Journal of Interdisciplinary and Multidisciplinary Research (JIMR)
E-ISSN:1936-6264| Impact Factor: 8.886| UGC CARE JOURNAL
Vol. 18, Issue 10, Oct 2023
Available online at: https://www.jimrjournal.com/
(An open access scholarly, peer-reviewed, interdisciplinary, monthly, and fully refereed journal.)

AIR POLLUTION TOLERANCE INDEX (APTI) OF ORNAMENTAL PLANTS

Mrs. Ratna Yadav, Research Scholar, Yashwantrao Chavan Maharashtra Open University, Nashik, Maharashtra
Dr. Jaydeep Nikam, Research Guide, Professor and Director, School of Continuing Education, Yashwantrao Chavan Maharashtra Open University, Nashik, Maharashtra

ABSTRACT

With the advent of industrial development and the world's population expanding, air pollution has become one of the grave issues that reflect the modern world. The vast majority of those affected live in metropolitan areas; factors contributing to the declining air quality include dense populations of manufacturing facilities, more cars on the road, ongoing elimination of trees (which removes significant amounts of carbon dioxide from the atmosphere), and building activities. Urban residents are more likely to be exposed to harmful pollutants like lead, carbon dioxide, ozone, particulate matter, and nitrogen oxides, which can cause severe health effects in humans, animals, and the environment. These issues can include lung, heart, and cancer. For a variety of ornamental plants in Silvassa city, the Air Pollution Tolerance Index (APTI) was determined. To calculate the Air Pollution Tolerance Index (APTI) of 10 ornamental species of plant found in the Silvassa city, leaf samples were taken and their biochemical parameters, relative water content, ascorbic acid, chlorophyll, and pH were measured.

Keywords: Air pollution tolerance index (APTI), biochemical parameters, ornamental plants.

INTRODUCTION

An emerging problem is pollution, which impacts an organism's metabolism. Infrastructure development, other anthropogenic activities and the density of automobiles is the main factor driving the increase in ambient air pollution in cities and an important challenge for cities. Continuous increase in vehicles and urbanization is adding further to the situation. Due to the rapid urbanization occurring in emerging nations, there is no clear demarcation between residential and industrial regions. In consequence of this, the main environmental issue in metropolitan areas is the decline in air quality. Particulate matter is of great concern in relation to their adverse impact on human health and vegetation (Rai, 2013). In addition to having a negative impact on human health, urban air pollution has a significant and hard to measure negative impact on plant life. Every kind of plant has a tendency to react differently to various contaminants and weather situations. Thus, the aim of the current study is to comprehend how adaptable and resistant plants are to air pollution.

Plants play major role in monitoring and maintaining the ecological balance. Apart from to actively contributing in the cycle of nutrients and gasses like carbon dioxide and oxygen, plants also give a vast amount of leaf surface for impingement, which helps to monitor and maintain the ecological equilibrium. Air pollutants' absorption and accumulation contribute to reducing the degree of pollution in the air (Escobedo et al., 2008). Plants have varying levels of sensitivity and responsiveness to air pollution. More sensitive plant species serve as biological indicators of air pollution. Analyzing the components that impact resistance and susceptibility might help us understand how plants respond to air pollution at the physiological and biochemical levels. Damage to plants can be seen, such as changes to their metabolic processes or the buildup of certain metabolites. The alterations can be used in evaluating a plant's APTI [1].

The effects of air pollution on plants have been studied by a number of researchers. The majority of plants go through physiological changes before their leaves show signs of damage

Analysis of various biological factors of each species aids in calculating the tolerance threshold based on how plants respond to air pollution. Numerous studies have been conducted on the effects of air pollution on ascorbic acid concentration [2], chlorophyll content [3], leaf extract pH [4], and RWC [5]. Ascorbic acid, total chlorophyll concentration, relative water content, and pH of the leaf extract were the four parameters examined and expressed collectively in one formula in the current study to assess the sensitivity and tolerance of plants to air pollutants.

The present study deals with bio monitoring potential of ten ornamental plant species (*Sansevieria trifasciata*, Epipremnum aureum, *Pedilanthus tithymaloides*, Syngonium podophyllum , Syngonium podophyllum , *Zamioculcas zamiifolia* , Ipomea fistulosa Mart., Ocimum sanctum , Croton sparsiflorus Morong., Rosa Indica and VInca rosea), at different location of Silvassa city.

MATERIALS AND METHODS

Silvassa is a city and administrative center of the Dadra and Nagar Haveli district located in the union territory of Dadra and Nagar Haveli ,Daman and Diu. Situated on the Daman Ganga River, the town is around 13 miles (21 km) southeast of Daman and about 15 miles (25 km) inland from the Arabian Sea.

It lies between 20.276266 latitude and 73.008308 E longitudes. **Silvassa, Dadra and Nagar Haveli, India** is located at *India* country in the *Towns* place category with the gps coordinates of 20° 16' 34.5576" N and 73° 0' 29.9088" E. Silvassa has a temperate climate. The average high temperature is 37.2°C, while the average low temperature is 11.6°C. Between June and September, the area receives the majority of its rainfall, with humidity levels ranging from 24 to 100%. There is around 1830 mm of rainfall in the area. Silvassa is selected for the study since numerous sources emit air pollutants including several major and minor industries located within the city. The study was carried in city .Leaf samples were obtained from 10 ornamental of different locations. The Air Pollution Tolerance Index (APTI) was determined by calculating the ascorbic acid, chlorophyll, pH and relative water contents in leaf samples. Ascorbic acid was estimated by 2, 6 - dichlorophenol indophenol dye method. Chlorophyll was calculated by spectrophotometer and pH was determined by digital pH meter. Relative water content of leaf material was estimated by taking the initial weight turgid weight and dry weight of leaf material. The APTI was calculated by using the following formula (Singh and Rao, 1983).

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

Where,

A= Ascorbic acid (mg/g dry wt.)

T= Total Chlorophyll (mg/g dry wt.)

P= pH of leaf extract.

R= Relative water content of leaf tissue (%).

The Entire sum was divided by 10 to obtain a small manageable figure.

Table 1: The APTI of selected ornamental plant species in Silvassa

Plant Species	**Total chlorophyll (mg/g)**	**pH of leaf extract**	**Ascorbic acid (mg/g)**	**Relative water content (RWC) (%)**	**APTI**	**Rounded figure**
Sansevieria trifasciata	5.21	6	6.7	68	14.9	15
Epipremnum aureum	5.03	6.3	9.3	65	16.1	16
Pedilanthus tithymaloides	6.2	5	9.7	82	19.1	19
Syngonium podophyllum	8.6	6.7	7.6	97	21.3	21
Zamioculcas zamiifolia	9.8	7	11.1	96	28.2	28
Ipomea fistulosa	7.51	6.2	2.1	72	10.1	10
Ocimum sanctum	5.2	6.0	3.12	80	11.1	11
Croton sparsiflorus Morong.	11.85	6.5	9.1	82	24.8	25
Rosa Indica	4.2	5.5	4.65	72	12.2	12
VInca rosea	8.3	5.5	19.1	72	33.5	34

RESULTS AND DISCUSSION

For 10 ornamental plant species growing in Silvassa city, the Air Pollution Tolerance Index (APTI) is computed. The results are shown in Table 1. Every biochemical parameter examined for APTI is important in determining the resistivity and susceptibility of different plant species. According to Conklin (2001), ascorbic acid is essential for the synthesis of cell walls, photosynthetic carbon fixation, and cell division. Scholz and Reck (1977) found that ascorbic acid sensitivity is indicated by pH, and ascorbic acid production is also correlated with total chlorophyll. When air pollution from vehicles and industrial areas is absorbed, adsorbed, stored, or integrated into the plant body, it may adversely affect the plant in numerous of ways if it is harmful. For sensitive species, the degree of damage will be severe, whereas for tolerant species, it will be minimal. Sensitive species aid in recognizing air pollution, whereas tolerant species serve in reducing it. (Subrahmanyam et al., 1985). Planting tolerant plants in polluted places can have a lot of positive effects on the environment since they act as pollution "sinks." It could be crucial to assess plants' levels of tolerance to air pollution for this reason. Singh and Rao (1983) investigated the degree of tolerance of several plant species to air pollution using four leaf parameters to support an empirical figure that represents the Air Pollution Tolerance Index (APTI). It was clear from the table that the plants' air pollution tolerance indices differed widely. The plants can be categorized into according to the APTI values (Kalyani and Singaracharya, 1995):

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

The biochemical characteristics and the APTI for plants at site It is observed that all the plant species collected exhibited a pH towards acidic side, ranging from 5.0 to 7.0. The acidic nature may be due to the presence of SOx, NOx or other acidic pollutants from the industrial and vehicular pollution in the ambient air causing a change in pH of the leaf sap towards acidic (Swami et al., 2004). Low leaf pH extract showed good correlation with sensitivity to air pollution and also reduce photosynthetic process in plants (Yan-Ju and Hui, 2008; Thakar and Mishra, 2010). A pH on higher site improves tolerance against air pollution (Agarwal, 1986; Shannigrahi et al., 2011). RWC was high in plants with thick leaves making them more tolerant (Table 1). High water content within a plant body will help to maintain its physiological balance under stress condition such as exposure to air pollution when the transpiration rates are usually high which may lead to desiccation. Therefore, maintenance of RWC by the plant may decide the relative tolerance of plants towards air pollution (Verma, 2003). The higher the RWC in a particular species, the greater is its drought tolerance capacity (Dedio, 1975). Thus, the higher RWC in sample may be responsible for normal functioning of biological processes in plants (Meerabai et al., 2012). Ascorbic acid is regarded as an antioxidant found in large amount in all growing plant parts and influence resistance to adverse environmental condition including air pollution (Keller and Schwager, 1977; Lima et al., 2000). The mean concentration of ascorbic acid in leaves of samples is summarized in Table 1. The ascorbic acid content increased in the leaves of plants at industrial. Table 1 show that, the concentration of ascorbic acid ranged from 2to19.5 mg g^{-1} with *Ipomea fistulosa* and 19.1recording the lowest and highest value, respectively. Ascorbic acid, a stress reducing factor is generally higher in tolerant plant species. Tripathi and Gautam (2007) reported pollution load dependent increase in ascorbic acid content of all the plant species might be due to the increased rate of production of reactive oxygen species (ROS) during photo-oxidation process.

Chlorophyll content of plant signifies its photosynthetic activity as well as the growth and development of biomass. Chlorophyll content of plant varies from species to species depending upon the age of leaf, pollution level as well as other biotic and abiotic condition (Katiyar and Dubey, 2001). The chlorophyll content was found to be low in the leaf samples for sensitive plants and high for tolerant plant in the investigated plant species. Table 1 clearly showed an increase in the APTI in tolerant plants. The tolerant plants have high APTI, high chlorophyll and high ascorbic acid. The APTI value estimated using the four biochemical parameters in plant leaves namely RWC, total chlorophyll content, pH and ascorbic acid value can be used as a predictor of air quality. Plants having higher index value are tolerant to air pollution while plants with lower index value show less tolerance (Singh and Rao, 1983). *VInca rosea* with highest APTI is tolerant plant and *Ocimum sanctum* with lowest APTI is sensitive plant.

CONCLUSION

Biomonitoring of air pollution and its impact on biochemical parameters is extremely relevant in air pollution science. The tolerant species and moderately tolerant species can be planted in houses and society premises for mitigating pollution. The sensitive species can be used as bio indicator.

ACKNOWLEDGEMENT
Authors are thankful to DNH Spinners for providing facilities and encouragement

REFERENCES

1. Khureshi SGD. Air pollution tolerance indices (APTI) of some plants around Ponnur, Guntur (Dist.). Int J Eng Res Tech 2013;2:2366-75.
2. Hoque MA, Banu MNA, Oluma E. Exogenous proline and glycine betaine increase NaCl-induced ascorbate-glythione cycleenzyme activities and praline improves salt tolerances more than glycine betaine in tobacco bright yellow-2 suspension cultural cells. J Plant Physiol 2007;164:1457-68
3. Flowers MD, Fiscus EL, Burkey KO. Photosynthesis, chlorophyll fluorescence and yield of snap bean (Phaseolus vulgaris L.) genotypes differing in sensitivity to ozone. Environ Exp Bot 2007;61:190-8.

4. Klumpp G, Furlan CM, Domingos M. Response of stress indicators and growth parameters of Tibuchina Pulchra Cogn exposed to air and soil pollution near the industrial complex of Cubatao, Brazil. Sci Total Environ 2000;246:79-91.
5. Rao DN. Plant as a pollution-monitoring device. Fertilizer News 1979;24:26-8.
6. Kalyani, Y. and Singaracharya, M. A. 1995. Biomonitoring of air pollution in Warangal city, Andhra Pradesh. Acta Botanica indica. 23(1): 21-24.
7. Singh, S. K. and Rao, D. N. 1983. Evaluation of plants for their tolerance to air pollution. In Proc. Symp. on Air pollution control, IIT, Delhi, pp 218-224.
8. Singh SK. Phytomonitoring of Urban-Industrial Pollutants: A New Approach. Environmental Monitoring and Assessment. 1993; 24, 27-34.
9. Agarwal, M. 1985. Plants factors as indicators of SO2 and O3 pollutants. Symp. on Bio-Monitoring state environment. New Delhi. Proceedings, pp 225-231.
10. Conklin, P. L. 2001. Recent advances in the role and biosynthesis of ascorbic acid in plants. Plant Cell Environment. 24: pp.383-394
11. Katiyar V, Dubey PS (2001). Sulphur dioxide sensitivity on two stage of leaf development in a few tropical tree species. Ind. J. Environ.
12. Tripathi AK, Gautam M (2007). Biochemical parameters of plants as indicators of air pollution. J. Environ. Biol. 28:127-132
13. Meerabai G, Venkata Ramana C, Rasheed M (2012). Effect of industrial pollutants on Physiology of Cajanus cajan (L.) - Fabaceae. Int. J. Environ. Sci. 2(4):1889-1894
14. Dedio W (1975). Water relations in wheat leaves as screening test for drought resistance. Can. J. Plant Sci. 55:369-378
15. Keller T, Schwager H (1977). Air pollution and ascorbic acid. Europ. J. Forest Pathol. 7:338-350.
16. Shannigrahi AS, Fukushim T, Sharma RC (2004). Anticipated Air Pollution Tolerance of some plant species considered for green belt development in and around an industrial/urban area in India:An overview. Int. J. Environ. Stud. 61(2):125-137.
17. Singh SK, Rao DN (1983). Evaluation of plants for their tolerance to air pollution. In Proc symp on air pollution control held at IIT Delhi pp. 218-224
18. Verma A (2003). Attenuation of automobile generated air pollution by higher plants. Dissertation, University of Lucknow.
19. Thakar BK, Mishra PC (2010). Dust collection potential and Air pollution Tolerance Index of Tree vegetation around Vedanta Aluminium Limited, Jharsuguda. Int. Q. J. Life Sci. 3:603-612.
20. Yan-Ju L, Hui D (2008). Variation in air pollution tolerance index of plant near a steel factory; implication for landscape- plant species selection for industrial areas. Environ. Dev. 1(4):24-30.