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Original Research Paper

Identification of Air Pollution Tolerant Tree Species for the Industrial City, Tirupur, Tamil Nadu

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ABSTRACT

To find out the response of certain locally available tree species to air pollution in the industrial city Tirupur, the plants have been studied by pooling the characters such as chlorophyll, moisture and ascorbic contents of leaves and pH of leaf extract. Of the 35 species analysed, 7 species *viz., Aegle marmelos, Azadirachta indica, Ficus benghalensis, F. religosa, Holopetea integrifolia, Pongamia pinnata* and *Tamarindus indica* registered higher APTI (Air Pollution Tolerance Index) values. The plantation of such species in polluted areas is suggested to reduce the effect of air pollution in Tirupur city.

INTRODUCTION

During the past many decades, there has been a growing awareness about the serious hazards of atmospheric pollution. Serious discussions are going on about the effects of green house gases and carbon gases on environmental security worldwide (Kanchev et al. 2005, Blottnitz & Curran 2007). The damaging effects of air pollution on vegetation have already been well recognized (Treshow 1970, Lal & Ambasht 1981). It is generally known that different plant species vary considerably in their susceptibility to air pollutants. Bennet & Hill (1973) have already reported the capacity of plants to reduce air pollution. Hence, a new approach has been evolved to grow green plants in and around industrial complexes and screening of plants for their sensitivity to air pollutants is of vital importance.

In India, Tamilnadu is among the leading states in industrial development. Tirupur textile city is most popular for garments and is an important trade centre. It is the seventh largest and one of the fastest developing cities in Tamilnadu. Further, huge number of automobiles pollute atmosphere drastically. In addition to automobiles, various industrial activities also release enormous quantity of air pollutants. Hence, to control the effect of air pollution, an attempt has been made in the present study at Tirupur to identify suitable air pollution tolerant tree species based on air pollution tolerance index.

MATERIALS AND METHODS

The locally available tree species were analysed for air pollution tolerance index (APTI) by estimating the contents of ascorbic acid, chlorophyll, relative moisture in leaf and leaf extract pH during the month of February, 2008. Leaves from tip, middle and basal canopy of trees were collected in the forenoon between 07.00 and 08.00 am. Care was taken for plants under investigation with respect to exposure of almost similar conditions for light, water, soil and pollutants. The same species of trees sampled away from the city at about 40 km in unpolluted regions served as control. The ascorbic acid content and total chlorophyll were estimated by the methods of Keller & Schwanger (1977) and MacLachlon & Zalik (1963) respectively. The leaf extract pH was measured by using a digital pH meter. The air pollution tolerance index (APTI) was determined by following the formula proposed by Singh & Rao (1983).

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

Where, A = Ascorbic acid content in leaf (mg/g); T = Total chlorophyll of leaf (mg/g); P = Leaf extract pH and R = Percent water content of the leaf. The sum value was divided by 10 to get the value in reduced scale.

RESULTS AND DISCUSSION

A considerable number of 35 locally available tree species was analysed in the Tirupur city. Many tree species showed wide variation in leaf chlorophyll content in the study area. Higher chlorophyll content was found in the trees like *Aegle marmelos, Azadirachta indica, Ficus benghalensis, F. religosa, Holopetea integrifolia, Pongamia pinnata* and *Tamarindus indica.* In other extreme, some other species contained lower amount of chlorophyll (Table 1). It is already reported that pollution stress decreases the chlorophyll level in plants (Speadding & Thomas 1973, Paulsamy 2000). However, the variation in chlorophyll content among the tree species in the study area may be attributed to species tolerance nature, age, genetic makeup and other environmental conditions in addition to pollution effect. The close proximity observed between the individuals of tree species of high chlorophyll content, which are grown in polluted and unpolluted regions, indicates that air pollution has no marked effect on the synthesis of chlorophyll pigment in these species of high chlorophyll content. It is also reported that the photosynthetic efficiency has not been affected under SO_2 stress in plants which contain highest chlorophyll concentration (Varshney 1982). Hence, it is known that the plants having high chlorophyll content under field condition are generally tolerant to air pollution.

The leaf extract pH was slightly acidic in the species like *Azadirachta indica, Melia azedarach, Nyctanthes arboristis, Ficus religosa, Pongamia pinnata* and *Tamarindus indica,* whereas the other species have moderately acidic pH. Scholz & Reck (1977) have reported that in presence of an acidic pollutant, the leaf pH is lowered and the decline is greater in sensitive species. A shift in cell sap pH towards the acid side in presence of an acidic pollutant might decrease the efficiency of conversion of hexose sugar to ascorbic acid. However, the reducing activity of ascorbic acid is pH controlled, being more at higher and less at lower pH. Hence, the leaf extract pH on higher side gives tolerance to plants against pollution (Agarwal 1989, Agarwal & Tiwari 1997). Ascorbic acid being a strong reluctant protects chloroplasts against SO_2 induced H_2O_2, O_2^- and OH accumulation and this protects the enzymes of the CO_2 fixation cycle and chlorophyll from inactivation. Together with leaf pH it plays a significant role in determining the SO_2 sensitivity of plants (Chaudhary & Rao 1977). Thus, plants maintaining higher ascorbic acid level under polluted condition are considered to be tolerants to air pollutants. The results of the present study revealed that the 7 species of high chlorophyll content can be considered to be pollution tolerant owing to their high ascorbic acid content in polluted regions.

Masuch et al. (1988) found that relative water content, associated with protoplasmic permeability in cells, causes loss of water and dissolved nutrients resulting in early senescence of leaves. A fairly good number of 13 species were present with higher content of water (generally > 70%) in their

Table 1: The contents of total chlorophyll, ascorbic acid, relative moisture and leaf extract pH in various tree species of Tirupur city with their air pollution tolerance index.

Sl. No.	Species	Total chlorophyll (mg/mL)	Leaf extract pH	Ascorbic acid (mg/g)	Relative moisture content (%)	Air pollution tolerance index (APTI)
1	*Acacia melanaxylon*	1.896 ±0.78	5.3±0.22	1.76±0.58	52.32± 1.42	6.52
2	*A. nilotica*	2.081±0.43	5.4±0.21	2.06±0.63	53.04±0.92	6.84
3	*Aegle marmelos*	4.831±0.71	6.2±0.05	4.58 ± 0.92	82.51 ±2. 13	13.35
4	*Albizzia lebbeck*	2.826±0.59	5.9±0.33	2.38 ± 0.56	56.47±4.81	7.72
5	*Aralia foliolosa*	1.903±0.25	5.8±0.34	2.79±0.51	53.14±3.31	7.45
6	*Azadirachta indica*	4.701±0.67	6.2±0.10	4.53 ± 0.82	82.65 ± 1.82	13.25
7	*Cassia montana*	2.891±0.29	5.6±0.26	2.61±0.44	62.23±2.14	8.45
8	*Cordia monoica*	2.004±0.61	5.4±0.13	2.59 ± 0.55	62.08±4.71	8.13
9	*Eucalyptus globulus*	1.510±0.47	5.1±0.44	2.05±0.47	67.05±4.64	8.07
10	*Ficus benghalensis*	4.586±0.74	6.1±0.15	4.89±0,64	74.35 ± 4.67	12.67
11	*F. elastica*	1.928±0.49	5.5±0.14	2.98 ± 0.60	56.46±7.86	7.89
12	*F. glomerata*	1.715±0.59	5.8±0.16	2.66 ± 0.62	63.78±1.15	8.41
13	*F. religiosa*	4.768±0.75	5.9±0.53	4.89±0.58	78.87±5.08	13.10
14	*Gmelina arborea*	1.866±0.48	5.2±0.29	1.84 ±0.46	57.71±3.29	7.09
15	*Grevillea robusta*	2.673 ± 0.28	6.1±0.05	2.49±0.51	56.23 ± 3.20	7.82
16	*Holopletea integrifolia*	4.673±0.69	5.9±0.31	4.65±0.62	74.63±3.14	12.39
17	*Mangifera indica*	2.244±0.52	5.3±0.15	1.98±0.60	60.84 ± 5.42	7.58
18	*Melia azedarach*	1.819±0.38	6.3±0.17	2.32 ± 0.82	56.91 ± 7.88	7.61
19	*Mimusops elengi*	2.330±0.57	5.8±0.10	2.69 ± 0.72	53.20±3.14	7.55
20	*Nyctanthes arbor-tristis*	1.848±0.31	6.1±0.17	2.62±0.51	55.49±6.05	7.63
21	*Pisonia morindifolia*	1.806±0.62	6.2±0.15	1.87±0.53	65.22±4.18	8.05
22	*Polyalthia longifolia*	2.530 ± 0.64	6.1±0.20	2.44±0.67	66.71±3.35	8.81
23	*Pongamia pinnata*	4.591±0.71	6.5±0.06	4.72±0.73	81.61±3.39	13.40
24	*Prosopis spicigera*	2.083±0.59	5.7±0.16	2.10 ± 0.50	66.43±5.19	8.30
25	*Psidium guajava*	1.904±0.59	5.3±0,21	2.50±0.75	40.12±2.56	5.83
26	*Samania saman*	2.486±0.15	5.9±0.13	2.44±0.88	59.54±5.08	8.00
27	*Simauruba glauca*	1.780±0.59	5.7±0.29	1.91 ±0.67	51.35±0.99	6.57
28	*Swietenia mahagoni*	2.801±0.34	6.2±0.05	2.29±0.81	57.55±3.02	7.83
29	*Syzigium cumini*	2.128±0.41	4.8±0.24	1.92±0.57	53.11±2.53	6.66
30	*Tamarindus indica*	4.772±0.66	6.5±0.05	4.60±0.62	73.15±5.48	12.52
31	*Tabebuia rosea*	1.627±0.61	6.0±0.10	2.47±0.37	61.58 ± 2.48	8.06
32	*Tectona grandis*	3.050±0.60	6.2±0.08	2.43 ± 0.52	64.26±2.92	8.77
33	*Terminalia catappa*	2.311±0.42	5.3±0.10	2.82 ± 0.47	67.53±4.16	8.91
34	*Thespesia populnea*	2.633 ± 0.68	6.3±0.24	2.17±0.67	68.12±3.38	8.77
35	*Wrightia tinctoria*	2.916±0.54	5.5±0.26	1.90±0.64	56.67±3.70	7.28

leaves (Table 1). All the remaining species except *Psidum guajava* contained a moderate level of water content between 50 and 60%. It is likely, therefore, that the tree species with high water content under polluted condition may be tolerant to pollutants.

Of the 35 tree species analysed, the 7 species namely, *Aegle marmelos, Azadirachta indica, Ficus benghalensis, F. religosa, Holopetea integrifolia, Pongamia pinnata* and *Tamarindus indica* have secured higher APTI value when compared to other tree species in Tirupur (Table 1). The tree species with high and low APTI value can serve as tolerant and sensitive ones respectively. Such tolerant plants can effectively be used as indicators and pollution scavengers (Singh & Rao 1983, Tiwari 1991, Agarwal & Tiwari 1997, Paulsamy et al. 2000, Santhoshkumar & Paulsamy 2006).

From the study it is suggested that these seven tree species with higher APTI value can be given priority for plantation programmes in and around industrial complexes and also new urbanized areas in Tirupur so as to reduce the effect of air pollution and to make the environment clean for our healthy life. This work is expected to fulfil the gap, throw some light and create awareness among the scientists and environmentalists to check the further degradation of our environment and to provide a pollution free environment to future generation.

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