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ORIGINAL ARTICLE

AIR POLLUTION TOLERANCE INDEX OF SOME TERRESTRIAL PLANTS AROUND AN INDUSTRIAL AREA

***R. Bakiyaraj and D. Ayyappan**

Department of Botany, Annamalai University, Annamalainagar- 608002, Tamilnadu, India.
*Email: bakya22@gmail.com

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ABSTRACT

Screening of plants for their sensitivity/tolerance level to air pollutants is important because the sensitive plants can serve as bio-indicator and the tolerant plants as sink for controlling air pollution in urban and industrial areas. In order to evaluate the susceptibility level of plants to air pollutants, ten parameters namely leaf extract pH, Relative Water Content, Ascorbic acid, Chlorophyll, protein, amino acid, reducing sugar, starch and phenol were determined and computed together in a formulation signifying the Air Pollution Tolerance Index (APTI) of Eleven frequently grown plant species around Neyveli Lignite Corporation Limited (NLC) area. The results showed that *Eucalyptus* sp (6. 52%) have the higher APTI value reflects the higher tolerance level in air pollution. Similarly *Murrya koenigii* (0.81) showed lower APTI value reflects sensitive nature against air pollution.

***Key words*:** APTI, Chlorophyll, Relative Water Content, Bio indicator.

1.INDRODUCTION

Plants are an integral basis for all ecosystems and also most likely to be affected by air borne pollution which are identified as the organisms with most potential to receive impacts from ambient air pollution. Also the effects are most often apparent on the leaves which are usually the most abundant and most obvious primary receptors of large number of air pollutants. Bio monitoring of plants is an important tool to evaluate the impact of air pollution. Hence in the latest years urban vegetation became increasingly important not only for social reasons but mostly for affecting local and regional air quality.

In recent times there has been significant development activity in terms of industrialization and urbanization in almost all cities, medium and small towns in India. As we know that air is the most important resources for the sustenance of life and other activities in the biosphere all organisms need clean air for their healthy growth and development. But this air has become highly polluted. A major contributor to the air pollution problem is the transport sector which contributes through the vehicular emission. Although newly design engines and technology exhaust less emission but drastic increase in the number of vehicle has been noted.

Air Pollution can be defined as the human introduction into the atmosphere of chemicals, particulate matter or biological materials that cause harm or discomfort to humans, or other living organism or damage the environment (Anonymous, 2008). Air pollution is a major problem arising mainly from industrialization (Odilora *et al*., 2006).

Sensitivity and response of plants to air pollutants is variable. The plant species which are more sensitive act as biological indicators of air pollution. The response of plants to air pollution at physiological and biochemical levels can be understood by analyzing the factors that determine resistance and susceptibility. Using plants, as indicator of air pollution is the possibility of synergistic action of pollutants (Lakshmi *et al*., 2009). The ambient environment of an urban area may be contaminated with several pollutants and the plants growing there would be exposed not only to one but too many pollutants and their different conditions. It is possible to estimate the overall effect of a large number of pollutants as total pollution by measuring changes in the plants.

Tree act as a sink of air pollutants and thus reduce their concentration in the air Prajapati and Tripathi, 2008). However, this function of pollution abatement is best performed by the pollution- tolerant species. It appears that tree plantation in industrial areas is a site- specific activity and knowledge of tolerance level of plant species to air pollution is necessary.

The efficiency of plants in absorbing pollutants is such that it can produce pockets of clean air (Gilbert, 1968). Plants growing in polluted environment often responded and showed significant changes in their morphology, physiology and biochemistry. The response of plants towards air was assessed by air pollution tolerance index. The aim of this study is therefore to determine the APTI values of twenty five plant species within the Neyveli Lignite Corporation, Neyveli and the study was carried out with a view to find out the tolerance as well as sensitivity of the common plant species subjected to industrial pollution.

2.MATERIALS AND METHODS

Area of Study

Neyveli is a mining and power generation township in Cuddalore District in the Indian state of Tamil Nadu. It is located at 11.30 o N - 79.29 o E. It is 52 km inland from Bay of Bengal, 197 km South of Chennai. Neyveli Lignite Corporation Limited (NLC) is a Mini- ratna, Government of India enterprise registered under Indian Companies Act 1956, engaged in commercial exploitation of the lignite deposit available at Neyveli region. It is an integrated complex, with three lignite mines having a combined production capacity of twenty four million tonnes per annum feeding lignite to three thermal power stations having a combined generating capacity of 2490 Mw. The industry is emitting lot of pollutants which affects the soil, air and water. The present study was conducted during the period of 3 months.

Sampling

Plants were randomly selected from the immediate vicinity of the station. This is designated as experimental site (ES). Leaf Samples of the various plants were then collected. Three replicates of fully matured leaves were taken and immediately taken to the laboratory for analysis. A composite sample of each plant species was obtained before analysis. A site nearby with similar ecological conditions was selected as the control site (CS). Samples were preserved in refrigerator for further analysis.

Relative Water Content (RWC)

According to the method described by Liu and Ding (2008) relative leaf water content was determined and calculated with the formula.

RWC = (FW - DW) x 10
TW-DW
FW = Fresh weight
DW = Dry weight
TW=Turgid weight.

APTI (Air Pollution Tolerance Index) Determination

An attempt has been made to determine the Air pollution Tolerance Index (APTI) which gives an empirical value for tolerance level of plants to air pollution. This was done by following the method of Singh and Rao (1983). The formula for APTI is,

APTI= A (T + P) + R

A-Ascorbic acid
T-Total chlorophyll
P-Leaf extracts PH
R-Relative Water Content of the leave's

Leaf extracts pH and Ascorbic acid

Leaf Extracts pH was estimated by Singh and Rao, 1983.Ascorbic Acid (AA) Content was analysed by Abida Begum and Harikrishna, 2010.

Biochemical Analysis

The Chlorophyll content was estimated by Arnon, 1949. The Carotene was estimated by Kirk and Allen, 1965. The Reducing Sugars was estimated by Nelson, 1944. The Total Sugars and Non-reducing Sugars were estimated by Nelson, 1944. The Amino acid content was estimated by following the method of Moore and Stein, 1948. The Phenol content was estimated by Bray and Thorpe, 1954.

3.RESULTS

The present study deals with the Air Pollution Tolerance Index of certain plants around the Neyveli Lignite Corporation Ltd (NLC), Neyveli.

Parameters Studied

Table 1. Effect of Air pollution on Leaf extracts P^H (mg/g fr.wt) and Relative water content of certain Plants around Neyveli town

S. No	Name of the plants	Leaf extract P^H		Relative water content	
		Control site	Experimental si :e	Control Site	Experimental Site
1	*Lawsonia inermis* L.	6.43 ±0.063	6.70 ±0.069	54.7 ±0.07	55.6 ±0.09
2	*Eucalyptus* Sp. (L.) Her.	8.21 ±0.078	8.32 ±0.080	94.5 ±0.05	95.9 ±0.08
3	*Morinda tinctoria* Ham.	7.34 ±0.067	7.86 ±0.071	76.0 ±0.05	76.8 ±0.09
4	*Lantana camera* L.	4.63 ±0.060	4.69 ±0.058	38.5 ±0.08	40.3 ±0.09
5	*Madhuca indica* Gmelin	5.92 ±0.058	6.10 ±0.060	78.6 ±0.09	79.6 ±0.12
6	*Crotolaria labumifolia* L.	5.34 ±0.049	5.70 ±0.051	46.5 ±0.06	49.9 ±0.13
7	*Citrus medica* L.	4.21 ±0.026	4.80 ±0.024	79.6 ±0.08	79.9 ±0.12
8	*Phyllanthus emblica* L.	6.74 ±0.045	6.90 ±0.043	70.9 ±0.09	71.9 ±0.17
9	*Murrya koenigii*	3.87 ±0.028	3.98 ±0.032	36.7 ±0.05	36.9 ±0.07
10	*Citus limon* L.	4.95 ±0.030	4.99 ±0.032	78.4 ±0.06	79.4 ±0.09
11	*Sesbania sesban (L.) Merr*	8.21 ±0.065	8.29 ±0.068	80.4 ±0.04	83.6 ±0.09

± Standard Deviation

Table 1 represents the leaf extract pH and Relative water content of control and experimental site plants. The higher leaf extract pH was recorded in experimental site (8.32 ± 0.080 mg/g fr.wt) and control site (8.21 ± 0.078 mg/g fr.wt) of *Eucalyptus* sp. plants. The lower leaf extract pH was recorded in experimental site (3.98 ± 0.032 mg/g fr.wt) and control site (3.87 ± 0.028 mg/g fr.wt) of *Murrya koenigii* plants. The higher relative water content was recorded in experimental site (95.9 ± 0.08 mg/g fr.wt) and control site (94.5 ± 0.05 mg/g fr.wt) *Eucalyptus* sp. Plants. Similarly, the lower relative water content in experimental site (36.9 ± 0.07 mg/g fr.wt) and control site (36.07 ± 0.05 mg/g fr.wt) was recorded in *Murrya koenigii* plants.

Table-2. Effect of Air pollution on Ascorbic acid and APTI (mg/g fr.wt) content of certain plants Around Neyveli town

s. No	Name of the plants	Ascorbic acid		APTI	
		Control site	Experimental Site	Control Site	Experimental Site
1	*Lawsonia inermis* L.	16.8 ±0.09	17.9 ±0.17	11.1 ±0.19	11.81 ±0.29
2	*Eucalyptus* Sp. (L.) Her.	23.5 ±1.89	23.9 ±1.99	18.0 ±0.56	18.9 ±0.59
3	*Morinda tinctoria* Ham.	12.7 ±0.15	12.9 ±0.19	10.2 ±0.27	11.4 ±0.32
4	*Lantana camera* L.	4.02 ±0.14	4.09 ±0.18	7.6 ±0.24	7.92 ±0.32
5	*Madhuca indica* Gmelin	11.8 ±0.09	12.3 ±0.17	10.4 ±0.26	10.9 ±0.29
6	*Crotolaria labumifolia* L.	5.78 ±0.03	5.99 ±0.09	7.85 ±0.12	7.99 ±0.18
7	*Citrus medica* L.	13.7 ±0.13	13.92 ±0.18	9.86 ±0.13	10.2 ±0.20
8	*Phyllanthus emblica* L.	14.7 ±0.15	15.7 ±0.19	8.69 ±0.39	9.12 ±0.40
9	*Murrya koenigii*	3.07 ±0.07	4.09 ±0.12	7.5 ±0.16	7.89 ±0.20
10	*Citus limon* L.	14.9 ±0.17	15.4 ±0.25	12.1 ±0.08	12.9 ±0.11
11	*Sesbania sesban (L.) Merr*	10.72 ±1.20	10.89 ±1.83	12.0 ±0.79	12.70 ±0.80

± Standard Deviation

Table- 3. Effect of Air pollution on Chlorophyll content (mg/g fr.wt) of certain plants around Neyveli town

S.No	Name of the plants	Chlorophyll	
		Control Site	Experimental Site
1	*Lawsonia inermis* L.	11.58±0.017	11.61 ±0.021
2	*Eucalyptus* Sp. (L.) Her.	14.90±0.004	14.96 ±0.005
3	*Morinda tinctoria* Ham.	11.70 ±0.057	11.72 ±0.060
4	*Lantana camera* L.	16.49 ±0.039	16.58 ±0.044
5	*Madhuca indica* J.F.Gmelin	12.53±0.030	12.54 ±0.035
6	*Crotolaria labumifolia* L.	6.83±0.009	6.96 ±0.010
7	*Citrus medica* L.	11.56±0.012	11.69 ±0.015
8	*Phyllanthus emblica* L.	11.49±0.009	11.50 ±0.010
9	*Murrya koenigii*	6.40±0.028	6.92 ±0.034
10	*Citus limon* L.	10.16±0.021	10.21 ±0.024
11	*Sesbania sesban (L.) Merr*	11.97±0.015	12.0 ±0.017

± Standard Deviation

Table- 4. Effect of Air pollution on Protein and Amino acid (mg/g fr.wt) content of certain plants

S.No	Name of the plants	Protein		Amino acid	
		Control Site	Experimental Site	Control Site	Experimental Site
1	*Lawsonia inermis* L.	12.59±0.018	12.42 ±0.021	4.92±0.03	4.99 ±0.047
2	*Eucalyptus* Sp. (L.) Her.	33.68±0.089	33.71 ±0.093	10.89±0.06	10.99 ±0.070
3	*Morinda tinctoria* Ham.	22.78±0.080	22.81 ±0.099	8.61±0.087	8.68 ±0.090
4	*Lantana camera* L.	20.20±0.052	20.48 ±0.061	8.00±0.06	8.01 ±0.064
5	*Madhuca indica* J.F.Gmelin	18.00±0.137	18.20 ±0.142	4.59±0.06	4.98 ±0.074
6	*Crotolaria labumifolia* L.	17.43±0.010	17.89 ±0.015	5.60±0.04	5.69 ±0.051
7	*Citrus medica* L.	14.61±0.078	14.62 ±0.099	6.75±0.04	6.86±0.052
8	*Phyllanthus emblica* L.	23.11±0.019	23.20 ±0.028	10.79±0.04	10.86 ±0.040
9	*Murrya koenigii*	10.01±0.021	10.80 ±0.031	4.09±0.04	4.80 ±0.056
10	*Citus limon* L.	14.65±0.032	14.7 ±0.043	4.76±0.004	4.82 ±0.005
11	*Sesbania sesban (L.) Merr*	19.24±0.347	19.28 ±0.445	5.14 ±0.007	5.17 ±0.007

± Standard Deviation

Table- 5. Effect of Air pollution on sugar content of certain (mg/g fr.wt) plants around Neyveli town

S No	Name of the plants	Reducing sugar		Total sugar	
		Control Site	Experimental Site	Control Site	Experimental Site
1	*Lawsonia inermis* L.	8.51 ±0.009	8.69±0.010	13.79 ±0.020	13.84±0.026
2	*Eucalyptus* Sp. (L.) Her.	14.87 ±0.029	14.90±0.034	18.62 ±0.062	18.69±0.070
3	*Morinda tinctoria* Ham.	5.10 ±0.017	5.28±0.021	7.57 ±0.082	7.64±0.099
4	*Lantana camera* L.	5.01 ±0.042	5.06±0.048	9.01 ±0.032	9.07±0.041
5	*Madhuca indica* Gmelin	11.73 ±0.024	11.82±0.027	15.30 ±0.062	15.38±0.062
6	*Crotolaria labumifolia* L.	6.10 ±0.009	6.29±0.011	9.62 ±0.018	9.68±0.023
7	*Citrus medica* L.	11.19 ±0.012	11.24±0.019	17.42 ±0.032	17.46±0.040
8	*Phyllanthus emblica* L.	11.01±0.003	11.09±0.004	17.92 ±0.09	18.00±0.011
9	*Murrya koenigii*	4.55 ±0.020	4.68±0.021	8.80 ±0.038	8.98±0.041
10	*Citus limon* L.	11.84 ±0.010	11.99±0.011	14.13 ±0.020	14.24±0.024
11	*Sesbania sesban (L.) Merr*	11.0 ±0.005	12.00±0.005	14.20 ±0.012	14.27±0.016

± Standard Deviation

Table- 6. Effect of Air pollution on Starch and Phenol content (mg/g fr.wt) of certain plants around Neyveli town

S. No	Name of the plants	Starch		Phenol	
		Control Site	Experimental Site	Control Site	Experimental Site
1	*Lawsonia inermis* L.	7.12 ±0.032	7.14 ±0.042	0.309 ±0.012	0.314 ±0.015
2	*Eucalyptus* Sp. (L.) Her.	13.13 ±0.038	13.20 ±0.041	1.703 ±0.029	1.716 ±0.035
3	*Morinda tinctoria* Ham.	11.14 ±0.032	13.14 ±0.049	0.701 ±0.029	0.712 ±0.035
4	*Lantana camera* L.	9.68 ±0.016	9.94 ±0.012	0.598 ±0.023	0.611 ±0.030
5	*Madhuca indica* Gmelin	8.10 ±0.010	8.14 ±0.020	0.934 ±0.043	0.914 ±0.045
6	*Crotolaria labumifolia* L.	7.79 ±0,004	7.86 ±0.006	0.320 ±0.004	0.329 ±0.001
7	*Citrus medica* L.	5.73 ±0.036	5.69 ±0.045	0.419 ±0.019	0.421 ±0.021
8	*Phyllanthus emblica* L.	9.46 ±0.004	9.84 ±0.006	0.198 ±0.011	0.211 ±0.010
9	*Murrya koenigii*	5.00 ±0.032	5.05 ±0.034	0.156±0.023	0.166 ±0.033
10	*Citus limon* L.	9.36 ±0.006	9.89 ±0.007	0.418 ±0.018	0.431 ±0.021
11	*Sesbania sesban (L.) Merr*	11.10 ±0.017	11.12 ±0.022	0.190 ±0.0110	0.211 ±0.010

± Standard Deviation

Table 2 represents the Ascorbic acid and APTI content of control site and polluted site plants. The higher Ascorbic acid content and APTI content was recorded in experimental site (23.9 ± 1.99; 18.9 ± 0.59 mg/g fr.wt) and control site (23.5 ± 1.89; 18.0 ± 0.56 mg/g fr.wt) of *Eucalyptus* sp. plants.

Table 3 represents the total chlorophyll content of control site and polluted site plants. The higher Total chlorophyll content was recorded in experimental site (14.96 ± 0.005 mg/g fr.wt) and control site (14.90 ± 0.004 mg/g fr.wt) of *Eucalyptus* sp. plants. Similarly, the lower chlorophyll content in experimental site (6.92 ± 0.034 mg/g fr.wt) and control site (6.40 ± 0.028 mg/g fr.wt) was recorded in *Murrya koenigii* plants.

Table 4 represents the protein and amino acid content of control site and polluted site plants. The higher protein and amino acid content was recorded in experimental site (33.71 ± 0.093; 10.99 ± 0.070 mg/g fr.wt) and control site (33.68 ± 0.089; 10.89 ± 0.060 mg/g fr.wt) of *Eucalyptus* sp. plants. Similarly, the lower protein and amino acid content in experimental site (10.80±0.031; 4.80±0.056 mg/g fr.wt) and control site (10.01 ± 0.021; 4.09 ± 0.040 mg/g fr.wt) was recorded in *Murrya koenigii* plants.

Table 5 represents the sugar content of experimental and control site plants. The higher sugar content was recorded in experimental site (14.90 ± 0.034; 18.69 ± 0.070 mg/g fr.wt) and control site (14.87 ± 0.029; 18.62 ± 0.062 mg/g fr.wt) of *Eucalyptus* sp. plants. Similarly, the lower sugar content was recorded in experimental site (4.68 ± 0.021; 8.98 ± 0.041 mg/g fr.wt) and control site (4.55 ± 0.020; 8.80 ± 0.038 mg/g fr.wt) of *Murrya koenigii* plants.

Table 6 represents the starch and phenol content of experimental and control site plants. The higher starch and phenol content was recorded in experimental site (13.20 ± 0.041; 1.716 ± 0.035 mg/g fr.wt) and control site (13.13 ± 0.038; 1.703 ± 0.029 mg/g fr.wt) of *Eucalyptus* sp. plants. Similarly, the lower starch and phenol content in experimental site (5.05 ± 0.034; 0.666 ± 0.033 mg/g fr.wt) and control site (5.00 ± 0.032; 0.602 ± 0.023 mg/g fr.wt) was recorded in *Murrya koenigii* plants.

4.DISCUSSION

The plants being constantly exposed to the environment absorb, accumulate and integrate pollutants impinging on their foliar surfaces. Consequently, they show visible or subtle changes depending on their sensitivity level (Trivedi and Raman, 2001).

High water content within plant body helps to maintain its physiological balance under stress conditions such as exposure to air pollution when the transpiration rates are usually high. It also serves as an indicator of drought resistance in plants. Relative Water Content (RWC) of a leaf is the water present in it relative to its full turgidity. Relative water content is associated with protoplasmic permeability in cells causes' loss of water and dissolved nutrients, resulting in early senescence of leaves (Agrawal and Tiwari, 1997). Therefore the plants with high relative water content under polluted conditions may be tolerant to pollutants. Water is crucial prerequisite for plant life. High water content within a plant body will help to maintain its physiological balance under stress condition such as exposure to air pollution when the transpiration rates are usually high. High RWC favour drought resistance in plants. Due to the air pollution there is reduction in transpiration rate and damage to the leaf engine that pulls water up from the roots. (1-2% of the total) consequently the plants neither bring minerals nor cool the leaf. Reduction in relative water content of plant species is due to impact of pollutants on transpiration rate in leaves (Swami *et al*., 2004).

Consequently, sensitive plants had lower leaf-extract pH than tolerant plants. Similar result was obtained in the present investigation. High pH may increase the efficiency of conversion from hexose sugar to Ascorbic acid, while low leaf extract pH showed good correlation with sensitivity to air pollution (Escobedo et al., 2008 & Pasqualini et al., 2001). Scholz and 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 dependent being more at higher and lesser at lower pH hence the leaf extract pH on the higher side gives tolerance to plants against pollution. Plants with alkaline leaf extract pH show high tolerance to pollution. There are so many factors controlling tolerance in plants. Plants with lower pH are more susceptible, while those with pH around 7 are more tolerant. But in overall observation most of the plants showed alkaline pH consequently, sensitive plants had higher leaf-extract pH than tolerant plants.

Pollution load dependent increase in ascorbic acid content of all the plant species may be due to the increased rate of production of reactive oxygen species (ROS) during photo-oxidation of So2 to So3 where sulfites are generated from So2 absorbed. Ascorbic acid is a strong reluctant and it activates many physiological and defense mechanism. Its reducing power is directly proportional to its concentration (Raza and Murthy, 1988). Total chlorophyll (TCH) is related to Ascorbic Acid productivity and Ascorbic acid is concentrated mainly in chloroplast. Photosynthetic efficiency was strongly dependent on leaf pH Photosynthetic rate was reduced in plants at low leaf pH. Varshney and Varshney (1984) are of the opinion that higher ascorbic acid content of the plant is a sign of its tolerance against sulphur dioxide pollution. Being a very important reducing agent, ascorbic acid also plays a vital role in cell wall synthesis, defense and cell division (Conklin, 2001).

High pH may increase the efficiency of conversion of hexose sugar to ascorbic acid and it is related to the tolerance to pollution (Escobedo et al., 2008). Production of reactive oxygen species (ROS) such as So3-2, HSO3-2 OH- and O2_ during photo-oxidation of So3-2 to So4-2 where sulphites are generated from So2 absorbed. The free radical production under So2 exposure would increase the free radical scavengers, such as ascorbic acid, super oxide dismutase (SOD), and peroxidase based on dosage and physiological status of plant. The increase level of ascorbic acid reported may be due to the defence mechanism of the respective plants (Cheng et al., 2007). It plays an important role in photosynthetic carbon fixation with the reducing power directly proportional to its concentration (Pasqualini et al., 2001).

A considerable loss in total chlorophyll in the leaves of plants exposed to air pollution stress supports the argument that the chloroplast is the primary site of attack by air pollutants. It is a strong reducer and plays important role in photosynthesis (Carbon-dioxide Fixation). Its reducing power is directly proportional to its concentration. Chlorophyll content of plants signifies its photosynthetic activity as well as the growth and development of biomass. It is known that chlorophyll content of plants varies from species to species; depending upon the age of leaf pollution level as well as with other biotic and abiotic conditions (Katiyar and Dubey, 2001). Degradation of photosynthetic pigment has been widely used as an indicator of air pollution (Ninave et al., 2001).The present study revealed that chlorophyll content in all the plants varied with the pollution status of the area. Higher the levels of Pollution lower the chlorophyll content. Chlorophyll content is an index of productivity of plant (Raza & Murthy, 1988).

Allen et al. (1987) demonstrated the increasing levels of total chlorophyll by certain pollutants. So, increase in chlorophyll content of the leaves in industrial site may be attributed to the influence of pollutants present in a smoke releasing from the industry. Irrespective of study stations, higher levels of total chlorophyll was observed in *Ficus bengalensis*, and this higher levels of total chlorophyll observed may be due to its tolerance nature (Beg et al., 1990 and Jothi and Jaya, (2010).Studies (Mir *et al*., 2008) also suggest that high levels of automobile pollution decreases chlorophyll content in higher plants near roadsides.

Air pollution tolerant 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 sink to mitigate pollution, while plants with low index value show less tolerance and can be used to indicate levels of air pollution (Singh and Rao, 1983). Similar study of air pollution tolerance index was also conducted by Karthiyayini *et al*., (2005); Agbaire and Esiefarienrhe, (2009); Tripathi, *et al*., (2009); Chauhan, A. (2010); Abida and Harikrishna, (2010) and Sirajuddin and Ravichandran, (2010). Agbaire & Esief, 2009 reported that the plants show alteration in the biochemical processes or accumulation of certain metabolites by the effect of certain pollutants.

Reduction in starch content in polluted stations can be attributed to increased respiration and decreased Co2 fixation because of chlorophyll deterioration. It has been mentioned that pollutants like So2, No2 and H2S under hardening conditions can cause more depletion of soluble sugars in the leaves of plants grown in polluted area. The reaction of sulfite with aldehydes and ketones of carbohydrates can also cause reduction in carbohydrate content. In certain plants higher accumulation of starch was observed in polluted region or significant difference was not observed. According to Tripathi *et al*., (2009) it is due to higher resistance of their photosynthetic apparatus and low starch export from the Mesophyll. Similar result was obtained by Tzvetkova and Kolarova (1996) in *T. argentea and Q. cerris*.

Due to urbanization and industrialization, there is an immense loss to the yield and in turn to the economy of the region. Hence APTI determination to various crops provides information regarding the tolerance capacity of them to air pollutants and such crops may be recommended to the farmers in industrialized urban and peri-urban areas.

5.CONCLUSION

In conclusion, APTI determination of plants is important because in recent century by increasing industrialization, danger of deforestation due to air pollution is threatening the environment. *Eucalyptus* sp., *Lawsonia inermis, Citus limon, Sesbania sesban* and *Morinda tinctoria* can be used as bio monitors pollution stress.

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