Research Article

Biochemical Changes in Plants Collected Near Cement Industry, its Soil Analysis

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ABSTRACT

The present study was designed in order to know the effect of pollution on plants as plants are immediate agents in capturing pollution in any form. Hence, *Azadirachta indica*, *Millettia pinnata, Wrightia tinctoria*, *Eucalyptus tereticornis*, *Delonix elata*, *Albizia amara*, *Mangifera indica*, *Citrus aurantiaca*, *Psidium guajava*, *Holoptelea integrifolia*, *Delonix regia*, *Bambusa tulda*, *Morinda pubescens*, *Manilkara zapota*, *Tetelia* were selected for the analysis of air pollution tolerance index and soil. Among the 15 plants studied, none was found to be tolerant instead showed sensitivity. The sensitivity might be due to the age, seasonal variation and several other factors. The ascorbic acid and chlorophyll level was low for all the plants studied, and it plays a major role in influencing air pollution tolerance index. The soil analysis shows higher potassium, Magnesium, Manganese and sufficient calcium content.

Keywords: Ascorbic acid, Minerals, Pollution, Plants, Soil.

INTRODUCTION

Thiruchengode is a city located at a distance of 46km from Salem. Having coordinates of 11°22′49.8″N 77°53′42.45″E, altitude of about 150-200 meters. The average rainfall approximates to 950mm. It has more industries rather than agriculture due to very less rain fall and depends on Cauvery river that flows near Pallipalayam, Erode.

In the surroundings of cement factory located at Palamedu village there were around 150 houses. The general survey showed that 7 lorrys, 2 Govt. Private buses, 7 Private college buses, 6 private school van, 50 two wheeler, 10 cycles, 03 cars enter into Palamedu village for transportation purposes. Only one Govt. school and no Govt. college was functioning in this village. Fifteen plants were selected for the present study. The plants selected for the present study and their approximate numbers are shown below: *Azadirachta indica*(30), *Millettia pinnata*(4), *Wrightia tinctoria*(50), *Eucalyptus tereticornis*(2), *Delonix elata*(2), *Albizia amara*(1), *Mangifera indica*(5), *Citrus aurantiaca*(1), *Psidium guajava*(1), *Holoptelea integrifolia*(1), *Delonix regia*(2), *Bambusa tulda*(2), *Morinda pubescens*(3), *Manilkara zapota*(5), *Tetelia*(1).

Hence, a study was planned to study the sensitivity, resistance nature of plants and the nutrient content of soil from the particular location.

MATERIALS AND METHODS

Leaf Sample Collection

For the present study, fresh leaves from each plant was collected from the experimental site near road sides of Cement industry located at Thiruchengode, Namakkal District, Tamil Nadu, India, during the month of December, 2014. Common plants identified were selected for the present study. All the selected plants were identified by Dr. A. Balasubramanian, and also by comparing with book named Dictionary of Medicinal Plants written by Dr. A. Balasubramanian Executive Director, ABS Botanical Garden, Salem, Tamil Nadu, India.

Extract Preparation

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

Soil Sample Collection

The soil samples were collected from the study area at a depth of 10-15cm.

The collected soil samples were removed and freed from debris, stones and then sieved. The sieved samples (500gm) was packed and sealed in an airtight plastic cover and sent for nutrient analysis.

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°C and reweighed to obtain the dry weight. RWC was determined and calculated by the method as described by Singh 1977.[1]

$$RWC = \frac{(FW - DW)}{(TW - DW)} \times 100$$

Where:

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

Ascorbic Acid Content

Ascorbic acid content was measured by Titrimetric method of Sadasivam 1987[2] 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 color develops. Similarly a blank is also developed.

Total Chlorophyll Content

For Total Chlorophyll analysis, 0.5 g fresh leaves material was grounded and diluted to 10 ml in distilled water.

A subsample of 2.5 ml was mixed with 10 ml acetone and then filtered.

Optical density was read at 645 nm (D645) and 663 nm (D663).[3]

Optical density of Total Chlorophyll (CT) is the sum of chlorophyll a (D645) density and chlorophyll b (D663) density as follows:

$$CT = 20.2\,(D645) + 8.02\,(D663)$$

Total Chlorophyll (mg/g DW) was calculated as follows:

$$Total\ Chlorophyll = 0.1CT \times \frac{(leaf\ DW)}{(leaf\ fresh\ weight)}$$

Calculation of APTI

The air pollution tolerance indices of the selected plants were determined by following the method of Singh and Rao (1983).[4] The formula of APTI is given as:

$$APTI = \frac{[A\,(T + P) + R]}{10}$$

Where:

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

Analysis of Soil Nutrients

The physio-chemical properties of soil were determined by following an alternative analytical indigenous technology developed by MCRC, IIT (M).

Statistical Tool

The Mean and Standard deviation (S) was calculated by using the following formula:

$$Mean = \frac{Sum\ of\ x\ values}{n\,(Number\ of\ values)}$$

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

RESULTS AND DISCUSSION

Table 1 shows the results of air pollution tolerance index of plants studied at the selected site i.e near cement factory, Thiruchengode, Namakkal District, Tamil Nadu, India.

Air pollution tolerance index and its components

The results of all the associated factors involved in air pollution tolerance index was shown in Table.1. Among the studied plants - *Azadirachta indica*, *Millettia pinnata, Wrightia tinctoria*, *Eucalyptus tereticornis*, *Delonix elata*, *Albizia amara*, *Mangifera indica*, *Citrus aurantiaca*, *Psidium guajava*, *Holoptelea integrifolia*, *Delonix regia*, *Bambusa tulda*, *Morinda pubescens*, *Manilkara zapota*, *Tetelia,* the highest APTI was observed in *Eucalyptus tereticornis,* its relative water content was also found to be high (*Eucalyptus tereticornis*-RWC-90.30, APTI-9.15).

The lowest relative water content was observed with *Wrightia tinctoria*, the same was showing lowest APTI value (*Wrightia tinctoria*-RWC-14.59, APTI-1.40). All the plants showed alkaline pH. Plants such as *Azadirachta indica*, *Millettia pinnata*, *Delonix elata*, *Albizia amara*, *Mangifera indica*, *Citrus aurantiaca*, *Psidium guajava*, *Holoptelea integrifolia*, *Delonix regia*, *Bambusa tulda*, *Morinda pubescens*, *Manilkara zapota*, *Tetelia* were showing moderate air pollution tolerance index values in the range of 5.36 to 8.21.

The APTI was achieved by means of internal components like pH, ascorbic acid, chlorophyll, relative water content. Changes observed in these components induce variations in APTI, as each component is interdependent.

The changes observed in pH, ascorbic acid, chlorophyll are dependent on factors like sun light, dust accumulated on leaf as it hinder or alters photosynthetic process. The results of the present study was well correlated with the previous reports in terms of *Azadirachta indica,*[5,12] *Albizia amara*,[6] for RWC, *Holepetela integrifolia*,[7] *Albizia sp*.,[10] *Wrightia tinctoria*[13] for chlorophyll, *Azadirachta indica*,[8] *Pinnata sp*.[10,12] for pH, *Pinnata sp.*,[10] *Citrus sp*.[13] for ascorbic acid, *Delonix sp*.,[9] *Azadirachta indica*,[14] *pinnata sp.*[14] for APTI.

The obtained APTI values of each plants were categorized according to Kalyani and Singaracharya, 1995.[15] The following are the four categories of APTI index range < 1= > very sensitive, 1 to 16 => Sensitive, 17 to 29 => Intermediate and 30 to 100 => Tolerant.

Based on this classification system, the plants were categorized as sensitive, very sensitive, intermediate, tolerant etc. In our study area, all the plants assessed were found to be sensitive as it has APTI values in the range of 1 to 16. Air pollution tolerance index is not an independent factor; it is influenced by the combination of parameters like pH, relative water content, ascorbic acid, chlorophyll. *Pinnata sp*.,[10] *Citrus sp*.[13] for ascorbic acid, *Delonix sp*.,[9] *Azadirachta indica*,[14] *pinnata sp.*[14] for APTI.

Table 1: Air pollution tolerance index and its components

S. No.	Name of the plants	pH	Relative water content (%)	Ascorbic acid (mg/g)	Chlorophyll (mg/g)	APTI
1.	*Azadirachta indica*	7 ± 0.00	62.50 ± 0.00	0.36 ± 0.16	0.72 ± 0.15	6.38 ± 0.00
2.	*Millettia pinnata*	8 ± 0.00	75.60 ± 0.00	0.36 ± 0.16	0.99 ± 0.43	7.71 ± 0.00
3.	*Wrightia tinctoria*	7 ± 0.00	14.59 ± 2.67	0.18 ± 0.12	0.79 ± 0.19	1.40 ± 0.19
4.	*Eucalyptus tereticornis*	6 ± 0.00	90.30 ± 0.00	0.14 ± 0.09	0.98 ± 0.56	9.15 ± 0.00
5.	*Delonix elata*	7 ± 0.00	73.0 ± 0.00	0.14 ± 0.09	0.39 ± 0.10	7.44 ± 0.00
6.	*Albizia amara*	6 ± 0.00	75.0 ± 0.00	0.16 ± 0.06	0.45 ± 0.01	7.62 ± 0.00
7.	*Mangifera indica*	6 ± 0.00	56.0 ± 3.46	0.18 ± 0.03	0.54 ± 0.28	6.23 ± 0.78
8.	*Citrus aurantiaca*	6 ± 0.00	50.66 ± 2.30	0.28 ± 0.20	0.62 ± 0.13	5.36 ± 0.25
9.	*Psidium guajava*	6 ± 0.00	54.00 ± 1.73	0.12 ± 0.07	0.62 ± 0.05	5.57 ± 0.05
10.	*Holepetela integrifolia*	7 ± 0.00	75.00 ± 0.00	0.29 ± 0.17	0.66 ± 0.06	6.57 ± 2.11
11.	*Delonix regia*	7 ± 0.00	73.33 ± 9.81	0.16 ± 0.06	0.32 ± 0.11	7.65 ± 0.66
12.	*Bambusa tulda*	7 ± 0.00	63.33 ± 6.35	0.18 ± 0.03	0.38 ± 0.24	6.77 ± 0.13
13.	*Morinda pubescens*	7 ± 0.00	78.33 ± 2.88	0.16 ± 0.06	0.70 ± 0.28	8.21 ± 0.06
14	*Manilkara sapota*	6 ± 0.00	70.40 ± 0.00	0.31 ± 0.15	0.77 ± 0.05	7.30 ± 0.00
15	*Tetelia*	7 ± 0.00	76.00 ± 3.46	0.16 ± 0.06	0.16 ± 0.10	8.09 ± 0.65

Values are Mean ± SD for three experiments.

Table 2: Soil Nutrient Analysis

S. No.	Nutrients	Results
1.	pH	7.48
2.	EC	0.17
3.	Organic Carbon (%)	0.58
4.	Nitrogen (Kg/acre)	115.14
5.	Phosphorus (Kg/acre)	13.86
6.	Potassium (Kg/acre)	146.11
7.	Calcium (mg/kg)	504.64
8.	Magnesium (mg/kg)	164.66
9.	Sodium (mg/kg)	118.4
10.	Iron (mg/kg)	9.02
11.	Manganese (mg/kg)	5.25
12.	Copper (mg/kg)	1.53
13.	Zinc(mg/kg)	0.42
14.	Boron (mg/kg)	0.59
15.	Sulfate (mg/kg)	15.06
16.	Humas (mg/kg)	104.65
	Total minerals (kg/acre)	275.11

Physio-chemical Properties of Soil

The results of soil nutrients and its normal values are depicted in Table.2 and Table.3. The total mineral content observed was 275.11kg/acre, the humus content calculated was 104.65kg/acre. The pH was alkaline in nature, which favors growth of most of the plants. The electrolytic conductance was found to be 0.17. The nitrogen level was 115.14, Phosphorus 13.86, Potassium 146.11 kg/acre, while, Calcium 504.64, Magnesium 164.66, Sodium 118.4, Iron 9.02, Manganese 5.25, Copper 1.53, Zinc 0.42, Boron 0.59, Sulfate content was 15.06mg/kg. The results obtained was compared with previous results of Krishnaveni similar findings were observed with humus,[16] sulfate,[16,17] boron[17,18] from Thoppur hill, Yercaud road side soil, as well as soil collected near railway junction. Values of sodium,[19] Iron,[19] copper[14] was also similar to earlier reports.

Table 3: Showing Normal Nutrient Values

Nutrient	Low	Medium	High
N (Kg/acre)	<113	113-182	>182
P (Kg/acre)	<18	18-36	>36
K (Kg/acre)	<60	60-138	>138
OC (%)	<0.75	0.75-1.5	>1.5
Mg (mg/kg)	<10	10-15	>15
HA (Kg/Acre)	<18	18-31	>31
Iron (mg/kg)	<6	6-8	>8
Mn (mg/kg)	<1	1.2-2.5	>2.5
Cu (mg/kg)	<0.3	0.3-1	>1
Zn (mg/kg)	<0.5	0.5-1	>1
Sulphur (mg/kg)	0-10	10-15	>15
Ca (mg/kg)	<300 (Deficient)	>300 (Sufficient)	-
Boron (mg/kg)	<0.5 (Deficient)	>0.5 (Sufficient)	-
Molybdenum (mg/kg)	<0.2 (Deficient)	>0.2 (Sufficient)	-

CONCLUSION

The plants were found to be sensitive as all plants have air pollution tolerance index value below 9. None of the plants were tolerant to pollution. Total mineral content of the soil was 275.11kg/acre.

The soil studied contains nitrogen in medium level, while the phosphorus content was low and potassium level was high. It shows that soil contains sufficient nutrients for the growth of the plants.

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