ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 3(K), pp. 25444-25447, March, 2018

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

EVALUATION OF AIR POLLUTION TOLERANCE INDEX OF SELECTED PLANTS IN SOUTH CHENNAI

Santhanalakshmi. P[1]., Mary Teresita. V[1]., Sathyabama S[2] and Avila Josephine.B[1]*

[1]Department of Chemistry, Stella Maris College, Chennai-86, India
[2]Department of Plant Biology and Biotechnology, Stella Maris College, Chennai-86, India

DOI: http://dx.doi.org/10.24327/ijrsr.2018.0903.1859

ARTICLE INFO

Article History:

Received 15th December, 2017
Received in revised form 25th January, 2018
Accepted 23rd February, 2018
Published online 28th March, 2018

Key Words:

Air pollution, Tolerance index, bio-chemical parameters, relative water content, polluted areas

ABSTRACT

One of the major problems faced by the world today is air pollution. Plants play a vital role in monitoring the air pollution. Plants are the ones, which have the ability to reduce the effect of air pollution. As they involve in this process, they are highly injured. The level of injury in plants is been studied through Air pollution tolerance index (APTI). APTI value can be calculated using four bio-chemical parameter namely, ascorbic acid content, total chlorophyll content, pH and relative water content. The study was carried out in two different locations of south Chennai in five different plants such as *Ixora coccinea* (santan), *Hibiscus rosa sinensius* (shoe flower), *Murraya koenigii* (curry leaves), *Plectranthus amboinicus* (Indian borage), *Bougainvillea glabra* (Paperflower). The plants taken inside the college campus were considered as plants in Stella Maris College campus and plants along the road side platform were taken as highly polluted areas in Chennai. The results were compared for both the locations, in which there was decrease in all the parameters in the highly polluted areas in Chennai which was highly polluted compared to plants in Stella Maris College campus.

INTRODUCTION

Air pollution is one of the major problem world is facing today. It deteriorates the ecological conditions by introducing harmful substances in air, causes abnormal increase or decrease in the concentration of normal component (Tripathi A.K *et.al*., 2007). The concentration of gaseous pollutants discussed by Joshi.N *et al*., 2009 has increased over the years due to the growth in human population, road transport, vehicular traffic and industrialization. These pollutants in the atmosphere damage the health of the plants. Plants play an important role in maintaining the ecological balance. The leaves are usually most abundant and most exposed primary receptors of air pollutants. The previous studies on air pollution have reported physiological changes in plants before exhibiting visible damage to leaves. Impact of air pollution on local crops causes major economic issues, which not only adds pollutant to environment but also to health of humans. Plants sensitivity and response are variable. The pollutants which directly pollute the air are called primary pollutants while those that are formed in the air when primary pollutants react or interact are known as secondary pollutants (Krishnaveni.M *et.al*., 2013). The plant species which are more sensitive, acts as a biological indicator of air pollution (Dohmen. G *et al*., 1990). The response of physiological and biochemical levels can be understood by analyzing the factor that determines the resistance and susceptibility. Air pollution tolerance index (APTI) is a number used to identify the quality of the air at a given location. APTI is determined by the response of the plants towards air. The level of air pollution tolerance in each plant is different. The adverse effect of plants can be studied by calculating four parameters such as ascorbic acid content, pH, relative water content and total chlorophyll content (Pierre. M *et al*., 1981). These four parameters are important as they are interlinked to each other for its survival. Based on their formation the pollutants are classified into two types.

Experimental Methods

Study area

The study was carried out in Stella Maris College. The plants inside the campus were taken as plants in Stella Maris College campus and plants near the road side are taken as highly polluted areas in Chennai. Study was carried out in comparison of both plants in Stella Maris College campus and highly polluted areas in Chennai.

Corresponding author:* **Santhanalakshmi. P
Department of Chemistry, Stella Maris College, Chennai-86, India

Ascorbic acid content

Ascorbic acid content was measure using titrimetric method using 2,6-Dichlorophenol indo phenol dye. 100 mg of leaf was extracted with 4% oxalic acid and titrated against dye until pink colour develops.

Leaf extract pH

100 mg of leaf was homogenized in 50 ml of deionised water, filtered and pH of filtered leaf extract was determined after calibrating using buffer solution.

Relative water content

Fresh weight was obtained by weighing the leaves. The leaf samples were immersed in water overnight, blotted dried and then weighed to obtain turgid weight. The leaves were then dried overnight in an hot air oven at 70° C and reweighed to get dry weight

RWC= [(FW-DW)/(TW-DW)] x100
(FW= fresh weight, DW= dry weight, TW= turgid weight)

Total chlorophyll content

500 mg of leaf was extracted with 10 ml of 80% acetone for 15 minutes and centrifuged for 3 minutes. The supernated liquid of leaf extract was transferred into a clean test tube. 1ml of this was further diluted with 5 ml of 80% acetone. The chlorophyll content was analyzed with the help of spectrophotometer and absorbance was measured at the wavelength of 643 nm, 645 nm, and 663 nm.

Chl a (mg/L) = 12.7 A_{643} – 2.96 A_{645}
Chl b (mg/L) = 22.9 A_{645} – 4.68 A_{663}
C_T (mg/L) = Chl a + Chl b
Chlorophyll content (mg/g) = C_T X V/ W / 1000

Where Chl a and Chl b are the concentration of Chlorophyll a and b of the leaf extract solution at the corresponding wavelength. A refers to absorbance of the solution measured at wavelength 643 nm, 645 nm and 663 nm. C_T (mg/L) is the total chlorophyll concentration of the solution, V is the total volume of the extracted solution (ml), W is the weight of the leaf extracted.

Calculation of Air pollution tolerance index

Air pollution tolerance index was assessed, to determine the tolerant/resistance power of plants against air pollution. The air pollution tolerance index was calculated using the formula

APTI = A(T+ P)+ R/10
Where: A =Ascorbic Acid (mg/g),
T =Total Chlorophyll (mg/g),
P = pH of the leaf extract,
R = Relative water content of leaf (%).

Sodium and potassium content

500mg of sample leaves was extracted using 15 ml of deionised water and further diluted by adding 10 ml of deionised waster to 5 ml of leaf extract. Standard solution of 5, 50 and 500 ppm were prepared. The sodium and potassium content in plants were determined using flame photometry.

RESULTS AND DISCUSSION

Bio-chemical measurements were done to determine APTI value for five plants *Ixora coccinea*, *Hibiscus rosa sinensius*, *Murraya koenigii*, *Plectranthus amboinicus*, *Bougainvillea glabra*. The results of the bio-chemical measurements where discussed for both plants in Stella Maris College campus and highly polluted areas in Chennai for each plant species. There tolerance and sensitive nature are compared.

Ascorbic acid content

Ascorbic acid is an antioxidant, it is associated with other components of the antioxidant system. It protects plants from oxidative damaging resulted from aerobic metabolism, photosynthesis and range of pollutants. On comparing both locations ascorbic acid content was high in *Hibiscus rosa sinensius* (0.6521 mg) and *Bougainvillea glabra* (0.3261 mg) have low value in plants in Stella Maris College campus (figure 1). In highly polluted areas in Chennai, *Ixora coccinea* have the high ascorbic acid content (0.5434 mg) and *Bougainvillea glabra* (0.2717) have low value. The plants which maintain a high ascorbic acid under polluted conditions are considered to be tolerant.

Total chlorophyll content

The chlorophyll content in plant was estimated using UV-VIS spectrophotometer between the wavelength range 400-800nm. The spectrum for the plant extract is shown in figure.2 (a-e). Acidic pollutant like SO_2 reduces chlorophyll content and cause phaeophytin formation by acidification of chlorophyll. In all the spectrum intensity of absorbance in plants in Stella Maris College campus is greater than highly polluted areas in Chennai. From which, effect of air pollution has reduced the chlorophyll content is clear. Calculating the value of total chlorophyll content *Hibiscus rosa sinensius* (0.16 mg/g) has higher value in plants in Stella Maris College campus. In highly polluted areas in Chennai *Bougainvillea glabra* (0.12mg/g) has high chlorophyll content. *Murraya koenigii* has low value (figure 3). All the plants have experienced decrease in total chlorophyll content highly polluted areas in Chennai.

Leaf extract pH

The photo synthetic efficiency of plant species strongly depends upon the leaf pH. Comparing the plants in Stella Maris College campus and in highly polluted areas in Chennai, the pH of the plants Ixoracoccinea, Hibiscus rosa sinensius is increased in highly polluted areas in Chennai, *Ixora coccinea*, *Hibiscus rosa sinensius* there pH is increased in highly polluted areas in Chennai. There has been decrease in highly polluted areas in Chennai in plant species such as *Murraya koenigii*, *Plectranthus amboinicus*, *Bougainvillea glabra*. The variations are shown in figure 3.

Total relative water content

Relative water content of a leaf is the water content present in plants, which helps to maintain its physiological balance under stress condition caused by pollutants. *Murraya koenigii* have the lowest value in highly polluted areas in Chennai of 69.23% and in plants in Stella Maris College campus of 72.73%. comparing the total relative water content to the plants that are present in our study *Plectranthus ambionicus* has a high relative water content of 87.91% in plants in Stella Maris College campus while in highly polluted areas in Chennai *Hibiscus rosa sinensius* has 83.78%(figure 3).

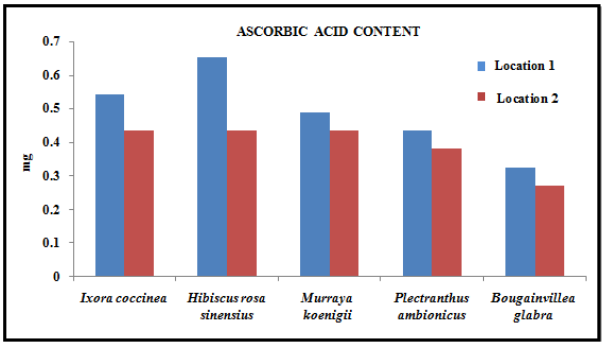

Figure 1 Comparison of ascorbic acid content in leaf extract of plants from plants in Stella Maris College campus and highly polluted areas in Chennai

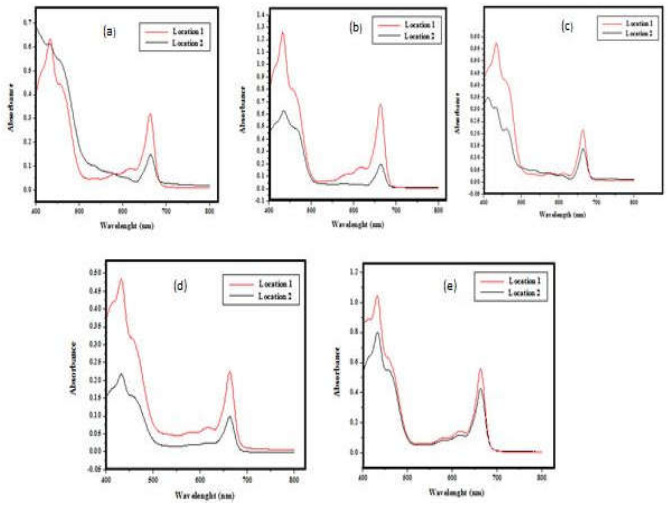

Figure 2 Comparison of UV-Visible spectrum of from location 1 (Stella Maris College campus) and location 2 (highly polluted areas in Chennai) of

(a) *Ixora coccinea* leaf extract
(b)*Hibiscus rosa sinensius* leaf extract
(c)*Murraya koenigii* leaf extract
(d) *Plectranthus ambionicus* leaf extract
(e) *Bougainvillea glabra leaf extract*

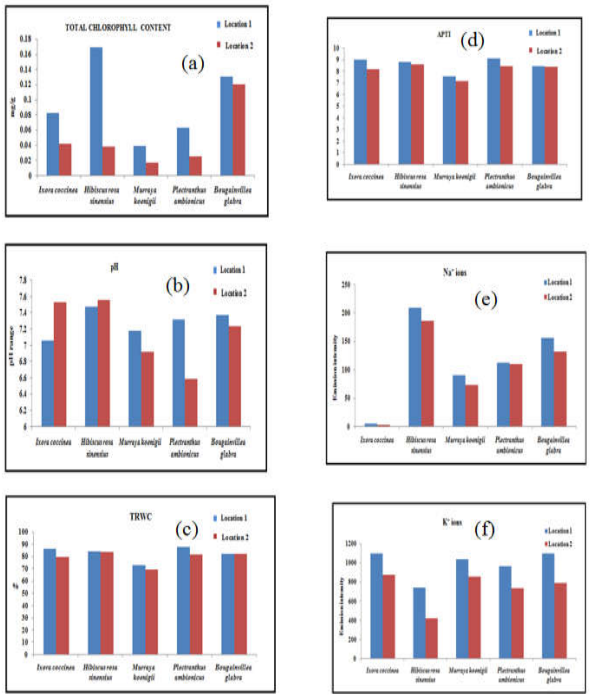

Figure 3 Comparison of leaf extract of plants from plants in location 1 (Stella Maris College campus) and location 2 (highly polluted areas in Chennai) of (a) Total Chlorophyll content (b) pH (c) Total relative water content (d) APTI (e) Emission intensity of Na^+ ions (f) Emission intensity of K^+ ions

Air pollution tolerance index of leaf extract

The APTI determination provides a reliable method for screening large number of plants with respect to their susceptibility to air pollutants. Plants having APTI value in the range of 30-100 were tolerant to pollution and APTI value in the range of 17-29 were intermediate to pollution and below 16 and up to 1 are sensitive and value less than 1 are very sensitive.

Applying this to our results *Plectranthus ambionicus* have APTI value of 9.12 and *Ixora coccinea* have the value of 9.02 in plants in Stella Maris College campus. All the plants presented in this work have APTI value below 16. Thus *Ixora coccinea, Hibiscus rosa sinensius, Murraya koenigii, Plectranthus ambionicus* and *Bougainvillea glabra* are sensitive plants. On comparing all the plants species in the plants in Stella Maris College campus and highly polluted areas in Chennai, there has been a decrease in all the APTI value of all plants that are present in highly polluted areas in Chennai. There variation in plants in Stella Maris College campus and highly polluted areas in Chennai also plays a major role in predicting the level of effect of air pollution in them.

Estimation of potassium and sodium in plant leaf extract

Sodium and potassium are the metals that are necessary for the growth and it involves in various metabolic activities. Potassium content is usually high in plants compared to the sodium. In plants in Stella Maris College campus, the sodium content was very low in *Ixora coccinea* (5.8), *Hibiscus rosa sinensius* (210) has high emitted intensity. The potassium content was high in *Ixora coccinea* and *Bougainvillea glabra* (1098) emitted intensity. *Hibiscus rosa sinensius* has emitted intensity (742.3) which is lower than all the plants present in plants in Stella Maris College campus.

In highly polluted areas in Chennai, the sodium content was low in *Ixora coccinea* (3.4) emission intensity and *Hibiscus rosa sinensius* (187) emitted intensity was high when compared to the all plants. Comparing the potassium content, *Hibiscus rosa sinensius* low emitted intensity (423) and *Ixora coccinea* has high emitted intensity (872.1).

CONCLUSION

The Air pollution tolerance index values were calculated for five different plant species. All the plant species were sensitive, comparing with respect to the locations *Hibiscus rosa sinensius* has been the tolerant species and *Ixora coccinea* is a sensitive species.

References

1. Tripathi A K, Gautam M, (2007). Biochemical parameters of plants as indicators of air pollution. *J. environ. Biol*, 28 (1): 127-132.
2. Joshi N, Chauhan A, Joshi P C, (2009). Impact of industrial air pollutants on some biochemical parameters and yield in wheat and mustard plants. *Environmentalist,* 29 (4): 398-404.
3. Krishnaveni M, Chandrasekar R, Amsavalli L, Madhaiyan, P, Durairaj S, (2013). *Int. J. Pharm. Sci. Rev. Res*, 20(1): 234-239
4. Dohmen G P, Loppers A, Langebartels C, (1990). Biochemical Response of Norway spruce (Picea Abies

(L) Karst) toward 14-Month Exposure to Ozone and Acid mist, effect on amino acid, Glutathione and Polyamine Titers. *Environ. Pollut*, 64 (4): 375-383.

5. Pierre M, Queiroz O, (1981). Enzymic and metabolic changes in bean leaves in continuous pollution by sub necrotic level of SO_2. *Environ Pollut*, 25: 41-51.

How to cite this article:

Santhanalakshmi. P *et al*.2018, Evaluation of Air Pollution Tolerance Index of Selected Plants In South Chennai. *Int J Recent Sci Res.* 9(3), pp. 25444-25447. DOI: http://dx.doi.org/10.24327/ijrsr.2018.0903.1859

****