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Original Article

AIR POLLUTION TOLERANCE INDEX INDUCED BY BIOCHEMICAL COMPONENTS IN PLANTS

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ABSTRACT

The response of plants towards air pollution was assessed by air pollution tolerance index, as plants are primary receptors. This study was conducted during the month of January 2014. The location selected for the study was plants located near road sides of New bus stand (study area1) and plants located near roadsides of Saradha college, Salem, Tamil Nadu, India (study area 2). Thirteen plants were selected for the study from both study areas, to know the difference in their air pollution tolerance index. Standard protocols were adopted for the analysis of pH, ascorbic acid, total chlorophyll, relative water content, airpollution tolerance index. The air pollution tolerance index was high with *Albizia saman* 9.85 in study area 1 and *Azadirachta indica* 15.56 in study area 2. The chlorophyll content was moderately higher for the plants studied in study area 1 (0.82 to 2.45mg/g) and it was low for the plants in study area 2. (0.14 to 0.53mg/g). Likewise, ascorbic acid content was good with plants located in study area 2 compared to study area 1. The air pollution tolerance index was found to be 10.22 (Study area 1) for *Psidium guajava, and* 15.56 for *Azadirachta indica* (Study area 2). All the plants studied in both the locations were found to be sensitive to pollution.

Keywords: APTI, Biochemical changes, New bus stand, Saradha college road, Salem.

INTRODUCTION

The climatic condition, physio-chemical properties of air pollutants and their residence time in the atmosphere have its impact on growing plants and animals [1]. The location selected for the present study was plants located near road sides of New bus stand, Salem, TN, India, Which is otherwise called as Bharatha Rathna Dr. MGR bus terminal. Total town buses were 780 and mofusal buses were 689 and 400 private buses. All these buses move out from new bus stand, Salem. Total vehicles that crosses signal approximately per hour was found to be 350 two wheeler, 250 four wheeler and only 30 cycles. The second study area, Saradha college road selected for the study was located 15 km away from new bus stand. Plants that are present in both locations were selected for the present study to analyse air pollution tolerance index. Thirteen plants that were assessed for their air pollution tolerance index, a scientific tool to measure the impact of pollution by means of plants as they are the immediate soul that will get affected by pollutants. Thirteen plants used for the present research are: *Polyalthia longifolia, Pungamiya pinnata, Ficus religiosa, Muntingia calabura, Albizia saman, Azadirachta indica, Cocus nusifera, Tamarindus indica, Tectona grandis, Casurina equisetifolia, Psidium guajava, Delonix regia*, *Terminalia catappa.*

MATERIALS AND METHODS

Leaf sample collection

For the present study, fresh leaves from each plants were collected from the experimental site near road sides of New bus stand, Salem, Tamil Nadu, India (study area 1) and near road sides of Saradha college road, Salem, Tamil Nadu, India (study area 2) during the month of January, 2014. Common plants identified were selected in both the areas.

Extract preparation

Fresh leaves were used according to the standard prescribed methods adopted. Aqueous extract was used for the whole study.

BIOCHEMICAL PARAMETERS

pH

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

Relative water content

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 overnight in a hot air oven at 70^0c and reweighed to obtain the dry weight. RWC was determined and calculated by the method as described by Singh 1977 [2].

RWC=[(FW-DW)/(TW-DW)] x 100.

Where: FW-Fresh weight,DW-Dry and TW-Turgid weight

Ascorbic acid content

Ascorbic acid content was measured by Titrimetric method of Sadasivam 1987 [3] using 2,6, Dichlorophenol indo phenol dye. 500mg of leaf sample was extracted with 4% oxalic acid and then titrated against the dye until pink colour develops. Similarly a blank is also developed.

Total chlorophyll and carotenoid content

This was carried out according to the method described by Arnon 1949 [4]. 500 mg of fresh leaves were blended and then extracted with 10 ml of 80% acetone and leave 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 645nm and 663nm for chlorophyll a, b and 480, 510 nm for carotenoid using a micro controller based visible spectrophotometer (340- 990 nm). Calculation were done by using the formula given below:

Total chlorophyll: Chlorophyll a + Chlorophyll b ;

CTc: 20.2 (D645) + 8.02 (D 663)

Tch : 0.1 CT x [leaf dry weight / leaf fresh weight]

Calculation of APTI

The air pollution tolerance indices of the selected plants were determined by following the method of Singh and Rao (1983) [5].

The formula of APTI is given as: APTI= [A (T+P) + R] / 10.

Where: A=Ascorbic acid content (mg/gm), T=Total chlorophyll (mg/gm), P=pH of the leaf extract, R=Relative water content of leaf (%).

Stastical tool

The Mean and Standard deviation (S) was calculated by using the following formula: Mean = Sum of x values / n (Number of values)

$$S = \frac{\sqrt{\sum(X-M)^2}}{n-1}$$

RESULTS AND DISCUSSION

The results of biochemical components and air pollution tolerance index for study area 1 and 2 are shown in Table.1 and Table.2

pH

The pH observed for all the plants studied were found to be alkaline in nature.

Relative water content

The relative water content in study area 1 was found to be high with *Cocus nusifera, Psidium guajava* . Plants such as *Delonix regia*, *Ficus religiosa, Tamarindus indica*, *Azadirachta indica*, *Terminalia catappa* showed moderate level of relative water content which ranges from 30.68 to 51.00 %.

Ascorbic acid

Ascorbic acid was found to be high with *Albizia saman* and *Azadirachta indica*. Moderate amount of ascorbic acid was found in *Psidium guajava*, *Tamarindus indica*, *Casurina equisetifolia*, *Terminalia catappa* shows only 0.26 mg/g ascorbic acid. Rest of the plants show values in the range of 0.42 to 0.90 mg/g ascorbic acid with respect to study area 1.

Chlorophyll

The chlorophyll content was higher with *Psidium guajava, Terminalia catappa, Azadirachta indica,Tamarindus indica*, *Muntingia calabura,* but the level was lower than this in *Delonix regia*, *Albizia saman*, *Pungamia pinnata*, *Cocus nusifera* in study area 1.

Air pollution tolerance index

The air pollution tolerance index was 10.22 for *Psidium guajava* and 10.06 *Azadirachta indica*. The index was less than 10 most of the plants collected from study area1. The air pollution tolerance index of the plants studied in study area 1 is listed as follows: *Pungamia pinnata* 3.91, *Polyalthia longifolia* 4.53, *Terminalia catappa* 5.35, *Muntingia calabura* 5.41, *Tectona grandis* 5.70, *Ficus religiosa* 6.92, *Delonix regia* 7.35, *Tamarindus indica* 7.36, *Cocus nusifera* 7.90, *Casurina equisetifolia* 8.17, *Albizia saman* 9.85.

pH

The pH observed for all the plants in study area 2 was found to be alkaline.

Ascorbic acid

The ascorbic acid content was high for *Azadirachta indica, Muntingia calabra, Albizia saman* in study area 2 and it was moderate for *Terminalia catappa, Delonix regia*, *Psidium guajava, Cocus nusifera*, *Cocus nusifera, Casurina equisetifolia, Tamarindus indica*. While it was low with rest of the plants and ranges from 0.26 to 0.53 mg/g ascorbic acid.

Table 1: Biochemical components and Air Pollution Tolerance Index (Site.1)

S. No.	Name of the plants	pH	Relative water content (%)	Ascorbic acid(mg/g)	Chlorophyll (mg/g)	APTI
1.	*Polyalthia longifolia*	8.2±0.0	41.31±0.48	0.42±0.18	1.38±0.31	4.53±0.31
2.	*Pungamiya pinnata*	8.5±0.0	30.68±0.63	0.90±0.92	0.84±0.14	3.91±0.15
3.	*Ficus religiosa*	8.8±0.0	64.40±0.34	0.42±0.18	2.45±0.16	6.92±0.17
4.	*Muntingia calabura*	8.8+0.0	44.41±0.46	1.01±0.09	1.12±0.22	5.41±0.22
5.	*Albizia saman*	8.8+0.0	43.99±0.53	4.96±0.27	0.89±0.22	9.85±0.10
6.	*Azadirachta indica*	8.2+0.0	59.70±0.62	4.10±0.18	1.77±0.12	10.06±0.13
7.	*Cocus nusifera*	8.5+0.0	75.90±0.28	0.42±0.18	0.82±0.12	7.90±0.12
8.	*Tamarindus indica*	8.2±0.0	62.24±0.49	1.12±0.27	1.54±0.17	7.36±0.18
9.	*Tectona grandis*	8.5±0.0	50.83±0.74	0.58±0.18	2.10±0.15	5.70±0.15
10.	*Casurina equisetifolia*	8.2±0.0	70.94±0.16	1.12±0.27	1.43±0.13	8.17±0.14
11.	*Psidium guajava*	8.2±0.0	75.90±0.51	2.50±0.09	2.33±0.09	10.22±0.09
12.	*Delonix regia*	8.5±0.0	64.75±0.41	0.90±0.18	0.90±0.43	7.35±0.43
13.	*Terminalia catappa*	8.0±0.0	51.00±0.36	0.26±0.18	1.85±0.07	5.35±0.07

Values are mean ± SD for three experiments

Table 2: Biochemical components and Air Pollution Tolerance Index (Site.2)

S. No.	Name of the plant	pH	Relative water content (%)	Ascorbic acid(mg/g)	Chlorophyll (mg/g)	APTI
1.	*Polyalthia longifolia*	8.8±0	68.00±0.62	0.58±0.18	0.2657±0.02	7.29±0.14
2.	*Pungamiya pinnata*	8.5±0	43.47±0.88	0.37±0.09	0.2132±0.01	4.66±0.13
3.	*Ficus religiosa*	8.8±0	75.91±0.63	0.53±0.09	0.4224±0.03	8.08±0.02
4.	*Muntingia calabura*	8.8±0	73.73±0.74	6.77±0.18	0.3741±0.03	13.63±0.01
5.	*Albizia saman*	8.8±0	58.00±0.84	6.34±0.18	0.5265±0.03	11.71±0.20
6.	*Azadirachta indica*	8.2±0	68.56±0.79	6.82±0.09	0.1647±0.04	15.56±0.11
7.	*Cocus nusifera*	8.5±0	54.21±0.17	2.24±0.27	0.2197±0.01	7.37±0.26
8.	*Tamarindus indica*	8.2±0	68.46±0.31	1.70±0.18	0.1392±0.02	8.26±0.16
9	*Tectona grandis*	8.5±0	39.05±0.42	0.26±0.18	0.1561±0.02	4.13±0.19
10	*Casurina equisetifolia*	8.2±0	49.14±0.54	1.92±0.27	0.1881±0.02	6.52±0.27
11	*Psidium guajava*	8.2±0	43.55±0.68	2.61±0.18	0.1535±0.05	6.53±0.18
12	*Delonix regia*	8.5±0	77.52±0.43	3.84±0.27	0.2615±0.02	11.11±0.28
13.	*Terminalia catappa*	8.0±0	58.19±0.43	5.54±0.09	0.1917±0.02	10.36±0.12

Values are mean ± SD for three experiments

Relative water content

The relative water content in study area 2 was higher with *Ficus religiosa*, *Muntingia calabura, Azadirachta indica, Tamarindus indica*, *Polyalthia longifolia*. Moderate level was observed with rest of the plants showing relative water content in the range of 39.05 to 58.00 %.

Chlorophyll

The chlorophyll content was lower in all plants studied in study area 2 and it ranges from 0.14 to 0.53 mg/g.

Air pollution tolerance index

The air pollution tolerance for the study area 2 observed are presented as follows: *Azadirachta indica* 15.56, *Muntingia calabura* 13.63, *Albizia saman* 11.71, *Delonix regia* 11.11, *Terminalia catappa* 10.36, *Tamarindus indica* 8.26, *Ficus religiosa* 8.08, *Cocus nusifera* 7.37, *Polyalthia longifolia* 7.29, *Psidium guajava* 6.53, *Casurina equisetifolia* 6.52, *Pungamia pinnata* 4.66 and 4.13 with *Tectona grandis*. The air pollution tolerance index was categorized according to Kalyani and singaracharya 1995 [6]. The following are the four categories APTI index range < 1-Very sensitive, 1to 16- Sensitive, 17 to 29 -Intermediate and 30 to 100 - Tolerant. Our study enumerates, that all plants were found to be sensitive as they have APTI value less than 10.22 and none found to be very sensitive, intermediate, tolerant.

CONCLUSION

The method adopted for present study is simple as it requires no costlier, heavier equipment for the measurement of air pollution tolerance level of plants. This study shows that most of the plants were sensitive in nature.

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