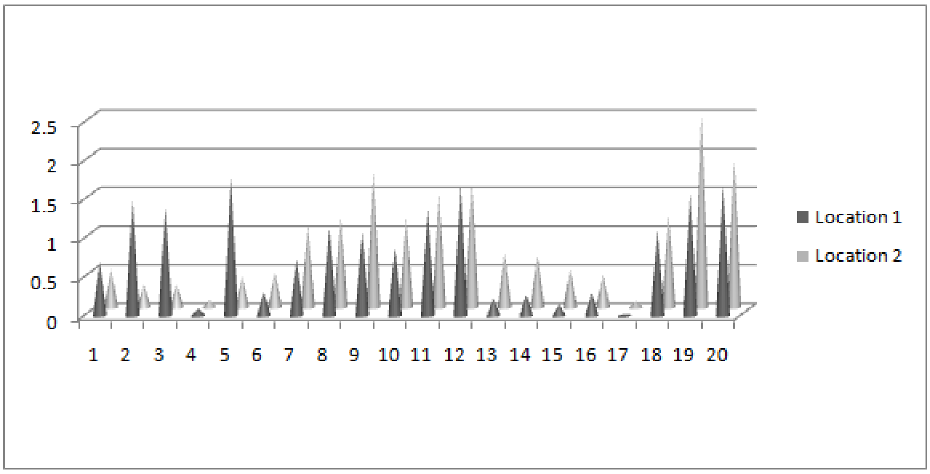

Figure 4: Total chlorophyll content

AIR POLLUTION TOLERANCE INDEX:

The air pollution tolerance index of plants analysed in both the locations are shown in Fig. 5. The tolerance index for the location 1 (near road sides of power loom) is given here in the decreasing order *Ficusbenghalensis<Ficusglomerata<Mangiferaindica<Tamarindusindica<Polyalthialongifolia<Psidiumguajava <Annonasquamosa<Syzygiumcumini<Santalumalbum<Ficusreligiosa<Ziziphusjujuba<Dalbergiasissoo<Euginiajambolana<Azadirachtaindica<Albizialebbeck<Pongamiapinnata<Cassiaauriculata<Calotropisgigantea<Neriumindicum<Bougainvilleaspectabilis*.

Likewise, the air pollution tolerance index of plants studied at second location (garden side). The increase in index value is given as follows: *Bougainvilleaspectabilis> Pongamiapinnata> Calotropisgigantea> Albizialebbeck>Cassiaauriculata>Polyalthialongifolia>Neriumindicum>Ziziphusjujuba>Annonasquamosa>Ficusbenghalensis>Ficusreligiosa>Euginiajambolana>Dalbergiasissoo>Santalumalbum>Syzygiumcumini>Psidiumguajava>Azadirachtaindica>Ficusglomerata>Tamarindusindica>Mangiferaindica*.

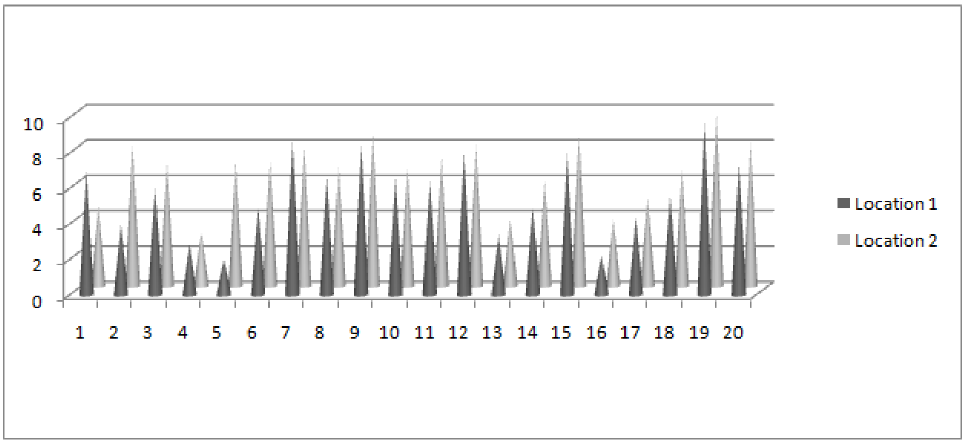

Figure 5: Air Pollution Tolerance Index

CONCLUSION

Plants that are continuously exposed to pollutants leads to accumulation of pollution, integration of pollutants in to their own system, thereby altering the nature of leaf and make them more sensitive. This sensitivity is measured through various biochemical changes and finally to air pollution tolerance index. In our study, all the plants were found to be sensitive species.

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