Research Article

Plants as Biomarker of Pollution – A Study on Thoppur Hill Road Side Plants, Dharmapuri, Tamil nadu, India

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ABSTRACT

Air pollution is a serious environmental stress to plants. Hence, its assessments from plants were studied on Thoppur hill road side plants. Three spots were finalized for plant collection and experiment was carried out using the plants brought by early morning. 11-12 plants were selected from each spot. Carotenoid content was lower for all the plants experimented at all three spots of Thoppur hill road side. Chlorophyll content was higher for *Azadirachta indica, Psidium guajava, Tectona grandis, Ficus religiosa, Cardia sebestena* from spot 1 but moderate with other two spots. Ascorbic acid content was high with *Madhuca longifolia* from spot 1 and *Azadirachta indica* from spot 2 and 3. Among the plants studied at three spots, the air pollution tolerance index was found to be high for *Azadirachta indica* at spot 1, 2 and 3 and *Peltophorum acutifolium* also showed higher APTI from spot 1. APTI of plants studied at three points were found sensitive to pollution.

Keywords: Air pollution, Biochemical changes, Pigments, Sensitive, Tolerance.

INTRODUCTION

Impact of air pollution on local plant species is one of the major economic issue, which adds pollutants not only to environment but also to health. Since, plants acts as a sink for air pollution, it reduces pollution level in the atmosphere. Hence, this study was aimed to assess the biochemical changes and its role in air pollution tolerance index, a major factor that gives sensitivity, tolerance to plants. The study site selected for the present research is Thoppur Hill roadsides. Three spots were choosen for the research from Thoppur hill road which is of 11km distance. The details of three spots and plants collected are given below:

The plants selected from spot 1 were taken from road sides i.e between 1st and 2nd kilometer: *Madhuca longifolia, Cardia sebestena, Psidium guajava, Tectona grandis, Mangifera indica, Ficus religiosa, Peltophorumacutifolium, Annona squamosa, Manilkara zapota, Causarina equistifolia, Tamarindus indica, Azadirachta indica.*

The plants selected from spot 2 were taken from road sides i.e near 6th kilometer: *Polyalthialongifolia, Syzygium cumini, Tamarindus indica, Ficus religiosa, Ficus benghalensis, Albizia saman, Pongamia pinnata, Albizia amara, Azadirachta indica, Tectona grandis, Carica papaya, Morinda tinctoria.*

The plants collected from spot 3 were taken from road sides i.e near 10th kilometer: *Peltophorum acutifolium, Tectona grandis, Tamarindus indica, Azadirachta indica, Annona squamosa, Madhuca longifolia, Psidium guajava, Cardia sebestena, Mangifera indica, Pongamia pinnata, Polyalthialongifolia.*

MATERIALS AND METHODS

Sample preparation

Leaf sample collection

For the present study, fresh leaves from 12 plants were collected early in the morning from the study sites1, 2, 3. This study was carried out during the month of January to March, 2014.

Extract preparation

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

Biochemical parameters

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.[1] RWC = [(FW-DW)/(TW-DW)] x 100. Where: FW-Fresh weight, DW-Dry weight, TW-Turgid weight

Total chlorophyll and carotenoid content

This was carried out according to the method described by Arnon 1949.[2] 500mg of fresh leaves were blended and then extracted with 10ml of 80% acetone 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 645nm and 663nm for chlorophyll a, b and 480,

510nm for carotenoid using a micro controller based visible spectrophotometer (340- 990nm). Calculation was done by using the formula given below:

Total chlorophyll : Chlorophyll a+Chlorophyll b; CTc:20.2 (D645) + 8.02 (D663), Tch : 0.1 CT x [leaf dry weight / leaf fresh weight], Carotenoid = 7.6 x 480 OD – 1.49 x 510 ODs

pH

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

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.

Calculation of APTI

The air pollution tolerance indices of selected plants were determined by following the method of Singh and Rao (1983).[4] 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 (%).

RESULTS AND DISCUSSION

Spot 1:

Table 1: Biochemical changes and air pollution tolerance index

Name of plants	pH	RWC (%)	Ascorbic acid (mg/g)	Chlorophyll (mg/g)	Carotenoid (mg/g)	APTI
Causarina equistifolia	8.2	55.60	1.70	0.43	0.06	7.01
Annona squamosa	8.5	81.70	1.06	0.75	0.13	9.1
Cardia sebestena	8.2	90.07	0.74	1.17	0.03	9.5
Azadirachta indica	8.2	87.95	3.68	2.38	0.03	12.6
Peltophorum acutifolium	8.5	74.44	3.2	0.52	0.01	12.8
Psidium guajava	8.2	22.24	1.86	1.67	0.03	4.1
Tamarindus indica	8.2	50.98	0.85	0.95	0.02	5.8
Manilkara zapota	8.2	90.78	0.53	0.57	0.03	9.5
Mangifera indica	8.5	53.55	1.17	0.28	0.05	6.4
Ficus religiosa	8.8	38.25	0.42	1.41	0.02	4.1
Tectona grandis	8.5	30.72	0.64	1.65	0.04	3.7
Madhuca longifolia	8.0	25.98	6.4	0.63	0.02	8.3

Spot 2:

Table 2: Biochemical changes and air pollution tolerance index

Name of plants	pH	RWC (%)	Ascorbic acid (mg/g)	Chlorophyll (mg/g)	Carotenoid (mg/g)	APTI
Albizia saman	8.8	57.68	3.41	0.69	0.02	9.00
Azadirachta indica	8.2	59.10	5.97	0.21	0.01	10.93
Tectona grandis	8.5	17.49	0.37	0.31	0.01	2.07
Tamarindus indica	8.2	18.06	0.26	0.22	0.01	2.02
Albizia amara	8.8	18.41	2.02	0.24	0.00	3.67
Carica papaya	8.5	17.08	5.65	0.49	0.01	6.79
Polyalthia longifolia	8.2	82.04	0.42	0.26	0.01	8.56
Ficus religiosa	8.8	21.73	0.21	0.54	0.02	2.37
Ficus benghalensis	8.8	91.47	0.42	0.41	0.01	9.53
Pongamia pinnata	8.5	88.39	0.58	0.45	0.02	9.36
Morinda tinctoria	8.8	39.90	0.90	0.33	0.01	4.81
Syzygium cumini	8.5	84.02	0.26	0.09	0.01	8.63

Spot 3:

Table 3: Biochemical changes and air pollution tolerance index

Name of plants	pH	RWC (%)	Ascorbic acid(mg/g)	Chlorophyll (mg/g)	Carotenoid (mg/g)	APTI
Peltophorum acutifolium	8.0	28.19	3.46	0.47	0.01	5.76
Tectona grandis	7.0	17.74	0.50	0.89	0.01	2.27
Tamarindus indica	8.0	20.41	0.8	0.63	0.01	2.74
Azadirachta indica	8.0	62.04	3.73	0.52	0.02	9.38
Annona squamosa	8.0	67.96	0.96	0.38	0.01	7.62
Madhuca longifolia	9.0	64.62	1.70	0.49	0.01	8.08
Psidium guajava	7.0	84.41	1.86	0.53	0.01	9.84
Cardia sebestena	9.0	75.69	0.8	0.47	0.01	8.35
Mangifera indica	8.0	83.04	1.01	0.90	0.01	9.22
Pongamia pinnata	8.0	21.24	0.37	0.86	0.01	2.46
Polyalthia longifolia	8.0	50.79	0.42	0.49	0.01	5.42

The changes in biochemical parameters, air pollution tolerance index of various plants analyzed at spot 1 was picturised in Table 1. The pH observed was same for all the plants studied. The relative water content was moderate for most of the plants analyzed and found to be high for *Manilkara zapota, Cardia sebestena*. Likewise, the ascorbic acid content was high for *Madhuca longifolia, Azadirachta indica, Peltophorum acutifolium* whereas, moderate level was observed for *Psidium guajava, Causarina equistifolia, Mangifera indica.* While, low level was observed with rest of the plants. Similar ascorbic content content was reported by Krishnaveni et.al for *Azadirachta indica* with respect to ascorbic acid.[5] Total chlorophyll content observed was high with Azadirachta *indica, Psidium guajava, Tectona grandis, Cardia sebestena* whereas moderate level was observed with rest of the plants assessed. All plants showed low level of carotenoid in site 1. Air pollution tolerance index assessed was high for *Azadirachta indica* (12.6), *Peltophorum acutifolium* (12.8), and moderate level was observed for all the plants, their indexes are listed as follows: *Cardia sebestena* (9.5), *Manilkara zapota* (9.5), *Annona squamosa* (9.1), *Madhuca longifolia* (8.3), *Causarina equistifolia* (7.01), *Mangifera indica* (6.4), *Tamarindus indica* (5.8), *Ficus religiosa* (4.1), *Tectona grandis* (3.7). (Table 1)

Table 2 depicts the results of biochemical changes and air pollution tolerance index for the plants studied at spot 2. The pH was alkaline for all the plants studied. The relative water content was high for *Ficus benghalensis, Pongamia pinnata, Syzygium cumini, Polyalthia longifolia* whereas it was moderate for all the other plants studied. Similar relative water content was reported by Krishnaveni et.al for *Azadirachta indica.*[10] Ascorbic acid content was high for *Azadirachta indica, Carica papaya, Albizia saman, Albizia amara* but it was low for all the other plants studied. All plants showed moderate amount of chlorophyll. Similar result for chlorophyll was reported by Krishnaveni et.al with respect to *Pongamia pinnata,*[6] *Azadirachta indica.*[7] Carotenoid content was very low for all the plants studied. The air pollution tolerance index was high for *Azadirachta indica* (10.93), *Ficus benghalensis* (9.53), *Pongamia pinnata* (9.36), *Albizia saman* (9.0), *Syzygium cumini* (8.63), *Polyalthia longifolia* (8.56), *Carica papaya* (6.79), *Tectona grandis*(2.07), *Tamarindus indica* (2.02). (Table 2) Similar APTI was reported by Krishnaveni et.al for *Azadirachta indica,* [10] *Ficus benghalensis.*[8]

The results of biochemical changes and air pollution tolerance index studied for plants collected from spot 3 is given in Table 3. The pH tested was alkaline in nature. Similar pH was reported by krishnaveni et.al for *Annona squamosa.*[9] The relative water content was higher for *Psidium guajava, Mangifera indica,* and it was found to be moderate with rest of the plants studied. Similar relative water content was reported by Krishnaveni et.al for *Azadirachta indica.*[10] The ascorbic acid content was high for *Peltophorum acutifolium, Peltophorum acutifolium.* Moderate amount of ascorbic acid was observed for *Psidium guajava, Madhuca longifolia, Mangifera indica* and very low level was observed with remaining plants. The observed chlorophyll content was moderate for all the plants studied, whereas, the carotenoid pigment was found to be very low for all the plants studied. The air pollution tolerance index was higher for *Psidium guajava, Azadirachta indica, Mangifera indica, Cardia sebestena, Madhuca longifolia.* The remaining plants showed moderate amount of air pollution tolerance index. (Table 3) Similar air pollution tolerance index was reported by Krishnaveni et.al for *Azadirachta indica.*[10] The APTI values calculated were categorized according to Kalyani and singaracharya, 1995.[11] The following are the four categories APTI index range < 1-Very sensitive, 1to 16-Sensitive, 17 to 29 -Intermediate and 30 to 100 - Tolerant. APTI of plants studied at three points were found sensitive to pollution.

CONCLUSION

Air pollution tolerance index is an instrument used to measure the level of tolerance of each plant studied at particular location. This index identifies whether a plant is sensitive, tolerant to pollution, a signal that keeps every one aware of our surrounding environment to protect our nature which adds beauty to our health especially breath. Here, our results showed that all plants were found to have lesser index and shows its sensitivity to pollution.

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