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Research Article

BIOCHEMICAL CHANGES IN PLANTS INDICATING AIR POLLUTION

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ABSTRACT

Objective: Environmental concern is a global issue. As a citizen of India, we must care about the environment where we are living to be aware of the upcoming threats. Hence, this study was aimed to analyse the biochemical changes in plants and their ability to tolerate pollution a common stress factor prevailing in the environment in order to know their tolerance, sensitivity.

Methods: Standard methods were adopted for ascorbic acid, pH, chlorophyll, relative water content, air pollution tolerance index analysis.

Results: Highest ascorbic acid content (4.65mg/g) was observed in *Albizia lebbeck.* pH was acidic in *Delonix elata.* Water content was found to be high for almost all the plants selected and chlorophyll was high with *Albizia amara* (24.38mg/g) and *Caesalpinia pulcherrima* (24.19mg/g). The air pollution tolerance index falls in the range of 06.75 -21.80.

Conclusion: The changes in air pollution tolerance index are biochemically induced due to the surrounding environmental condition. Thus, it is concluded that *Albizia amara* was found to be an intermediately tolerant species whereas all the other species were found to be sensitive.

Keywords: APTI, Plants, Environment, Pigment.

INTRODUCTION

A major environmental concern to most city is air pollution and it remains a major challenge. According to World Bank experts, between 1995 through 2010, India has made one of the fastest progress in the world, in addressing environmental issues and improving its environmental quality. [1,2] Population density in 2011, was about 368 human beings per square kilometre. Per capita oxygen requirement for a day is 0.75kg. So, it is a must to keep the air clean and safe as we live by inhaling air. The air in a forest is pleasant as trees discharge approximately 12 ton oxygen through photosynthesis. Therefore, it is our responsibility to know our environment and the role plants in indicating pollution. Hence, present study was aimed to evaluate the biochemical changes in plant leaf that are collected in and around Salem city.

MATERIALS AND METHODS

Preparation of Extract

100mg of fresh leaf samples from the selected twelve tree species were brought to the laboratory for air pollution tolerance index (APTI) analysis by estimating the contents of ascorbic acid [3], chlorophyll [4], relative water content [5,6], pH in leaf [7] using water extract of the leaf. Readings were taken using UV Spectrophotometer for the biochemical analysis. The formula proposed by Singh and Rao 1983 [7] was used for air pollution tolerance index: APTI = A (TC + P) +R/10. Where, A= ascorbic acid content in leaf (mg/g), T= total chlorophyll content in leaf (mg/g), P= leaf extract pH and R= per cent water content of the leaf. The sum value obtained is divided by 10 to get a value in reduced scale. This study was carried out during February, March 2013.

RESULTS AND DISCUSSION

Biochemical, APTI analysis

The results of biochemical changes observed and its impact on APTI is shown in Table.1. Likewise Table.2 depicts grades allotted to APTI.

Ascorbic acid

The ascorbic acid content was high for *Albizia lebbeck*, *Albiziz amara*, moderate amount of ascorbate was observed with *Tridax procumbens, Syzygium cumini, Morinda pubescens, Delonix elata*, *Annona squamosa, Strychnos nux-vomica,Alangium salviifolium, Holarrhena anti dysenterica* and very low levels of ascorbate was observed with *Aegle marmelos*. Ascorbic acid being a strong reductant protects chloroplast against sulphur dioxide induced H_2O_2, O_2^- and OH accumulation. Similarly, it protects the enzymes of CO_2 fixation cycle and chlorophyll from inactivation. [8] Defence mechanism in plants cause increased level of ascorbic acid.

pH

The pH was found to be alkaline for *Annona squamosa, Tridax procumbens, Strychnos nux vomica, Alangium salviifolium, Albizia lebbeck, Morinda pubescens*, neutral pH was observed *with Syzygium cumini, Aegle marmelos,* whereas *Delonix elata, Albizia amara*, *Holarrhena antidysenterica, Caesalpinia pulcherrima* showed acidic pH. Chlorophyll aiding in starch synthesis can indicate environmental pollution likewise pH helps in physiological responses caused by stress. pH change influence stomatal sensitivity and leaves with low pH are more susceptible to pollution but those having neutral pH are more tolerant.

Table 1: Biochemical parameters, APTI of selected plants

Botanical Name	Family	Ascorbic acid mg/g	pH	RWC %	Chlorophyll mg/g	APTI
Annona squamosa L.	Annonaceae	1.35	8.0	96.07	00.06	10.71
Tridax procumbens L.	Asteraceae	3.45	8.0	95.32	00.31	12.40
Syzygium cumini (L.) Skeels	Myrtaceae	3.45	7.0	98.60	00.42	12.42
Aegle marmelos (L.) Corr.	Rutaceae	0.45	7.0	99.25	19.55	11.11
Strychnos nux-vomica L.	Loganiaceae	1.95	8.0	99.64	16.99	14.83
Albizia amara (Roxb.) Boivin	Mimosaceae	4.05	5.0	99.67	24.38	21.80
Alangium salvifolium Lam.	Alangiaceae	1.05	8.0	80.34	22.05	11.18
Caesalpinia pulcherrima (L.) Sw.	Caesalpiniaceae	2.85	6.0	64.18	24.19	15.02
Albizia lebbeck (L.) Willd.	Mimosaceae	4.65	8.0	97.50	01.67	14.24
Delonix elata (L.) Gamble	Caesalpiniaceae	1.65	4.0	50.45	06.36	06.75
Holarrhena antidysenterica (Roxb.) Wall.	Apocynaceae	2.55	6.0	81.94	17.29	14.13
Morinda pubescens J.E. Smith	Rubiaceae	2.58	8.0	65.30	12.5	11.81

RWC- Relative water content, APTI - Air pollution tolerance index.

Relative water content

Relative water content was found to be high for all the selected plants whereas it was moderate for *Delonix elata* , *Morinda pubescens*. Water is an essential factor for the transportation of food, minerals. So, Plants with relatively high water content are highly resistant to pollution [9].

Chlorophyll

Chlorophyll was found to be high for *Albizia amara, Delonix elata, Alangium salvifolium, Holarrhena antidysenterica, Strychnos nux-vomica, Aegle marmelos, Morinda pubescens,* whereas it was very low for *Syzygium cumini, Tridax procumbens, Annona squamosa.* Loss in total chlorophyll content of plant depends on the degree of pollution. Degradation of photosynthetic pigment indicates air pollution [10].

Air pollution tolerance index

APTI can be used as bioindicators of air quality. The air pollution tolerance index found to decrease in the following order *Albizia amara < Caesalpinia pulcherrima<Strychnos nux-vomica< Albizia lebbeck < Holarrhena antidysenterica< Syzygium cumini< Tridax procumbens< Morinda pubescens< Alangium salvifolium< Aegle marmelos< Annona squamosa< Delonix elata.* Sensitivity of plants are always related to low APTI value. Their tolerance is relatively proportional to the levels of pollution which gives variation from one species to another species and capacity to resist pollutants in the environment without showing any external damage or loss. The obtained index were graded [11], values below 10 was considered negligible.

Table 2: Showing air pollution tolerance index and their grades

Botanical Name	Air pollution tolerance index	Grade allotted
Annona squamosa L.	10.71	+
Tridax procumbens L.	12.40	+
Syzygium cumini (L.) Skeels	12.42	+
Aegle marmelos (L.) Corr.	11.11	+
Strychnos nux-vomica L.	14.83	+ +
Albizia amara (Roxb.) Boivin	21.80	+ + +
Alangium salvifolium Lam.	11.18	+
Caesalpinia pulcherrima (L.) Sw.	15.02	+ +
Albizia lebbeck (L.) Willd.	14.24	+
Delonix elata (L.) Gamble	06.75	Negligible
Holarrhena antidysenterica (Roxb.) Wall.	14.13	+ +
Morinda pubescens J.E. Smith	11.81	+

CONCLUSION

The importance of plants in tolerating pollution is studied through APTI analysis as it is economical and does not involve costlier equipments. Air pollution tolerance index is a synergistic effect of biochemical indices. All plants studied were found to be sensitive species to pollution except *Albizia amara* as it have APTI of 21.8 and +++.

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