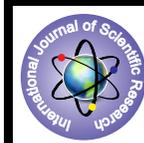


Impact of air pollution induced by automobile exhaust pollution on air pollution tolerance index (APTI) on few species of plants



Environmental Science

KEYWORDS : Air Pollution, Automobile pollution, Chlorophyll Content, Carotenoids Content and Ascorbic Acid

Abhishek Swami

Department of Applied Sciences Dronacharya Group of Institutions, Greater Noida-201308, India

Deepika Chauhan

Department of Botany and Microbiology Gurukula Knagri University, Haridwar-249407, India

ABSTRACT

Present study was carried out to determine level of tolerance of air pollution by automobile exhaust of few tree species viz, Mango (*Mangifera indica*), Sagon (*Tectona grandis*), Sal (*Shorea robusta*) and Eucalyptus around Haridwar. On the basis of total chlorophyll content, ascorbic acid, pH, and relative moisture content, air pollution tolerance index value (APTI) of above tree species was determined. Present investigation reveals that Highest value of air pollution tolerance index was recorded for Sal (11.27) and lowest (7.19) value of APTI was recorded for Eucalyptus. Thus this study reveals that *S. robusta* is more suitable species to work as pollution sink and can be planted in areas, which are facing vehicular pollution.

Introduction:

Air pollution was primarily a problem of urban and industrial regions in the developed nations. In the last three decades, however, changes in the pattern of air pollutant emissions, including increases in those from motor vehicles, have led to greater pollutant impacts in more remote rural areas. Furthermore, the rapid pace of industrial development and urbanization in many developing countries means that adverse impacts on agriculture are beginning to be felt in many parts of the world outside the industrialized West.

Air pollution poses an acute problem for the world as its control through effective remedial measure is rather difficult to achieve. Vegetation sustain and support the biosphere of which also a part. Any damage to vegetation, therefore, results in damage to the entire natural balance. It is well known that plants have an excellent capacity to withstand the polluted environment. They probably act as a vast sink for the air pollution. At the same time they also filter the particulate matter before it reaches the earth (Tiwari and Rai, 2004). Different plant species vary considerably in their susceptibility to air pollutants. Screening of plants for their sensitivity to air pollutants is of vital importance. Capacity of plants to reduce air pollution is very well known (Tingey, 1968; Bannett and Hill, 1973) to check the spread of such air pollutants emitted from an industrial complex, it is recommended to grow a green vegetation around by many scientists (Fleming, 1967; Warren, 1973 Agrawal et al., 1988, 1989; Tiwari, 1991).

The present study examines the air pollution tolerance index (APTI) of few selected plants species, plants have higher tolerance index have higher capacity to withstand in polluted environment than plants have lower air pollution index values.

Material and Methods:

Present study has been carried out around district Haridwar (Uttaranchal), India. It is one of the holiest cities of India. Haridwar lies between latitude 29° 26' N and longitude 77° 30' E. It is about 60 kms in length from east to west and about 80 kms in width from north to south. District Haridwar lies in the foot hills of Shivalik ranges. It is separated in the North from Dehradun district by the Shivalik ranges, in the east from Bijnor by the river Ganges; in the west and south from the state of Uttar Pradesh and in the south it is continuous with the district Muzaffarnagar of Uttar Pradesh.

Plant leaf samples were collected mainly from Highway no 58 which bears high traffic flow through the day. Six plant leaf samples (5 replicates of each sample) were collected for the purpose of chemical analysis (total chlorophyll, ascorbic acid, pH of leaf extract and relative water content) and all values were mentioned as an average.

The ascorbic acid content mg g⁻¹ dry wt. was estimated by the method of Sadasivam and Manikam, 1991. Total chlorophyll mg g⁻¹ dry wt. was estimated by following Arnon, 1949. Relative water content was determined by method proposed by Weatherly, 1965. pH of leaf extract was measured with a digital pH meter. To evaluate the tolerance level of plant species to air pollution, Singh and Rao (1983) used four leaf parameters to derive an empirical number indicating the Air Pollution Tolerance Index (APTI). APTI is thus calculated as follows:

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

Where:

A = ascorbic acid content of leaf mg g⁻¹ dry wt.

T = total chlorophyll of leaf in mg g⁻¹

P = pH of the leaf extract

R = per cent relative water content of leaf.

Results:

Table-1 showing status of different plant parameter due to stress of automobile emission. Table also contain air pollution tolerance index which results combinations of all other parameters such as ascorbic acid, pH, relative moisture content and total chlorophyll.

Table 1- Comparative Study of air pollution tolerance index (APTI) of few planted tree species of Haridwar, India.

Tree Species	Parameters						
	Chlorophyll 'a' mg g ⁻¹	Chlorophyll 'b' mg g ⁻¹	Total Chlorophyll mg g ⁻¹	Ascorbic Acidic mg g ⁻¹	pH	Relative water content (%)	Air-pollution Tolerance Index
<i>Mangifera indica</i> Linn.	5.50	4.50	10.01	1.88	5.93	63.73	9.58
<i>Tectona grandis</i> Linn.f.	1.72	0.63	2.35	1.28	5.64	62.58	9.29
<i>Eucalyptus citridora</i> Hook. Syn.	1.91	0.58	2.49	1.95	6.27	55.05	7.19
<i>Shorea robusta</i> Gaertn. f.	3.40	1.66	5.06	2.00	6.39	87.33	11.27
<i>Mallotus philippinensis</i> Muell-Arg.	1.79	1.00	2.79	1.52	6.25	57.56	7.13
<i>Holoptelea integrifolia</i> (Roxb.)	1.33	0.88	2.21	1.81	6.02	74.32	8.92

Highest amount of chlorophyll "a" pigment 5.50 mg g⁻¹ was calculated in *Mangifera indica* Linn. Lowest amount of chlorophyll "a" pigment calculated in *Holoptelea integrifolia* (Roxb.) 1.33 mg g⁻¹. Chlorophyll "b" content was recorded highest level in *Mangifera indica* Linn. 4.50 mg g⁻¹, whereas its lowest concentration 0.58 mg g⁻¹ was observed in *Eucalyptus citridora* Hook. Syn. Highest amount of Total chlorophyll content was recorded in *Mangifera indica* Linn. 10.01 mg g⁻¹ and its lowest concentration was observed 2.21 mg g⁻¹ in *Holoptelea integrifolia* (Roxb.)

Highest amount of ascorbic acid content was calculated in *Shorea robusta* Gaertn. f. 2.00 mg g⁻¹ and lowest amount of ascorbic acid was observed 1.28 mg g⁻¹ in *Tectona grandis* Linn. f. Highest amount of pH values of leaves was recorded in *Shorea robusta* Gaertn. f. 6.39, whereas its lowest value 5.93 recorded in *Mangifera indica* Linn. Maximum amount of relative moisture content 87.33 % was recorded in *Mangifera indica* Linn. Lowest amount of relative moisture content observed in 55.05 % *Eucalyptus citridora* Hook. Syn. Highest level of air pollution tolerance index (APTI) value recorded in 11.27 in *Shorea robusta* Gaertn. f. and lowest amount of air pollution tolerance index (APTI) recorded in *Mallotus philippinensis* Muell-Arg.

7.13.

Discussion:

Ascorbic acid is a strong reluctant protects chloroplasts against SO₂ induced H₂O₂ O₂ - and OH - accumulation and thus protects the enzymes of the CO₂ fixation cycle and chlorophyll from inactivation (Tanaka et al., 1982). Together with leaf pH, it plays a significant role in determining the SO₂ sensitivity of plants (Chaudhary and Rao, 1977). Thus plants maintaining high ascorbic acid concentration under polluted conditions are considered to be tolerant to air pollution stress.

The ability of each plant species to absorb and adsorb pollutants by their foliar surface varies greatly and depends on several biochemical, physiological and morphological characteristics (Singh and Verma, 2007). The sensitive species help to indicate air pollution and tolerant ones help in abatement of air pollution. The tolerant species of plants function as pollution sink and therefore a number of environmental benefits can be obtained by planting tolerant species in polluted areas. For this purpose, evaluation of plants with respect to their tolerance level to air pollution may be essential (Lakshmi et al., 2009). There are many factors controlling tolerance in plants. For instance, the importance of pH in modifying the toxicity of SO₂ has been shown. It was reported that plants with lower pH are more susceptible, while those with pH around 7 are more tolerant (Singh and Verma, 2007).

Another parameter that may decide the tolerance of plant to air pollution is ascorbic acid content, which is also called vitamin C. It plays a significant role in light reaction of photosynthesis

(Singh and Verma, 2007), activates defense mechanism (Arora et al., 2002) and under stress condition, it can replace water from light reaction II (Singh and Verma, 2007). Ascorbic acid, a natural antioxidant in plants has been shown to play an important role in pollution tolerance (Joshi and Swami, 2007).

Ascorbic acid plays a 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. High pH may increase the efficiency of conversion from hexose sugar to AA, while low leaf extract pH showed good correlation with sensitivity to air pollution (Escobedo et al., 2008).

Depletion in chlorophyll immediately causes a decrease in productivity of plant and subsequently plant exhibits poor vigor. Therefore, plants maintaining their chlorophyll even under polluted environment are said to be tolerant ones (Singh and Verma, 2007).

It is evident from the above discussion that the plant species of *Shorea robusta* Gaertn. f.

have highest amount of air pollution tolerance index, so it can withstand highest pollution environment whereas plant species with low air pollution tolerance index 7.13 value have lower capacity to combat against air pollution induced by automobile.

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