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APTI of Some Selected Plants in Shivamogga City, South Asia

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Abstract **- Air pollution is the human introduction into the atmosphere of chemicals, particulate matter or biological materials that cause harm or discomfort to humans or other living organism or damage the environment The study examined air pollution indices (APTI) of fourteen plant species around Shivamogga city of Karnataka State India .Four physiological and biochemical parameters, leaf relative water content (RWC) , ascorbic acid (AA), total leaf chlorophyll (TCH), and leaf extract $_{P}$H were used to compute the APTI values .The result showed that combining variety of these parameters gave more reliable result than those of individual parameter .The order of tolerance is as follows: *Azadirachta indica*,(37.74) *Mangifera* indica, (28.4) *Eucalyptus mysoresins (*27.93), *Carica papaya*(24.62), *Ricinus communis* (22.46), *Polyalthia longifolia*(20.76), *Calotropis gigantean*(19.84), *Nerium indicum (*18.49), *Psidium guajava* (17.51), *Parthenium hysterophorus* (14.91), *Bougainvillea glabra* (13.35), *Muntingia calabura* (11.68), *Terminalia cattapa* (10.71) and *Tamarindus indica* (9.12).**

Key words **-Air pollution indices (APTI), ascorbic acid (AA), total leaf chlorophyll (TCH), Shivamogga city.**

I. INTRODUCTION

All combustion releases gases and particles in to the air. These can include sulphur and nitrogen oxides, carbon monoxide and soot particles, as well as smaller quantities of toxic metals, organic molecules and radioactive isotopes .Air pollution is a major problem arising mainly from industrialization [1]. Air pollution can directly affect plants via leaves or indirectly via soil acidification [2]. It has also been reported that when exposed to air pollutants, most plants experience physiological changes before exhibiting visible damage to leaves [3].Several contributors agree that air pollutants affect plant growth adversely [4,5,6]. The aim of this study is to determine the air pollution tolerance index of fourteen plant species in Shivamogga city of Karnataka state ,India.

II. MATERIALS AND METHODS

Shivamogga is one of the most important city of Karnataka State and is situated on the banks of river Tunga and spread over an area of 50 km^2 (19.31 square miles) with a total population of 474,105 (during 2007) The geographical location of the city is $3^0$55'18'' N, 75°34'12'' E. Its height is 584 m above MSL (Mean Sea Level). It is a blend of history and tradition and a thriving commercial city. It is exposed to southwest monsoon. Humidity is more during the month of July (78%). The annual rainfall is 200.97 mm and the average wind velocity is 9.7km/h from southwest. The studies were conducted based on location, population, regional background and other such factors .The study area was classified into two zones, control site and experimental site. The control site leaf samples were collected from Kuvempu University (premises of Shankarmattha temple) where there is no disturbance of any kind and is relatively unpolluted. Similarly, plant species were collected randomly from experimental site i.e. Shivamogga city. The collected leaf samples were immediately brought to the lab in a heatproof container. The leaf fresh weight was taken immediately upon getting to the laboratory, and then samples were preserved in refrigerator for further analysis.

III. METHODOLOGY

APTI Assessment

a. Relative Leaf Water Content (RWC)

RWC was determined and calculated with the formula as described by Singh (1977),

$$RWC = \frac{(FW-DW)}{(TW-DW)} \times 100 \qquad (1)$$

Where,

FW= Fresh weight

DW= Dry weight

TW= Turgid weight

Fresh weight was obtained by weighing the leaves. The leaf samples were then immersed in water overnight blotted dry and then weighed to get the turgid weight. The leaves were then dried overnight in a hot air oven at 70^0 C and reweighed to obtain the dry weight.

b. Total Chlorophyll Content (TCh)

This was carried out according to the method described by Arnon (1949). 3gm of fresh leaves were blended and then extracted with 10ml of 80% acetone and left for 15 min. The liquid portion was decanted into another test tube and centrifuged at 2,500 rpm for 3 min. The supernatant was collected and the absorbance was then taken at 645 nm and 663 nm using a spectrophotometer. Calculations were done by using the formula given below:

Chlorophyll a =12.7Dx 663 – 2.69DX 645 *V/1000W mg/gm

Chlorophyll b = 22.9 Dx 645 – 4.68 DX663*V/1000W mg/gm

TCH = Chlorophyll a + b mg/gm (2)

Where,

Dx= absorbance of the extract at the wavelength Xnm

V = Total volume of the chlorophyll solution (ml)

W = Weight of the tissue extracted (g)

c. Leaf Extract using pH Tester

5gm of fresh leaves were homogenized in 10ml deionised water. This was filtered and the pH of the leaf extract determined after calibrating pH-meter with buffer solution of pH 4 and 9.

d. Ascorbic acid (AA) content

Ascorbic acid contents were determined by the method of Aberg (1958) and Sadasivam and Manickam (1997).

5ml of the working standard solution was pipette out in to a 100 ml conical flask and 10 ml of 4% oxalic acid was added and titrated against the dye (V_1 ml). End point is the appearance of pink color which persists for a few minutes. The amount of the dye consumed is equivalent to the amount of ascorbic acid.

After extracting the sample (0.5-5gm depending on the sample) in 4% oxalic acid, the volume was made up to a known volume and centrifuged. 5ml of this supernatant was taken in the conical flask and 10 ml of 4% oxalic acid was added and titrated against the dye (V_2 ml).

Amount of ascorbic acid mg/100 gm sample was calculated by,

$$\text{Ascorbic acid} = \frac{[0.5 \text{ mg}/V_1 \text{ ml} * V_2/5 \text{ ml} * 100 \text{ ml}}{\text{wt. of sample}]} \times 100 \quad (3)$$

***Calculation of APTI*:**

The air pollution tolerance index (APTI) was computed by the method suggested by Singh and Rao (1983) using the equation,

$$APTI = \frac{[A\,(T + P) + R]}{10} \qquad (4)$$

Where,

A = Ascorbic acid content (mg/gm)

T = Total Chlorophyll (mg/gm)

P = pH of the leaf extract

R = Relative water content of leaf (%)

IV. RESULT AND DISCUSSION

Table 1: Air pollution tolerance index (APTI) of plant species growing in experimental site. (Shivamogga)

Sl .No.	PLANT SPECIES	RWC	TCH	pH	AA	APTI
1	*Carica papaya*	86.04	0.79	6	23.6	24.62
2	*Calotropis gigantea*	61.22	0.76	6.5	18.9	19.84
3	*Eucalyptus mysoresins*	85.71	0.25	5.6	33.1	27.93
4	*Parthenium hysterophorus*	79.1	0.51	6.9	9.45	14.91
5	*Nerium indicum*	84.37	0.93	6.2	14.1	18.49
6	*Polyalthia longifola*	87.8	0.24	6.1	18.9	20.76
7	*Mangifera indica*	90.9	0.51	4.6	37.8	28.4
8	*Ricinus communis*	89.7	1.24	5.9	18.9	22.46
9	*Psidum guajava*	77.14	1.25	5.7	14.1	17.51
10	*Mutangia calibra*	59.25	0.39	5.7	9.45	11.68
11	*Bougainvillea glabra*	69.56	1.17	5.6	9.45	13.35
12	*Terminalia cattapa*	83.72	0.47	4.5	4.72	10.71
13	*Azadirachta indica*	91.92	0.15	5.9	47.2	37.74
14	*Tamarindus indica*	50.9	0.07	4.2	9.45	9.12

RWC = Relative water content

TCH =Total Chlorophyll content

AA= Ascorbic acid

APTI = Air Pollution tolerance index

Table.2: Air pollution tolerance index (APTI) of plant species growing in control site Kuvempu University (premises of Shankarmattha temple)

SL.NO.	PLANT SPECIES	RWC	TCH	pH	AA	APTI
1	*Carica papaya*	71.09	0.6	6.2	18.91	19.96
2	*Calotropis gigantea*	57.8	0.18	5.7	14.18	14.11
3	*Eucalyptus mysoresins*	75.54	0.13	5.2	28.3	22.63
4	*Parthenium hysterophorus*	77.92	0.38	6.7	4.72	11.13
5	*Nerium indicum*	78.63	0.06	5.8	9.45	13.4
6	*Polyalthia longifola*	79.59	0.2	5.9	14.18	16.6
7	*Mangifera indica*	53.14	0.15	4.5	33.1	20.7
8	*Ricinus communis*	75.04	0.18	5.7	14.18	15.84
9	*Psidum guajava*	74.32	0.67	4.9	9.45	12.69
10	*Mutangia calibra*	41.88	0.15	5.5	4.72	6.85
11	*Bougainvillea glabra*	65.85	0.06	5.4	4.72	9.16
12	*Terminalia cattapa*	70.29	0.29	4.2	4.72	9.14
13	*Azadirachta indica*	77.29	0.15	5.6	37.8	29.46
14	*Tamarindus indica*	44.94	0.07	3.2	4.72	6.03

RWC = Relative water content

TCH =Total Chlorophyll content

AA= Ascorbic acid

APTI = Air Pollution tolerance index

From the present study it is evident that out of the 14 species studied , *Azadirachta indica* (37.74) has high APTI value in the experimental site(Table 1) and is most tolerant among all fourteen, followed by *Mangifera* indica, (28.4) *Eucalyptus mysoresins (*27.93), *Carica papaya*(24.62), *Ricinus communis* (22.46), *Polyalthia longifolia*(20.76), *Calotropis gigantean*(19.84), *Nerium indicum (*18.49), *Psidium guajava* (17.51), *Parthenium hysterophorus* (14.91), *Bougainvillea glabra* (13.35), *Muntingia calabura* (11.68), *Terminalia cattapa* (10.71) and *Tamarindus indica* (9.12).

A similar work has been carried out by [7] who have worked on ten plant species around the Erhoike- kokori oil exploration station of Delta State. The APTI values of plant species growing in control site is given in the (Table 2). High APTI values are reported in the species *Azadirachta indica (29.46), Eucalyptus mysoresins (22.63),Carica papaya (19.96) Polyalthia longifolia (16.6), Ricinus communis (15.84) and Calotropis gigantean (14.11).*The APTI values of remaining species ranged from (13.4 to 6.03).

CONCLUSION

Air Pollution Tolerance Index determination is of utmost importance because with increased vehicular movements, urbanization and a rapid increase in small scale industries the pollution load is on the rise. The results of such studies are helpful for future planning. Vegetation naturally cleanses the atmosphere by absorbing gases and some particulate matter through leaves. Plants have a very large surface area and their leaves function as an efficient pollutant-trapping device. Some plants have been classified according to their degree of sensitivity and tolerance towards various air pollutants. Sensitive plant species are suggested to act as bio-indicators. Levels of air pollution tolerance vary from species to species, depending on the capacity of plants to withstand the effect of pollutants without showing any external damage. In this study, the air pollution tolerance index (APTI) of 14 plant species has been evaluated. High values of APTI were recorded in *Azadirachta indica, Mangifera* indica, *Eucalyptus mysoresins*, and *Carica papaya*, *Ricinus communis, Polyalthia longifolia, Calotropis gigantean, Nerium indicum, Psidium guajava, Parthenium hysterophorus, Bougainvillea glabra, Muntingia calabura, Terminalia cattapa, Tamarindus indica.*

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