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Evaluation of Anticipated Performance Index of Certain Tree Species in Virudhunagar, India

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Abstract. In the present study the Air Pollution Tolerance Index (APTI) of about fifteen tree species collected from a semi urban area. The study examined ,the air pollution tolerance indices of plant species around three areas of Virudhunagar .The physiological and biochemical parameter ,which are relative to leaf's water content(RWC) ,ascorbic acid content (AA),total leaf chlorophyll(TCH) and leaf extract PH were used to compute the APTI values.The anticipated performance index (API) of these plant species was also calculated by considering their APTI values together with other socioeconomic and biological parameters .According to API most tolerant plant species for green belt development in Virudhunagar area were identified. Mangifera indica and Ficus relogiosa with highest scoring (69 %) and it was assessed that good for heavy traffic areas or planting along road sides. It was assessed well (% scoring 69) for planting Ficus religiosa and Eugenia jambolana in areas around industries.

Keywords: APTI; API; Green belt; Virudhunagar; Ficus religiosa; Mangifera indica

1. Introduction

Air pollution is the human introduction in to the atmosphere of chemicals, particulate matter or biological materials that cause harm or discomfort to humans or other living organism or damage the environment, various efforts have been done for environmental restoration in India but still it seems to be a formidable task. Plants ,the main Green Belt(GB) component act as a sink and as living filters to minimize air pollution by absorption,adsorption,accumulation and metabolization without sustaining serious foliar damage or decline in growth, thus improving air quality by providing oxygen to the atmosphere [1] [2]. Air pollution can directly affect plants via leaves or indirectly via soil acidification [3]. The high sensitivity of plants towards some pollutants means that a great variety of plants can be used as bio indicators of air pollution .The main focus of this work is to provide an assessment of the use of biochemical parameters of plants for GB .So that these biochemical indicators can be used for assigning APTI for plants in selected areas. Plants sensitivity and tolerance to air pollutantants varies with these parameters .On the basis of the APTI and API of various plants was determined for green belt development in selected location.

2. Materials and Methods

2.1. Area of study

The present research work was mainly confined in Virudhunagar which is in southern part of Tamil Nadu, India. Virudhunagar is a selection grade Municipality, spread over an area of 6.39 sq.km holding a population of 72,081 as of 2001(adopting population projection, it is interpolated the population of this town was 77449 in 2009).It is located at 9°35' North latitude and 77°57' East longitude, at 101.3m above mean sea level. The climate of the town is hot and dry throughout the year with April to June being the hottest months.

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The maximum temperature is rarely above 38.5°C, the minimum temperature is below 34.2°C.The town receives rainfall mostly during Northeast monsoon, and the average rainfall is 780mm per annum

2.2. Calculation of Air Pollution Tolerance Index (API).

Fully matured leaf samples of the selected plant species were collected from different locations during winter and summer(Dec,2010 to May,2011).Utmost care was taken that the samples from each sampling location (Site-1,control area ;Site-2,heavy traffic area;Site-3,industrial area) were collected from plants selected for this study. Carefully collected leaf samples were analyzed for ascorbic acid, total chlorophyll, leaf extract Ph, relative water content using the standard procedures of Keller and Shewager (1977) [4], Arnon (1949) [5], Varshney (1992) [6], Singh and Rao. Air pollution Tolerance Index (APTI) determination was done by the method given by Singh and Rao (1983) [7] using the formula

APTI = [A (T+P) + R]/10

Where:

A = Ascorbic acid content (mg/g)

T = total chlorophyll (mg/g)

P = pH of leaf extract

R = relative water content of leaf (%).

2.3. Calculation of Anticipated Pollution Index (API)

Table 1. Anticipated Performance Index (API) of plants

Grade	**% Score**	*Assessment category*
	Up to 30	Not recommended
1	31-40	Very poor
2	41-50	Poor
3	51-60	Moderate
4	61-70	Good
5	71-80	Very good
6	81-90	Excellent
7	91-100	Best

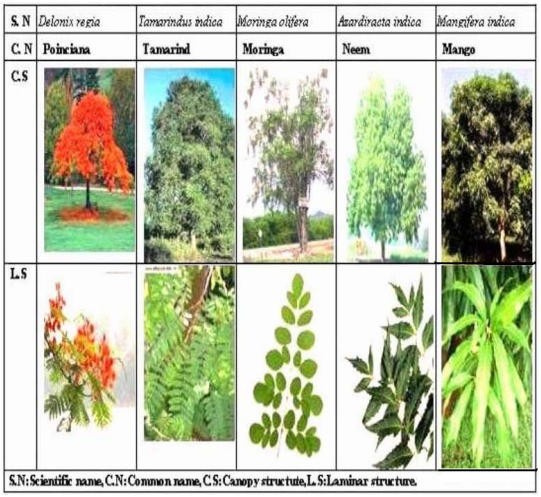
The results of APTI value combined with some related biological and socio economic characters such as plant habit, canopy structure, type of plant and economic value. Depending upon these characters different grades (+ or -) given to the selected plants. ,and the plants scored according to their grades .The criteria given for calculating the API of different plants are given in Table .1. A statistical treatment of the data carried out by using SPSS version.17.Statistical difference of the means checked out using Analysis of Variance(ANOVA).Linear correlation and regression analysis was performed between independent variables viz. ascorbic acid, total chlorophyll, leaf extract Ph, RWC and dependant variable of this work(APTI).

Table 2. Mean APTI value of the leaf samples of selected plant species

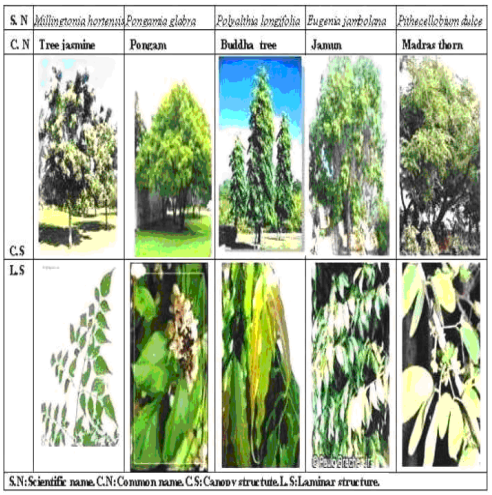
Plant	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Site 1	4.17	12.92	14.87	7.6	10.5	4.9	13.70	12.8	14.9	14.6	13.3	3.7	4.1	4.1	2.7
Site 2	6.92	16.53	20.52	19.6	21.7	8.8	16.18	17.0	19.9	17.4	16.1	6.8	6.8	7.4	5.3
Site 3	18.77	16.04	16.70	21.7	18.7	14.8	16.16	17.6	21.4	17.0	19.7	9.1	6.7	8.4	9.4

This study was carried out for the period of one year (June 2010 to May 2011). There are fifteen tree species selected for this study.[*1:Delonix regia,2:Tarmarindus indica,3:Moringa olifera,4: Azardiracta indica, 5:Mangifera indica,6:Millingtonia hortensis,7:Pongamia glabra,8:Polyalthia longifolia,9:Eugenia jambolana,10:*Pithecellobium *dulce,11:Ficus religiosa,12:Ficus benghalensis,13:Tectona*

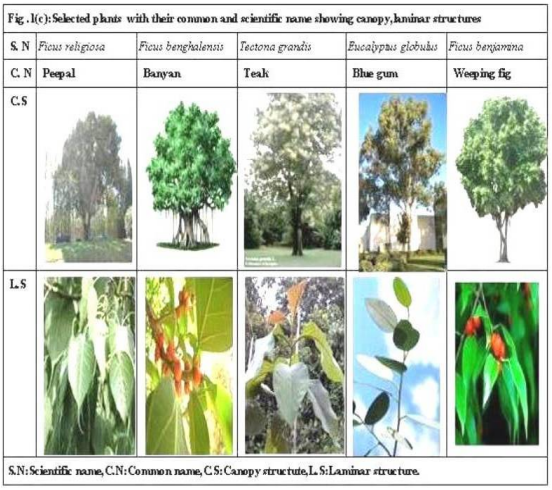
grandis,14:Eucalyptus globulus,15:Ficus benjamina.] which are commonly seen in this area were selected for this study [Fig 1 (a), Fig 1 (b), Fig 1 (c)].



(a)Trees 1-5 showing Canopy & laminar



(b) Trees 6-10 showing Canopy & laminar



(c)Trees 11-15 showing Canopy & laminar

Fig 1.

Air pollution tolerance index (APTI) was calculated for studied plat species growing in both polluted and control site and mean value of apti for each plant analyzed in selected locations presented in Table .3.Calculated values were statistically analysed and they were significantly varied. Although all the species showed significant variation in all the biochemical indicators, which were analyzed the extent up to which plant species were affected varies from species to species and site to site. Thus on the basis of this study the selected trees assessed in to eight categories (Table.4).

3. Results and Discussion

These parameters were subjected to a grading scale to determine the anticipated performance of plant species advocated in reference [7]. It is mentioned in Virudhunagar municipality city corporate cum business plan final report [11] that native tree species would be identified with the help of the forest department and educational institutions. And With the help of NGO could be sought for planting maintenance of the trees the components identified for improvement are

- avenue trees on important roads
- Planting of trees with full coverage of town at road margin and municipal roads.

Table 3. Evaluation of Trees on the basis of some biological and socio-economic characters

Tree species	T.H	C.S	T.T	L.S	L.T	H	E	T
D. *regia*	+	++	-	-	-	-	-	**3**
T. *indica*	++	+	+	-	-	-	++	**6**
M. olifera	-	-	-	-	-	-	++	**2**
A. *indica*	++	++	+	-	-	-	++	**7**
M *.indica*	++	+	+	-	+	+	++	**8**
M *.hortensis*	-	-	+	-	-	-	-	**1**
P *.glabra*	+	+	+	+	+	+	-	**6**
P *.longifolia*	-	-	+	+	+	+	-	**4**
E *.jambolana*	++	+	+	+	-	+	+	**7**
P *.dulce*	++	+	+	-	-	-	+	**5**
F *.religiosa*	++	++	+	+	+	+	+	**9**
F *.bengalensis*	++	++	+	+	-	+	+	**8**
T *.grandis*	+	-	-	++	+	+	+	**6**
E *.globulus*	++	+	+	++	-	+	++	**9**
F*.benjamina*	++	++	+	+	-	+	+	**8**

According to that Table 3. F.relogiosa and E.globulus were scored high. Green belt plantation around the polluted area can never be a claim for the removal of air pollutants at the region, but effectively planted trees in the green belt may potentially remove the toxic gases in considerable amount [8] [9]. It was stated that tree plantations or green belts are one of the strategy for air pollution amelioration [10].And Plant species assessed for plantation along road sides and in industrial areas were evaluated for various biological socio economic as well as few biochemical parameters including APTI, plant, habit, canopy structure type of plant were shown in Table .4 and 5.

T.H:Tree habit, C.S:Canopy structure,T.T:Type of tree,L.S:Laminar size,L.T:Laminar texture,E:Economic importance,H:Hardness,T:Total plus

Table 4. Anticipated performance index (API) of studied plant species at site2

Name	APTI Grade	*S.E Grade	Total plus	% scoring	API Grade	Assessment category
D. *regia*	-	3	3	19	0	Not recommended
T. *indica*	2	6	8	50	2	Poor
M. olifera	3	2	5	31	1	Very poor
A. *.indica*	2	7	9	56	3	Moderate
M *.indica*	3	8	11	69	4	Good
M *.hortensis*	-	1	1	6	0	Not recommended
P *.glabra*	2	6	8	50	2	Poor
P *.longifolia*	2	4	6	38	1	Very poor
E *.jambolana*	2	7	9	56	3	Moderate
P *.dulce*	2	5	7	44	2	Poor
F *.religiosa*	2	9	11	69	4	Good
F*.benghalensis*	-	8	8	50	2	Poor
T *.grandis*	-	6	6	38	1	Very poor
E *.globulus*	-	9	9	56	3	Moderate
F *.benjamina*	-	8	8	50	2	Poor

Table 5. Anticipated performance index (API) of studied plant species in site3

Name	APTI Grade	*S.E Grade	Total plus	% scoring	API Grade	Assessment category
***D**. regia*	2	3	5	31	1	Very poor
***T**. indica*	2	6	8	50	2	Poor
M.olifera	2	2	4	25	0	Not recommended
***A**.indica*	3	7	10	63	4	Good
***M**.indica*	2	8	10	56	3	moderate
***M**.hortensis*	1	1	2	13	0	Not recommended
***P**.glabra*	2	6	8	50	2	Poor
***P**.longifolia*	2	4	8	38	1	Very poor
E.jambolana	3	7	10	63	4	Good
***P**.dulce*	2	5	7	44	2	Poor
***F**.religiosa*	2	9	11	69	4	Good
***F**.benghalensis*	-	8	8	50	2	Poor
***T**.grandis*	-	6	6	38	1	Very poor
***E**.globulus*	-	9	9	56	3	Moderate
***F**.benjamina*	-	8	8	50	2	Poor

*** Socio Economic Grade**

4. Conclusion

It was predicted in Table 4. Mangifera indica and Ficus relogiosa with highest scoring (>60 %) and it was assessed that good for heavy traffic areas or planting along road sides. In Virudhunagar area workers are facing so many health problems as they are directly exposed to toxic fumes in these industries. So, this study is useful for the selection of suitable plant species (with high API grade) for plantation in industrial area. It was assessed well (scoring >60%) for planting Ficus religiosa, Eugenia jambolana and Azardiracta indica in areas around industries (from table 5).Even though Delonix regia possess high APTI value, it could not score a reasonable API.

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