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DUST COLLECTION POTENTIAL AND AIR POLLUTION TOLERANCE INDEX OF TREE VEGETATION AROUND VEDANTA ALUMINIUM LIMITED, JHARSUGUDA

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ABSTRACT

The work was undertaken on tree vegetation around Vedanta Aluminium Limited at Jharsuguda, Orissa. The objective was to identify the major tree vegetation and to calculate the Air Pollution Tolerance Index (APTI) of each species. The dust collection was quantified over a period of 24 hr. from previously cleaned and tagged leaves and expressed in mg/cm^2.The calculation of APTI was based on parameters like , relative water content of leaves,Ascorbic acid content (AAC),total leaf chlorophyll, leaf extract pH.Forty species of tree were identified around the Vedanta Aluminium Factory in the radius of 5km from the point source during the month of April 2009 to Sept, 2009 to determine their dust collection and Air Pollution Tolerance Index.The most tolerant species are *Mangifera indica, Dalbergia sisoo, Psidium guajava, Bogainvillea spectabillis, Ailanthus excelsa, Diospyros melanoxylon, Shorea robusta, Ficus bengalensis, Artocarpus heterophyllus* where as *Tectona grandis, Ficus religiosa, Polyalthia longifolia, Azadirachta indica, Schleichera oleosa, Madhuca indica, Tamarindus indica, Anacardium occidentale, Pongamia pinnata* were categorized under moderately tolerant**.** The intermediate tolerant species are *Ficus glomerata, Syzigium cumini, Eucalyptus citriodora, Mimusops elengi, Delonix regia, Bombox ceiba, Anthocephalus chinesis, Acacia arabica, Butea monosperma, Aegle marmelos, Bambusa bamboos, Ziziphus jujuba, Calotropis gigantea, Tabernaemontana divaricata, Annona squamosa, Ceasal pinnia, Holorrhena pubescens ,where as Buchania lanzen, Gmelina arborea, Cuscuta reflexa, Lantana camara, Pithocolobium dulce* were categorized as Sensitive species.The species with high APTI can be utilized for development of the green belt around the sources.

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INTRODUCTION

Air borne particulate matter represents a complex mixture of organic and inorganic substances of varying size and may enter an organism or plant in a number of ways. Many plants are very sensitive to air pollutants which can damage their leaves, impair plant growth and limit primary productivity (Agrawal 1985,Agrawal and Agrawal 1992). The most obvious damage occurs in the leaves.The major damages caused by air pollutants to plants include chlorosis, necrosis and epinasty (Prasad and Choudhury ,1992). Plants demonstrates a wide array of responses when exposed to pollutants in the form photosynthesis, respiration, enzymatic reactions, stomatal behavior, membrane disruption, senescence and ultimately death. In India, although there are no well documented data relating to magnitude of economic loss as a result of plant damage by air pollution, there have been sporadic reports of the damage done to the crops. In Orissa, people have protested on the crop damage due to fluoride emission by NALCO in Angul and HINDALCO at Hirakud. However, not all the plants are sensitive to air pollution. Some plants can resist fairly high levels of pollution and can be employed as indicators of air pollution (Trivedy and Goel, 1995).Biomonitoring of air pollution has been found to be extremely useful to detect the kind and level of pollutants in air with and without measurement of air pollutants(Prusty *et al.,* 2005). In biomonitoring programme, the presence, absence, abundance, distribution, morphology and chemical characteristics of plants are used to arrive at a conclusion regarding air quality of that area(Posthumus 1984 ,1985 ,Dwivedy and Tripathy, 2007)

Air Pollution Tolerance Index (APTI) is an inherent quality of plants to encounter air pollution stress which is presently of prime concern particularly in urban and industrial areas. Since plants are stationary and continuously exposed to chemical pollutants from the surrounding atmosphere, air pollution injury to plants is proportional to the intensity of the pollution. APTI is a species dependent plant attribute which expresses the inherent ability of plant to encounter stress emanating from pollution(Tiwari *et al.,* 1993).Plants provide an enormous leaf area for impingement, absorption and accumulation of air pollutants to reduce the pollutant levels or the air environment (Escobedo *et al.,* 2008) which varied according to species (Chaphekar, 1972). Air pollutants can directly affect plants via leaves or indirectly via soil acidification (Chaphekar *et al.*, 1980). When exposed to air-borne pollutants most plants experienced physiological changes before exhibiting visible damage to leaves. A number of workers have also included a variety of parameters like ascorbic acid, chlorophyll content and relative water content to assess the air pollutants effect (Flowers *et al.,* 2007, Klumpp *et al.,* 2000, Rao and Pal, 1979).However, these separate parameters gave conflicting results on same species. Ailanthus altissima behaved as sensitive to pollution using one parameter (Han *et al.,* 1995) but tolerant using another (Zhou, 1996). For this reason a single parameter may not provide a clear picture of the pollution – induced changes. Therefore in the present study, air pollution tolerance index based on four important parameters has been used for identifying tolerance level of tree species located within 5 km radius of a largest privately-owned plant, Vedanta Aluminium Limited at Jharsuguda which has the Aluminium smelter plant in operation (capacity 2.5 MT) since last three years and a captive power plant with a generation capacity of 1215 MW.The APTI has been correlated with dust collection potential of tree species.

MATERIALS AND METHODS

The study area is located in Jharsuguda of Western Orissa. Before a decade, the industrial activity in the area was limited to a paper mills at Brajrajnagar, Refractory at Belpahar, Thermal Power Plant at Banharpali and Coal mining at Ib Valley Coalfields, all located within 5 – 10 km air distance from Jharsuguda. However, there has been industrial proliferation in the area with the establishment of Iron and Steel industries, sponge iron plants including Aluminium Smelter and Power Plants of Vedanta Aluminium Ltd (VAL). Recent report of Ministry of Environment and Forest, Govt. of India declares the Jharsuguda area as one of the worst polluted sites in the country. The extent of dust pollution in the area has been visible with reduction in visibility.The present study was undertaken to identify the tree species present within 5 km radius of VAL, quantifying the dust collection potential of leaves of the trees and to calculate APTI of these species based on four physiological parameters ie. Relative water content, ascorbic acid content, pH of leaf extract and total chlorophyll content.

Dust Collection Potential

Leaves of 40 tree species identified through a survey, were collected within the radius of 5 km of VAL, Jharsuguda from April to June, 2009. Three replicates of fully mature leaves of each species were marked. The upper dorsal surface of all these leaves were cleansed using a fine brush. All the leaves were left for 24 hr. to allow dust to accumulate on their surface. After 24 hr. the selected leaved were cut from the petiole and carefully taken to quantify dust accumulation. The individual leaf area was calculated by tracing marginal outline on a graph paper and average from three leaves was taken into consideration. The samples were weighed using an electrical 4 digit balance and the amount of dust was calculated using the equation :-

$$W = \frac{W_2 - W_1}{a}$$

Where W = Dust content (mg/cm^2)
W_1 = Weight of leaf with dust
W_2 = Weight of leaf without dust
a = Total area of leaf in cm^2.

Air Pollution Tolerance Index

A total of 40 species were selected for analysing APTI taking the biochemical parameter of leaf materials namely pH, ascorbic acid, relative water content and total chlorophyll content.

The samples were collected from sites with similar light, water and soil conditions. Samples were immediately taken to the laboratory for analysis in ice bucket. Leaf fresh weight was taken immediately upon returning to the lab. Dry weight (DW) was taken to express AA content and total chlorophyll content (TCh). Samples were preserved at 4^0C till AA, total chlorophyll and leaf extract pH analysis.

Relative Leaf Water Content (RWC)-The method described by Liu and Ding (2008), was followed to determine RWC based on the formula,RWC= (wf – wd) x 100 / (wt – wd) Where,wf-fresh wt of the leaf, wt-turgid weight of the leaf after immersiing into water overnight and wd-dry weight of the leaf.Fresh weight (wf) of the leaf was increased when leaf pieces were weighed after immersing in water overnight to get turgid (wt). The leaf pieces were then blotted to dryness and placed in a dryer at 115^0C (for 2 hr.) and reweighed to get dry weight.

Total Chlorophyll content-For total chlorophyll content analysis first 0 – 0.5 g of fresh leaves was taken and grounded with acid washed sand and acetone in a mortar. A subsample of 2.5 mL filtered sample was read for optical density at 645 nm (D645) and 663 nm (D663).Optical density of TCh (C_T) is the sum of chlorophyll a (D645) density and chlorophyll b(D663) density (Liu and Ding 2008).

Leaf Extract pH- About 4 g of fresh leaves were homogenized in 40 mL deionized water and centrifuged at 7000 g. Extract pH was measured with digital calibrated pH meter.
Ascorbic Acid Content Analysis-1 g of fresh sample were weighed and homogenized with distilled water and volume was measured. To 25 mL of diluted sample, 2.5 mL of 5% metaphosphoric acid was added. Then 2 drops of bromine water was added to oxidise ascorbic acid in its dihydroform. The solution was centrifuged for 5 minutes and supernatant was collected to estimate the ascorbic acid by spectrophotometric method at 540 nm after incubation at 37^0C for 3 hr. followed with the addition of concentrated conc H_2SO_4.
APTI Calculation-The APTI value was calculated referring to the formula given below (Liu and Ding, 2008).

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

Where A = Ascorbic acid content (mg/g).
P = pH of the leaf extract.

T = Total chlorophyll content (mg/g).
R = Relative leaf water content (%).

Gradation of APTIs-The spectrum of APTI was divided to four grades of air pollution tolerance such as T(Tolerant) Grade – I,MT(Moderately Tolerant)Grade – II,I(Intermediate) Grade – III, and S(Sensitive) Grade IV.

(1) Tolerant : APTI > mean APTI + SD
(2) Moderately Tolerant : Mean APTI < APTI < Mean APTI + SD
(3) Intermediate : Mean APTI – SD < APTI <Mean APTI
(4) Sensitive : APTI < Mean APTI – SD

To develop ranges of APTI values for each category, the mean APTI and its standard deviation for selected tree species was calculated.

RESULTS AND DISCUSSION

Tree species identified and their dust collection potential

A total of 40 tree species were identified within 5 km radius of VAL and presented in table 1 along with their common names and families. The dust collection potential varied from a maximum of 0.01 mg/cm^2 in Calotropis gigantean, Lantana camara and Bogainvillea spectabilis to a minimum of 0.002 mg/cm^2 in Pithocolobium dulce. It is observed that the dust collection efficiency depends on the factors like tree height ,canopy ,leaf geometry ,leaf surface,cuticular thickness and petiole length(Sharma and Butler, 1975; Sharma 1992)

Most excellent collector of the dust are calotropis gigantean because of it thick oily cuticle on leaves and short peticle. *Lantana camara, Bogainvillea spectabilis* are also excellent collectors because of the rough surface of the lamina. *Tectona grandis, Ficus religiosa, Delonix regia, Buchania lanzen, Mangifera indica, Tabernaemontana divarieata* and *Annona squamosa* are standing in leading position of their dust collection potentiality. As we go deep into the leaf structure and surface, more rough the surface and short the petiole, collection increases . *Bogainvillea spectabilis, Annona squamosa* are of short height but their collection capacity is more than the taller plants. Depression in the middle of the leaf is found in *Ailanthus excelsa Psidium guajava, Madhuca indica* and *Ficus glomerata* are excellent in dust accumulation because of their depression in middle of the leaves. Where as *Acacia arabica*, *Dalbergia sisoo, Tamarindus indica* have less dust accumulation potential because of their smooth leaf surface, long petiole, tall height of the tree.*Pongamia pinnata, Azadirachta indica, Cuscuta reflexa, Artocarpus heterophyllus, Ceasalpinia, Anacardium occidentale* and *Pithocolobium dulce* are having least dust collecting capacity because of their smooth surface, long petiole and no depression in the middle of the leaves samples. Hence, their existence in the vacinity of and industrial area is always not appreciable. Trees with high dust collecting potential can solve the problems of air particulate pollution to a great extent (Chaphekar, 1972, Dwivedy and Tripathy, 2007).

Leaf extract pH

Leaf extract pH for different species significantly varied from a minimum of 2.84 to maximum of 7.62. High pH increase the efficiency of conversion from hexose sugar to AAC, while low pH showed good correlation with sensitivity to air pollution. Tch is also related to AAC productivity and AAC is concentrated mainly in chloroplasts. Photosynthetic efficiency was noted strongly dependent on leaf pH. Photosynthesis reduced in plants when the leaf pH was low(Table 2).

Relative Water Content (mg/g)

Relative water content (mg/g) varied from a maximum of 91.13 in *Ailanthus excelsa* to a minimum of 53.48 in *Ziziphus jujube*. Liu and Ding (2008) recorded a variation of 89.5 in *Ampelopsis aconitifollia* var.glabra to 60.3 in *Greuia biloba*.A High water content within a plant body will help to maintain its physiological balance under stress conditions such as exposure to air pollution when the transpiration rates are usually high. High RWC favours draught resistance in plants if the leaf transpirartion rate reduces due to air

Table 1: Dust collected from leaf samples of forty tree species

Sl. No. of the Specimen	Common Name	Scientific Name	Family	Dust Collected (mg/cm²)
1	Arakha (White arkh)	*Calotropis gigantea*	Asclepiadacae	0.01
2	Lantana (Chaneri)	*Lantana camara*	Verbenaceae	0.01
3	Banganvilas	*Bogainvillea spectabilis*	Nyctaginaceae	0.01
4	Teak	*Tectona grandis*	Verbenaceae	0.009
5	Peepal	*Ficus religiosa*	Moraceae	0.009
6	Krushna chuda	*Delonix regia*	Ceasal Pinaceae	0.009
7	Char	*Buchania lanzen*	Anacardiaceae	0.009
8	Mango	*Mangifera indica*	Anacardiaceae	0.009
9	Cure	*Tabernaemontana divaricata*	Apocynaceae	0.009
10	Sarifa	*Annona squamosa*	Annonaceae	0.009
11	Banyan	*Ficus bengalensis*	Moraceae	0.008
12	Deodar	*Polyalthia longifolia*	Annonaceae	0.008
13	Mahua	*Madhuca indica*	Sapotaceae	0.008
14	Bela	*Aegle marmelos*	Rutaceae	0.008
15	Koli (bair)	*Ziziphus jujuba*	Rhmnaceae	0.008
16	Guava	*Psidium guajava*	Myrtaceae	0.008
17	Mahalimb	*Ailanthus excelsa*	Simarubaceae	0.008
18	Fig	*Ficus glomerata*	Moraceae	0.007
19	Kendu (Ebanaceal)	*Diospyros melanoxylon*	Ebenaceae	0.007
20	Kusum	*Schleichera oleosa*	Sapindaceae	0.007
21	Nilgiri (Safeda)	*Eucalyptus citriodora*	Myrtacea	0.006
22	Sal	*Shorea robusta*	Diplterocarpaceae	0.006
23	Palasa	*Butea monosperma*	Fabaceae	0.006
24	Koruaa	*Holarrhena pubescens*	Apocynaceae	0.006
25	Gumhari	*Gmelina arborea*	Verbenaceae	0.005
26	Bamboo	*Bambusa bamboos*	Poaceae	0.005
27	Black Berry	*Syzigium cumini*	Myrtaceae	0.004
28	Baula	*Mimusops elengi*	Sapotaceae	0.004
29	Simli	*Bombax ceiba*	Bombacaceae	0.004
30	Kadamb	*Anthocephalus chinesis*	Rubiaceae	0.004
31	Kateri babul	*Acacia arabica*	Mimosaceae	0.004
32	Sishoo	*Dalbergia sisoo*	Fabeceae	0.004
33	Tamarind	*Tamarindus indica*	Ceasalpinaceae	0.004
34	Karanja	*Pongamia pinnata*	Fabeceal	0.003
35	Margosa (neem)	*Azadirachta indica*	Meliaceae	0.003
36	Nirmuli	*Cuscuta reflexa*	Convolvulaceae	0.003
37	Panasa	*Artocarpus heterophyllus*	Moraceae	0.003
38	Gulmohar	*Ceasal pinia*	Ceasalpiniaceae	0.003

pollution, plant cannot live well due to losing its engine that pulls water up from the roots to supply for photosynthesis then the plants neither bring minerals from the roots to leaf where biosynthesis occurs not cool the leaf.

The Relative water content in the plant species varied from 53.48% to 91.13 mg/g ((Table 2). There were variation in the relative water content based on the weather conditions and availability of moisture content in soil. It depends on maximum humidity too. Where humidity is high, plants are having high moisture too because of less transpiration. The samples were collected in the month of July when plants were with less number of stomata, the relative water content was less.

Total Chlorophyll Content

Total chlorophyll content in leaf samples varied from 7.98 to 16.07 mg. Chlorophyll content in the leaf depends on the rate of photosynthesis, amount of nutrient availability in soil. Chlorophyll is mainly formed due to presence of magnesium in the concerned soil and rate of photosynthesis done by the tree vegetation. Lantana camara showed least Tch of 7.98 mg/gm Other leaves with variation of Tch from 7-10 mg/g were

Table 2: Physiological and biochemical parameters and apti of leaf samples

Sl. No	Scientific Name of Species	Dust Collected (mg/cm^2)	P^H of Leaf Extract	Relative Water content (mg/g)	Chlorophyll Content (mg/gm)	AscorbicAci Content (mg/gm)	APTI
1.	*Tectona Grandis*	0.009	6.13	70.61	15.44	6.45	20.97
2.	*Ficus Glomerata*	0.007	5.80	73.23	8.73	8.20	19.23
3.	*Syzigium Cumini*	0.004	5.76	78.82	9.67	7.22	19.02
4.	*Eucalyptus Citriodora*	0.006	5.11	72.85	9.09	7.63	18.11
5.	*Diospyros Melanonylon*	0.007	6.10	76.34	12.22	8.93	23.99
6.	*Ficus Religiosa*	0.009	4.89	87.44	11.63	9.17	23.89
7.	*Pongamia Pinnata*	0.003	3.97	83.61	11.82	7.59	20.34
8.	*Mimusops elengi*	0.004	4.53	80.12	10.01	5.72	16.32
9.	*Shorea robusta*	0.006	4.83	74.60	14.89	8.35	23.92
10.	*Ficus bengalensis*	0.008	4.67	79.25	15.33	8.11	24.14
11.	*Delonix regia*	0.009	5.12	74.83	13.31	6.06	18.65
12.	*Buchania lanzen*	0.009	5.03	76.18	9.43	4.39	13.96
13.	*Polyalthia longifolia*	0.008	2.84	89.43	15.44	7.88	23.34
14.	*Mangifera indica*	0.009	7.24	89.50	16.07	8.92	29.74
15.	*Azadirachta indica*	0.003	5.13	76.61	12.02	8.60	22.41
16.	*Bombax ceiba*	0.004	5.19	78.53	14.91	4.50	16.89
17.	*Gmelina arborea*	0.005	3.22	73.44	11.56	4.05	13.32
18.	*Anthocephalus chinesis*	0.004	6.16	76.49	14.06	5.08	17.92
19.	*Acacia arabica*	0.004	5.23	74.26	9.64	6.27	16.74
20.	*Sghleichera oleosa*	0.007	6.01	78.41	12.42	7.99	22.56
21.	*Butea monosperma*	0.006	5.43	73.54	10.03	8.13	19.92
22.	*Madhuca indica*	0.008	5.40	78.59	12.26	8.98	23.71
23.	*Aegle marmelos*	0.008	5.12	82.23	11.86	6.53	19.31
24.	*Dalbergia sisoo*	0.004	6.91	86.10	12.43	9.47	26.92
25.	*Bambusa bamboos*	0.005	6.31	63.75	8.76	7.93	18.32
26.	*Cuscuta reflexa*	0.003	6.32	74.66	10.91	3.43	13.37
27.	*Ziziphus jujuba*	0.008	5.85	53.48	10.29	8.01	18.27
28.	*Artocarpus heterophy llus*	0.003	5.13	89.01	13.08	8.76	24.85
29.	*Calotropis gigantean*	0.01	5.62	75.41	8.21	7.49	17.89
30.	*Lantana camara*	0.01	4.89	59.98	7.98	6.42	14.26
31.	*Tabernamontana divaricata*	0.009	5.80	83.21	8.99	5.12	15.89
32.	*Annona squamosa*	0.009	4.59	69.45	12.03	6.32	17.44
33.	*Psidium guyava*	0.008	5.61	83.12	13.13	9.81	26.69
34.	*Ceasal pinia*	0.003	5.21	79.05	11.27	5.39	16.78
35.	*Tamarindus indica*	0.004	7.23	77.61	13.01	7.60	23.14
36.	*Bogainvillea spectabilis*	0.01	5.79	79.69	14.85	9.33	27.22
37.	*Pithocolobium dulce*	0.002	5.10	71.60	10.41	4.69	14.43
38.	*Anacardium occidentale*	0.003	7.62	82.24	15.51	6.03	22.17
39.	*Ailanthus excelsa*	0.008	5.89	91.13	14.32	8.03	25.34
40.	*Holarrhena Pubescens*	0.006	6.23	83.10	8.99	5.99	17.42

of *Ficus glomerata, Bambusa bamboos, Calotropis gigantean, Tabernamontana divaricata, Holarrhena pubescens, Syzigium cumini, Eucalyptus citriodora, Buchania lanzen, Acacia Arabica.Mimusops elengi, Butea monosperma, Custuta reflexa, Ziziphus jujuba, Pithocolobium dulce, Ficus religiosa, Pongamia pinnata, Gmelina arborea, Aegle marmelos, Ceasal pinia, Diospyros melanoxylon, Azadirachta indica, Schleichera oleosa, Madhuca indica, Dalbergia sisoo, Annona squamosa, Delonix regia, Artocarpus heterophyllus, Psidium guajava, Tamarindus indica, Shorea robusta, Bombax ceiba, Anthocephalus chinesis, Bogainvillea spectabillis, Ailanthus excelsa* showed a variation from 10-15 mg/g.*Tectona grandis, Ficus bengalensis, Polyalthia longifolia, Anacardium occidentale* and *Mangifera indica* showed a Tch content of more than 15 mg/g with maximum of 16.07 mg in *Mangifera indica* (Table 2).

Ascorbic Acid Content

The highest Ascorbic acid content of 9.81mg/g was recorder in *Psidium guajava* and lowest 3.43 mg/g in

Table 3: Correlation coefficient parameters studied

	Dust	RWC	pH	Total Ch.	AA	APTI
Dust	1	-0.076	-0.081	0.032	0.278	0.199
RWC		1	0.020	0.445	0.231	0.540
pH			1	0.084	0.153	0.295
Total Chlorophyll				1	0.225	0.644
Ascorbic Acid					1	0.850
APTI						1

Table 4: Plants tolerance gradation according to apti

Sl. No. of the Species	Local Name of the Species	Scientific Name of Species	Family	Gradation
1.	Teak	*Tectona grandis*	Verbenaceae	MT
2.	Fig	*Ficus glomerata*	Moraceae	IT
3.	Black Berry	*Syzigium cumini*	Myrtaceae	IT
4.	Nilgiri (Safeda)	*Eucalyptus citriodora*	Myrtacea	IT
5.	Kendu (Ebanaceal)	*Diospyros melanoxylon*	Ebenaceae	T
6.	Peepal	*Ficus religiosa*	Moraceae	MT
7.	Karanja	*Pongamia pinnata*	Fabeceal	MT
8.	Baula	*Mimusops elengi*	Sapotaceae	IT
9.	Sal	*Shorea robusta*	Diplterocarpaceae	T
10.	Banyan	*Ficus bengalensis*	Moraceae	T
11.	Krushna chuda	*Delonix regia*	Ceasal Pinaceae	IT
12.	Char	*Buchania lanzen*	Anacardiaceae	S
13.	Deodar	*Polyalthial longifolia*	Annonaceae	MT
14.	Mango	*Mangifera indica*	Anacardiaceae	T
15.	Margosa (neem)	*Azadirachta indica*	Meliaceae	MT
16.	Simli	*Bombax ceiba*	Bombacaceae	IT
17.	Gumhari	*Gmelina arborea*	Verbenaceae	S
18.	Kadamb	*Anthocephalus chinesis*	Rubiaceae	IT
19.	Kateri babul	*Acacia arabica*	Mimosaceae	IT
20.	Kusum	*Sghleichera oleosa*	Sapindaceae	MT
21.	Palasa	*Butea monosperma*	Fabaceae	IT
22.	Mahua	*Madhuca indica*	Sapotaceae	MT
23.	Bela	*Aegle marmelos*	Rutaceae	IT
24.	Sishoo	*Dalbergia sisoo*	Fabeceae	T
25.	Bamboo	*Bambusa bamboos*	Poaceae	IT
26.	Nirmuli	*Cuscuta reflexa*	Convolvulaceae	S
27.	Koli (bair)	*Ziziphus jujuba*	Rhmnaceae	IT
28.	Panasa	*Artocarpus heterophyllus*	Moraceae	T
29.	Arakha (White arkh)	*Calotropis gigantea*	Asclepiadacae	IT
30.	Lantana (Chaneri)	*Lantana camara*	Verbenaceae	S
31.	Cure	*Tabernaemontana divaricata*	Apocynaceae	IT
32.	Sarifa	*Annona squamosa*	Annonaceae	IT
33.	Guava	*Psidium guajava*	Myrtaceae	T
34.	Gulmohar	*Ceasal pinia*	Ceasalpiniaceae	IT
35.	Tamarind	*Tamarindus indica*	Ceasalpinaceae	MT
36.	Banganvilas	*Bogainvillea spectabilis*	Nyctaginaceae	T
37.	Jungle jalebi	*Pithocolobium dulce*	Mimosaceae	S
38.	Cashewnut	*Ancardium occidentale*	Annacardiaceae	MT
39.	Mahalimb	*Ailanthus excelsa*	Simarubaceae	T
40.	Koruaa	*Holarrhena pubescens*	Apocynaceae	IT

T = Tolerant
MT = Moderately Tolerant
IT = Intermediate Tolerant
S = Sensitive

Cuscuta reflexa. Ascorbic acid plays an important role in cell wall synthesis, defense and cell division. It is also a strong reducer and plays important roles in photosynthetic carbon fixation with the reducing power directly proportional to its concentration. So it has been given top priority and used as a multiplication factor in the formula. The variation in different tree leaves are presented in Table 2.

Ficus religiosa, Dalbergia sisoo, Psidium guajava, Bogainvillea spectabillis, Ficus glomerata, Diospyros melanoxylon, Shorea robusta, Ficus bengalensis, Mangifera indica, Azadirachta indica, Butea monosperma, Madhuca indica, Ziziphus zujuba, Artocarpus heterophyllus and *Ailanthus excelsa* showed a variation between 8-10 mg/g.The Ascorbic Acid Content varied from 6 to 8 mg/g where as *Syzigium cumini, Eucalyptus citriodora, Pongamia pinnata, Polyalthia longifolia, Schleichera oleosa, Bambusa bamboos, Calotropis giantea, Tamarindus indica, Tectona grandis, Delonix regia, Acacia arabica, Aegle marmelos, Lantana camara, Annona squamosa, Anacardium occidentale*.In leaves of *Mimusops elengi, Anthocephalus chinesis, Tabernaemontana divaricata, Ceasal pinia, Holarrhena pubescens, Buchania lanzen, Bombax ceiba, Gmelina arborea, Pithocolobium dulce* and *Cuscuta reflexa* AA content varied from 4 to 6 mg/g.

Air Pollution Tolerance Index

Highest value of APTI 29.74 was recorded for *Mangifera indica* and least value of 13.33 for *Gmelina arborea*.On the basis of the above parameters it is observed from Table 3 that the pH value, Tch, RWC and AAC are co-related to give APTI. The more acidic nature demonstrates that the air pollutants, mostly gaseous type like SO_2, NO_x diffuse and form acid radicals in the leaf matrix by reacting with cellular water.Varoius tree species falling under Tolerant species(APTI > 23.92),Moderantly Tolerant(19.88 < APTI > 23.92),Intermediate Tolerant(15.84 < APTI < 19.88) and sensitive Species(APTI < 15.84) are presented in Table 4.

Based on the study it can be said thatthe deposition of atmospheric dust in plant leaves varies with structure, geometry, height, canopy of the tree, Smaller plants with short petioles and rough surface accumulate more dust than larger plants with long petioles and smoother leaf surface. The Air Pollution Tolerance Index (APTI) values estimated using the four biochemical parameters in plant leaves namely relative water content, chlorophyll, P^H and ascorbic acid value can be used as a predictor of air quality. These parameters are significant in studies between plant environment interactions and used for development of tolerant & sensitive plants. The APTI of a particular geographical area can be used for biomonitoring air quality. The tolerance species and the species having more to collect dust can be used for green belt development in polluted areas.

REFERENCES

Agrawal, M . 1985. Plant factors as indicators of SO_2 and O_3 pollutants. In : Biological Monitoring of the State of the Environment (Bioindicators). *Indian National Science Academy,* New Delhi. pp. 225-231.

Agrawal, M. and Agrawal, S. B.1992. Use of plants in air pollution monitoring. *In: Environmental issues and Programmes in India.*

Chaphekar, S. B. 1972. Effects of atmospheric pollutants on plants in Bombay. *J. Biol. Sci*. **15:** 1-6.

Chaphekar, S.B. Boralkar, D.B. and Shetey, R.P.1980. Effects of industrial pollution on plants. Final report of UGC sponsored project.

Dwivedi, A. K. and Tripathy, B. D.2007. Pollution Tolerance and distribution pattern of plants in surrounding area of coal fired industries. *J. Environmental Biology*. **28(2):** 257 – 263 .

Escobedo, F. J., Wagner, J. E. and Nowak, D. J. 2008. Analyzing the cost effectiveness of Santiago, Chile's policy of using urban forest to improve air quality, *J. Environmental Management*. **86:** 148-157.

Flowers, M. D., Fiscus, E. L. and Burkey, S. 2007. Photosynthesis, Chlorophyll fluorescence and yield of snap bean (Phaseolus Vulgaris L.) genotypes differing in sensitivity to ozone. *Environmental and experimental Botany.* **61:** 190-198.

Han, Y., Wang, Q. Y. and Han, G. H. 1995. The analysis about SOD activities in leaves of plants and resistanceclassification of them, *J. Liaoning University (Natural Sciences Edition)*. **22:** 71-74.

Klumpp, G., Furlan, C. M. and Domingos, M. 2000. Response of stress indicators and growth parameters of Tibouchina Pulchra cogn, exposed to air and soil pollution near the industrial complex of Culoutao, Brazil, *The Science of the Total Environment*. **246:** 79-91.

Liu, Y. J. and Ding, H. 2008. Variation in air pollution tolerance index of plants near a steel factory. *Transaction on Environment and Development*. **4:** 1790-5079.

Posthumus, A. C. 1963. Higher plants as indicators, accumulators of gaseous air pollution. *Environ. Monitor. and Assers*. **3:** 263-272.

Posthumus, A. C. 1984. Monitoring levels and effects of air link pollutants. In : M. Theshow (Ed.) Air Pollutants and Plant Life. *John Wiley and Sons Ltd*. 37 – 95.

Posthumus, A. C. 1985. Plants as bio indicators for atmospheric pollution. In : H. W. Nurnberg (Ed.) pollutants and their ecotoxicological significance. *John Willy and Sons Ltd*. 55-65.

Prasad, D., Choudhury, 1992. Effects of air pollution. In : Misra, S. G. (Ed): Environmental Pollution Air, Environmental Pollution and Hazards Series. *Venus Publishing House,* New Delhi. pp. 58 – 60.

Prusty, B. A. K., Mishra, P. C. and Azeez, P. A. 2005. Dst accumulation and leaf pigment content in vegetation near the National Highway at SBP, Orissa, India. *Ecotoxicology and Env. Safety*: **60:** 228-235.

Rao, D. N. and Pal, D. 1979. The effects of fluouride pollution on cattle. 281-290.

Sharma, G. K. and Butler, J. 1975. Environmental Pollution: Leaf cuticular pattern in *Trifolium prantense* L. *Ann. Bot*. **39:** 1087-1090.

Sharma, G. K. 1992. Bogainvillea glabra L. cuticular response to environmental pollution. *Geobios*. **19:** 239-242.

Tiwari, S., Bansal, S. and Rai, S. 1993. Air pollution tolerance index of some plants in urban areas of Bhopal. *Adv. Ecologia* **16(1):** 1-8.

Trivedy, R. K. and Goel, P. K. 1995. An introduction to air pollution. *Technoscience Publ.,* Jaipur (India). 262.

Zhou, Z. L. 1996. Screening, propagating and demonstration of pollutant- tolerant trees in Beijing, *Garden Specific Technological information*. **9:** 1-9.