

PLANTS AS AIR POLLUTANT ABSORBERS – MODIFIED APTI ABIDS HYDERABAD-TELANGANA

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ABSTRACT

AIR being an important & vital component of earth's environment and slight change in its composition can have varied effects on growth & development of organisms on this Planet. Rapid Industrialization & Urbanization coupled with increase in vehicular traffic in urban areas has become threat to air quality. Air Pollutants released by Automobiles exerts detrimental effects on vegetation. In the present study Evaluation of Modified Air Pollution Tolerance Index [Modified APTI] of 15 selected plants was carried out to assess their response to ambient levels of air pollutants along the commercial roadways of Abids. Based on **Modified APTI 7-Tolerant , 3- Intermediate & 4 Sensitive Plants** were identified. The 7-Tolerant plants were *Peltaphorum pterocarpum [DC] Hayne*, *Delonix regia [Bojer ex.Hook]Raf.* , *Tecoma stans [L] Juss.ex.Kunth* , *Thespesia populanea [L] Sol ex.Correa* , *Azadiracta indica L* , *Pongamia pinnata L* , *Terminalia catappa L* can be employed as sinks for vehicular pollutants.

Key Words: *Abids, Air Pollutants, Intermediate Plants, Modified APTI, Sensitive Plants & Tolerant Plants,*

I. INTRODUCTION

Plants absorb Air Pollutants such as SO₂, NO_x etc. Particulate Matter i.e. TSPM & RSPM including dust settled on the leaves which provides enormous surface for the accumulation of Air Pollutants.

Increasing Population Explosion, Automobiles, Industrialization, Urbanization is deteriorating the quality of air in the developing Cities in India. In Hyderabad Metropolis the Hyderabad Metro Rail Project is at full swing leading to the increase in Air Pollution. Construction of Malls, 16-24 storied Residential complexes are adding to the Air Pollution.

As transportation systems i.e. number of two wheelers and four wheelers are increasing everywhere. Therefore , air pollution has become a growing problem in cities. In developing countries the air quality crisis in cities often attributes in large measures [40-80%] to vehicular emission. Despite the improved performance of technology is presently insufficient to counteract the growth of vehicles [Arnon., 1980] and associated pollution problems. Thus, it is necessary to evaluate the status of urban air pollution continuously and to assess its impact on human health and Plants, so that proper initiative measures can be implemented.

Air Pollution Tolerance Index was studied in 1983[1]. Later much work has been done on Air Pollution Tolerance Index.

A study on Air Pollution Tolerance Index of Plants was reported in Hyderabad City 2015[2]. It was reported that Air Pollution Tolerance Indices of Six Ornamental Plants at Ebano Tunnel in Enugu Urban, Nigeria [3].



Air Pollution Tolerance Index of some selected Evergreen Plants were identified across NH60 Road Side of Balasore District, Odisha, India [4]. A Survey on Air Pollution Tolerance Index of various plants species in 2012 F.M. University campus, Balasore, Odisha, India [5]. Air Pollution Tolerance Index of Hyderabad was reported in 2008 [6].

In the present study Modified Air Pollution Tolerance Index was calculated by adding Free Amino Acids and Total Carbohydrates. Therefore An attempt has been made to determine the Modified Air Pollution Tolerance Index [APTI] which gives an empirical value for tolerance level of plants to air pollution .

II. MATERIALS & METHODS

In the present study Fifteen common Plant species were selected 3 were shrubs and remaining 12 are Trees. The three different shrubs are Nerium oleander L, Calotropis procera L, Tecoma stans [L] Juss.ex.Kunth and the Trees are Polyalthia longifolia var.pendula[Sonn] , Thespesia populanea [L] Sol.ex.Correa, Sterculia foetida L, Azadiracta indica L, Dalbergia sissoo Roxb., Pongamia pinnata L, Delonix regia [Bojer ex Hook]Raf. , Peltaphorum pterocarpum[DC]Hayne, Albizzia saman L, Terminalia catappa L, Syzygium cuminii [L] Skeels, and Ficus religiosa L .

The present study was carried out commercial, at **Abids** Nampally Mandal of Hyderabad district during the year August 2009-2010 July

The plant leaf samples were collected at the lower most position of canopy at a height of 6-7ft from ground surface at Abids and is carried to laboratory for the plant analysis of certain Biochemical Parameters such as pH of leaf extract, Singh & Rao [1983]; Ascorbic Acid & Relative Water Content, Singh [1977] Total Chlorophyll, Arnon [1949] ; Free Amino Acid , Thimmaiah.S.K. [1999]; Total Carbohydrates Hedge J.E & Hofreiter B.T.[1962] Modified Air Pollution Tolerance Index Johnson & Shyamala [2015] for a period of two Years i.e, Aug 2009- July 2010.

Modified Air Pollution Tolerance Index [Modified APTI] evaluated to assess the tolerant & resistance of Plants against Air Pollution. Modified APTI is a unique index because it incorporates six biochemical parameters such as pH, Total Chlorophyll , Ascorbic Acid , Relative Water Content, Free Amino Acid, Total Carbohydrates .

The formula for Modified APTI is $\text{Modified APTI} = \frac{A + C + AA}{[T + P] + R}$

10

A = Ascorbic Acid [mg/g]

C= Tot.Carbo. [mg/g]

AA = Free Amino Acid [mg/g]

T= Tot.Chl. [mg/g]

P= pH of leaf extract

R=RWC [%]

This will give a comprehensive picture of the Air Pollution Tolerance Index. It is a better indicator of Tolerance Index.



III. RESULTS & DISCUSSION

The present study was carried out commercial, at **Abids** Nampally Mandal of Hyderabad district during the year August 2009-2010 July .

The **Abids** commercial area with few Residential pockets i.e, Chapel Road,Chiragali,Gunfoundry, Boggulakunta along with Schools like Little Flower School, St.Georges Grammar School, Rosary Convent School, All Saints School, Stanely Girls High School, Seventh Day Adventist HighSchool , Sujatha High School, Slate School etc . This commercial area has risen its importance because of its close proximity to Nampally Railway station which is situated half kilometer from it. It is the National Highway the main road links Charminar on one side & Vanasthalipuram , L.B. Nagar, Nagarjuna Sagar road on the other via Koti. It links Panjagutta, Kukatpally & also Mehdipatnam, Langerhouse etc. Along with heavy vehicular traffic in the region shows varied concentrations of particulates, Sulphurdioxide, Nitrogendioxide and Carbonmonoxide.

Today the whole area Abids is one of the main shopping centre in the city & the main street is known as Abid Road.The state Government building GHMC is adjacent to GPO are located here.Major business shops like textiles,hotels,jewelry,foot wear,electronic goods are established. Hence Abids is an important commercial centre along with many schools and residential areas.

The Biochemical analysis was done in fifteen Plants they included pH, Ascorbic Acid, Total Chlorophyll, Relative Water Content, Free Amino Acids & Total Carbohydrates. The results of biochemical components involved in Modified Air Pollution Tolerance Index assessment is shown in Table 1.

Table 1. Averages of pH,Ascorbic Acid, Tot.Chl., RWC. , Free A.A and Tot. Carbo. in Fifteen plants studied at Abids.

S.NO	Plants	pH	AscorbicAcid [mg/g]	Tot.Chl. [mg/g]	RWC[%]	Free.A.A [mg/g]	Tot.Carbo. [mg/g]
1	<i>Nerium oleander L</i>	7.99	5.0	1.15	58.22	0.31	0.56
2	<i>Calotropis procera L</i>	6.58	4.53	2.43	63.81	0.35	0.32
3	<i>Tecoma stans[L] Juss.ex Kunth</i>	7.45	4.77	4.43	59.75	0.27	0.41
4	<i>Polyalthia longifolia var.pendula [Som]</i>	7.51	5.87	3.48	60.42	0.51	0.49
5	<i>Thespesia populanea[L] Sol. ex Correa</i>	7.68	6.47	1.31	57.44	0.37	0.34
6	<i>Sterculia foetida L</i>	6.91	4.53	1.02	61.78	0.41	0.33
7	<i>Azadiracta indica L</i>	7.22	6.02	0.95	63.39	0.35	0.42
8	<i>Dalbergia sissoo Roxb.</i>	6.56	5.58	2.21	66.35	0.36	0.30
9	<i>Pongamia pinnata L</i>	7.47	6.16	1.08	63.48	0.47	0.53
10	<i>Delonix regia [Bojer ex Hook] Raf.</i>	6.79	6.95	4.28	59.78	0.42	0.30
11	<i>Peltaphorum pterocarpum [DC]Hayne</i>	7.31	6.55	3.27	63.57	0.30	0.35
12	<i>Albizzia samanL</i>	7.18	6.09	3.58	56.36	0.30	0.32
13	<i>Terminalia catappa L</i>	7.64	4.84	3.78	60.70	0.48	0.32
14	<i>Syzygium cuminii [L] Skeels</i>	6.54	5.54	3.02	62.58	0.43	0.54
15	<i>Ficus religiosa L</i>	7.05	4.56	0.90	65.24	0.54	0.52



The formula for Modified APTI is $\text{Modified APTI} = \frac{A + C + AA}{[T+P]+R}$

10

A = Ascorbic Acid [mg/g]

C= Tot.Carbo. [mg/g]

AA = Free Amino Acid [mg/g]

T= Tot.Chl. [mg/g]

P= pH of leaf extract

R=RWC [%]

This will give a comprehensive picture of the Air Pollution Tolerance Index. It is a better indicator of Tolerance Index.

Carbohydrates & Free Amino Acids play significant role in plant metabolism. Modified APTI is an inherent quality of plants to encounter air pollution stress. These six Physiological factors will help plants to adjust to stress in the environment. It is worth noting that combining a diversity of six parameters gave a more reliable result than when a single biochemical parameter was analysed [Agbaire, 2009] .

Ascorbic Acid plays a significant role in cell wall synthesis, defense and cell division. It is also a strong reducer and plays important role in Photosynthetic carbon fixation, with the reducing power directly proportional to its concentration. Hence it was given top priority and first multiplication factor in the formula.

Carbohydrates are important components of storage and structural materials in the plants. They exist as free sugars and Polysaccharides. The basic units of Carbohydrates are the monosaccharides which cannot be split by hydrolysis into more simple sugars. Carbohydrates are carbon compounds that in most cases contain hydrogen and oxygen in the ratio of 2:1 . Chemically they are Polyhydroxyaldehydes [aldoses] or PolyhydroxyKetones [Ketones] or condensation products of such compounds.

Carbohydrates are major constituents of plants and animal tissues. They are of fundamental importance in living organisms as a source of metabolic energy; structural components cellulose in plant cell walls, Mucopolysaccharides of skin and connective tissue in animals and reserve storage food starch in plants and glycogen in animals. So it is given importance and used as Second multiplication factor in the formula.

The Amino Acids are the basic building blocks of all proteins. Those AminoAcids which exist in the free form in tissues and not bound to proteins are called as Free Amino Acids. Normally, during diseased conditions in plants , there will be a change in the Free Amino Acid composition. Incorporation of Free Amino Acids gives an indication about physiological and health condition of the plants.

Free Amino Acids are individualized in monomer forms. Due to their low molecular weight, plant assimilate this form of amino acid rapidly & their effects on the process of plant and the most profound. So, it is given significance and used as third multiplication factor in the formula.

pH indicates the Hydrogen ion concentration and it expresses the intensity of acidity [or] alkalinity of the leaf extract. High pH may increase the effectiveness of conversion from hexose sugar to Ascorbic Acid, While low leaf extract pH show good correlation with sensitivity to air pollution [Escobed et.al, 2008].

Relative Water Content [RWC %] High Relative Water Content within a plant will help to maintain its physiological balance under stress condition such as exposures to air pollution when the transpiration rates are usually high. High Relative Water Content [%] favours drought resistance in plants. If the leaf transpiration rate



reduces because of the air pollution, plants cannot live well due to inability to pull water up from the roots for Photosynthesis [1 to 2% of the total].

Total Chlorophyll content is one of important widely employed & analysed parameter of Environmental assessment. Chlorophyll content of plant signifies its Photosynthetic activities as well as growth and development of biomass.

The Product of Ascorbic Acid [A] , Carbohydrates [C] , Free Amino Acids [AA] , Sum of leaf extract pH and Total Chlorophyll was added with RWC [R] in the Modified APTI formula.

The Modified APTI gives a Comprehensive picture. Based on the Modified APTI plants are categorized into Sensitive, Intermediate & Tolerant types .

In the present study Modified Air Pollution Tolerance Index was calculated in fifteen plants. The Modified Air Pollution Tolerance Index was categorized into three types such as **Sensitive** 8.3- 9.4 , **Intermediate**- 9.5- 10.6, and **Tolerant** – 10.7-13.0.

From the fifteen plants selected *Ficus religiosa* L [9.46], *Calotropis procera* L [9.44] , *Albizia saman* L [9.44], *Dalbergia sissoo* Roxb. [8.93] *Sterculia foetida* L [8.62] were considered as **Sensitive**, *Nerium oleander* L [10.22] , *Polyalthia longifolia* var. *pendula* [Sonn] [10.04], *Syzygium cuminii* [L] Skeels [9.93] were considered as **Intermediate** category, while *Peltaphorum pterocarpum* [DC] Hayne [13.16], *Delonix regia* [Bojer ex. Hook] Raf. [13.14], *Tecoma stans* [L] Juss. ex. Kunth [12.53], *Thespesia populanea* [L] Sol ex. Correa [11.18] , *Azadiracta indica* L [11.03] *Pongamia pinnata* L [10.96], and *Terminalia catappa* L [10.72] are **Tolerant** Category

Table 2: Modified APTI of Tolerant, Intermediate, Sensitive at Abids.

Tolerant	Intermediate	Sensitive
<i>Peltaphorum pterocarpum</i> [DC] Hayne	<i>Nerium oleander</i> L	<i>Ficus religiosa</i> L
<i>Delonix regia</i> [Bojer ex. Hook] Raf.	<i>Polyalthia longifolia</i> var. <i>pendula</i> [Sonn]	<i>Calotropis procera</i> L
<i>Tecoma stans</i> [L] Juss. ex. Kunth	<i>Syzygium cuminii</i> [L] Skeels	<i>Albizia saman</i> L
<i>Thespesia populanea</i> [L] Sol ex. Correa		<i>Dalbergia sissoo</i> Roxb.
<i>Azadiracta indica</i> L		<i>Sterculia foetida</i> L
<i>Pongamia pinnata</i> L		
<i>Terminalia catappa</i> L		

Modified Air Pollution Tolerance Index is an index denotes capability of a plant to combat against air pollution. Plants which have higher index value are tolerant to air pollution and can be caused as a sink to mitigate pollution, while plants with low index value show less tolerance and can be used to indicate levels of air pollution [Singh & Rao ,1983].

The results of present study become very useful in landscaping, for phyto-remediation of urban roads of polluted air environment. **Tolerant** species of plants should be considered in advance for use, when air pollution



is high, and **Intermediate** species can be modified into Tolerant Category in due course of time, while **sensitive** species should be used as **bio-indicators** of air quality.

IV. CONCLUSIONS

Based on the present study it is concluded that the Modified APTI can be used as predictor of air quality. From the 15 plants studied it were 7 plants exhibited Tolerant Category, 3 plants were Intermediate, and 5 were Sensitive. The 7 plants were *Peltaphorum pterocarpum* [DC] Hayne, *Delonix regia* [Bojer ex.Hook]Raf. , *Tecoma stans* [L] Juss.ex.Kunth , *Thespesia populanea* [L] Sol ex.Correa , *Azadiracta indica* L , *Pongamia pinnata* L , *Terminalia catappa* L can be employed as sinks for vehicular pollutants, as they can play vital role in absorption and detoxification of toxic air pollutants. This Modified APTI is **unique** and very apt to calculate the **Tolerant** Plant species which can be used as **Biomonitor**s.

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