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RESEARCH ARTICLE

Biological monitoring of road side plants exposed to air pollution

■ D. SARALA THAMBAVANI AND V. PRATHIPA

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SUMMARY: The quality of air with respect to SPM, RPM, SO_2 and NO_X of the various traffic and industrial area of Dindigul town has been assessed. The effect of air pollution has been recorded on the various parameters of the leaves- chlorophyll 'a', chlorophyll 'b', total chlorophyll content and carotenoid of some plant species *viz., Azadiracta indica, Delonix regia, Moringa tinctoria, Calotropis gigantea*, *Thyme rosemary* and *Cynodon dactylon* growing along the roadside of traffic and industrial area. The result indicated that the photosynthetic pigment of the leaves decreased in all the studied species at the polluted sites. Changes in the concentration of photosynthetic pigments such as chlorophyll 'a', chlorophyll 'b' and total carotenoid were inferred in the selected plant species at different sampling sites. Reduction in chlorophyll 'a', chlorophyll 'b' and total carotenoid found in all the plant species at traffic and tannery sites compared to the control site.

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Author for correspondence :
D. SARALA THAMBAVANI
Department of Chemistry, Sri Meenakshi Govt College for Women, MADURAI (T.N.) INDIA
E-mail: sarala_dr@yahoo.in

See end of the article for **Coopted authors'**

The use of plants as monitors of air pollution has long been established as plants are the initial acceptors of air pollution. They act as the scavengers for many air borne particulates in the atmosphere. Demand of rapid modes of transportation has increased many folds during the last few decades because of the continuous rise in the human population. This in turn has led a tremendous increase in the number of different types of vehicles, which now has become a major source of air pollution throughout the world. The use of automobiles is growing fast, globally at large and with much greater space in developing countries.

Urban air pollution is worsening due to upward trends in power consumption, industrialization, vehicle use and scores of other developmental activities taken up by human beings. It has been estimated that vehicular pollution is the primary cause of air pollution in the urban areas (60%), followed by the industries (20-30%) in India (Sivasamy and Srinivasan, 1997). There are five major harmful substances released into the atmosphere in sufficient quantities as a result of natural events or by human activities. They are carbon monoxide, hydrocarbons, particulates, sulphur dioxide and nitrogen compounds (Deepa, 1993). The role of air pollutants causing injury to plants either by direct toxic affect or modifying the host physiology renders it more susceptible to infection. In severe case of pollution, the injury symptoms were expressed as foliar necrosis or completely disappearance of the plant. Several plants could be used as biomonitor, which can detect the presence of gaseous pollutants. Leaf is most sensitive and reliable part than any other parts of plant like stem, root, flower, fruit and seed, it may act as a persistent absorber and is exposed to the polluted environment. Several studies have been carried out in India to highlight the existing air quality status in relation to SPM, NO_2 and SO_2 (Tiwari *et al.*, 1993; Gajghate and Hasan, 1995; Joshi and Mishra, 1998; Naik and Purohit, 1998; Alam *et al.,*1999; Mohanty, 1999; Prakash and Allappat, 1999; Venkatasubramaniam *et al.*, 1999; Sivacoumar, 2000; Tripathy and Panigrahi, 2000) and effect of air pollutants on micromorphological parameters of different plant species (Salgare and Nath,1991; Salgare and Swain, 1991; Modi *et* *al.,*1992; Tiwari *et al.,*1993; Shahare and Varshney, 1994; Palaniswamy *et al.,* 1995; Chattopadhyay, 1996; Dhir *et al.,* 1999; Pal *et al.*,1999; Pratibha and Sharma, 2000).

Chlorophyll is the principal photoreceptor in photosynthesis, the light-driven process in which carbon dioxide is "fixed" to yield carbohydrates and oxygen. Carotenoids are a class of natural fat-soluble pigments found principally in plants, algae and photosynthetic bacteria, where they play a critical role in the photosynthetic process (Ong and Tee, 1992; Britton,1995) and also protect chlorophyll from photoxidative destruction(Siefermann-Harms, 1987). When plants are exposed to the environmental pollution above the normal physiologically acceptable range, photosynthesis gets inactivated (Mizalski and Mydlarz, 1990). Studies on the effects of air pollutants due to automobiles on morphology, physiology and biochemistry of plants have been carried out by a number of workers (Treshow, 1985; Kozial and Whately, 1984; Ahmed *et al.,* 1988; Salgere and Nath, 1991; Raina and Agarwal, 2004; Tripathi and Gautam, 2007) in the different parts of the world. According to a study by Dwivedi and Tripathi (2007), the distribution of plant diversity is highly dependent on presence of air pollutants in the ambient air and sensitivity of the plants. Chlorophyll measurement is an important tool to evaluate the effects of air pollutants on plants as it plays an important role in plant metabolism and any reduction in chlorophyll content corresponds directly to plant growth (Wagh *et al.,* 2006). Leaf chlorophyll content and carotenoids thus, can provide valuable information about physiological status of plants. Present study has been carried out to know the changes in the concentration of chlorophyll and carotenoids in the leaf samples of the plants exposed to roadside pollution.

EXPERIMENTAL METHODOLOGY

Study sites:

Polluted site was located at the bus stand in Dindigul which is the busiest area in Dindigul and traffic jam condition prevalent here throughout the day, posses a high number of two wheelers, three wheelers, and four wheelers. Another polluted site was sampled near the tannery area where many number of tanneries are located at Thomaiyarpuram, Dindigul. While the control site was located at Lakshmanapuram, Dindigul. The control site was situated about 12 kms away from polluted site where pollution level was almost very low. The fresh leaf samples were collected from both sites, polluted and control, grown on the edge of the road almost with similar topography or conditions and all these leaves were free from pathogens or any disease.

The control of air pollutants (SO_2, NO_X, SPM and RPM) monitoring data at polluted site in Dindigul Town. The control site was measured with the help of RDS APM 460 by sucking air into appropriate reagent for 24 hours at every 30 days. The SPM and RPM were analyzed using Respirable Dust Sampler (RDS) APM 460 and operated at an average flow rate of 1.0 – 1.5 $m^3 min^{-1}$. Preweighed glass fiber filters (GF/A) of Whatman were used as per standard methods.

SO_2 and NO_X were collected by bubbling the sample in a specific absorbing (Sodium tetrachloromercuate of SO_2 and sodium hydroxide for NO_X) solution at an average flow rate of 0.2 – 0.5 min^{-1}. The impinger samples were put in ice boxes immediately after sampling and transferred to a refrigerator until analyzed. And procured into lab within same day and analyzed immediately for the concentrations level. The concentration of NO_X was measured with standard method of Modified Jacobs- Hochheiser method, (1958), SO_2 was measured by modified West and Geake method (1956), SPM and RPM using filter paper methods. The apparatus was kept at a height of 2 m from the surface of the ground. Using air pollutants data the air quality index was calculated.

Pigment analysis :

Chlorophyll and carotenoid were extracted from the leaves and estimated by the method of Arnon (1949).

Extraction :

Five hundred milligrams of fresh leaf material was ground with 10 ml of 80 per cent acetone at 4^0C and centrifuged at 2500 xg for 10 minutes at 4^0C. This procedure was repeated until the residue became colourless. The extract was transferred to a graduated tube and made up to 10 ml with 80 per cent acetone and assayed immediately.

Estimation :

Three milliliters aliquots of the extract were transferred to a cuvette and the absorbance was read at 645,663 and 480 nm with a spectrophotometer (U-2001-Hitachi) against 80 per cent acetone as blank. Chlorophyll content was calculated using the formula of Arnon (1949).

$$\text{Total chlorophyll (mg/ml)} = (0.0202) \times (A.645) + (0.00802) \text{X} (A.663)$$

$$\text{Chlorophyll 'a' (mg/ml)} = (0.0127) \times (A.663) - (0.00269) \times (A.645)$$

$$\text{Chlorophyll 'b' (mg/ml)} = (0.0229) \times (A.645) - (0.00468) \times (A.663)$$

and expressed in milligram per gram fresh weight. Carotenoid content was estimated using the formula of Kirk and Allen (1965) and expressed in milligrams per gram fresh weight.

$$\text{Carotenoid} = A.480 + (0.114 \text{x} A.663 - 0.638 \text{x} A.645)$$

The Air quality index (AQI) was calculated using the formula as given below:

$$Q = 100 \text{x} \frac{O}{O_s}$$

The assessment studies were conducted on *Azadiracta* *indica, Delonix regia, Moringa tinctoria, Calotropis gigantea*, *Thyme rosemary* and *Cynodon dactylon* during the study period.

EXPERIMENTAL FINDINGS AND DISCUSSION

The findings of the study have been discussed in detail as under:

Concentration of primary pollutants :

The concentration of primary pollutants recorded has been presented in Table 1. The concentration of NO_X at the tannery site was 32.0 and 33.3 μg/m^3 during winter and summer seasons, respectively. At the commercial-cum-traffic area, it was found as 25.6 and 29.7 μg/m^3 during winter and summer seasons, respectively. At the control site, it was determined as 20.0 and 14.7μg/m^3 during winter and summer seasons, respectively. SO_2 recorded at the tannery site and commercial -cum -traffic area were 11.4, 9.5, 15.0 and 18.7 μg/m^3 during winter and summer seasons, respectively. While at the residential area, it was found as 14.2 and 9.9 μg/m^3 during winter and summer seasons, respectively. The concentration of RPM at the tannery site, commercial-cum-traffic site and at the residential site were 47.0, 42.5, 66.5, 53.1, 50.2 and 42.1 ug/m^3 during winter and summer seasons, respectively. The highest concentration of SPM recorded at the commercial-cum -traffic area and tannery were 158.4, 147.6,111.2 and 99.4 μg/m^3 during winter and summer seasons, respectively, while the lowest concentration (98.0 and 65.5 μg/m^3) was recorded at the residential area during winter and summer seasons, respectively .

Table 1 : Seasonal variations in air quality in Dindigul area (μg/m^3)

Parameters	Seasons	Tannery area	Commercial -cum -traffic area	Residential area
SPM	Winter	111.2	158.4	98.0
	Summer	99.4	147.6	65.5
RPM	Winter	47.0	66.5	50.2
	Summer	42.5	53.1	42.1
SO_2	Winter	11.4	15.0	14.2
	Summer	9.5	18.7	9.9
NO_X	Winter	32.0	25.6	20.0
	Summer	33.3	29.7	14.7

Using Table 1, the Air quality index (AQI) values were calculated which are presented in Table 2 and 2a. AQI observed during winter and summer seasons at the tannery site were 23.95 and 21.90, respectively. Tannery site was termed under the categories "Clean Air" (CA). AQI calculated at the commercial-cum-traffic site was 28.94 and 29.48 during winter and summer seasons. The polluted site was termed under the categories "Light air pollution" (LAP). Polluted site is very busy road which bears high numbers of scooters, motor cycles,

Table 2 : Air quality status for SPM, RPM , SO_2 and NO_X

Location	Seasons	SPM (μg/m^3)			RPM (μg/m^3)			SO_2 (μg/m^3)			NO_X (μg/m^3)			Air quality index (AQI)
		PV*	OV*	QR*	PV*	OV*	QR*	PV*	OV*	QR*	PV*	OV*	QR*	
Tanneries	Winter	300	111.2	37.06	300	47.0	15.6	80	11.4	14.25	80	32	40	23.95
	Summer	300	99.4	33.13	300	42.5	14.16	80	9.5	11.8	80	33.3	41.62	21.90
Commercial -	Winter	300	158.4	52.8	300	66.5	22.16	80	15.0	18.75	80	25.6	32	28.94
cum -traffic	Summer	300	147.6	49.2	300	53.1	17.7	80	18.7	23.37	80	29.7	37.12	29.48
Residential	Winter	140	98	70	140	50.2	35.85	60	14.2	23.66	60	20	33.33	37.58
	Summer	140	65.5	46.78	140	42.1	30.07	60	9.9	16.5	60	14.7	24.5	27.60

*PV – Permissible value *OV - Observed value *QR - Value of quality rate

Table 2a : Rating scale of AQI values at polluted and control sites

Index value	Remarks	Tannery site		Traffic site		Residential site	
		Winter	Summer	Winter	Summer	Winter	Summer
0-25	Clean air (CA)	CA	CA	LAP	LAP	LAP	LAP
26-50	Light air pollution (LAP)						
51-75	Moderate air pollution (MAP)						
76-100	Heavy air pollution (HAP)						
>100	Severe air pollution (SAP)						

three wheelers, cars and buses. As polluted site bears very high traffic volumes and there is traffic jams condition because roads are very narrow at two sides of bus stand . The higher concentration of SO_2, NO_X, SPM and RPM were observed during the study period at polluted site of Dindigul town. It may be due to plying of petrol and diesel vehicles (Chauhan, 2008). It has been reported that heavy diesel vehicles emitted 24 times (empirically) more fine particulates than light duty gasoline powered vehicles (Krichstetter, 1999). The concentration of SPM, RPM, SO_2 and NO_X were lower than the standard limits of CPCB.

Over all difference is based on two way ANOVA. Test was performed for comparison of all the parameters at their respective locations, where F values in ANOVA are significant. Significant difference at $\rho < 0.001$ by multiple comparison tests.

Chlorophyll pigment :

Variation in physiological characteristic of selected plant species exposed to ambient air pollutants are given in Tables 3 and 4.

It is evident from Table 3 that the chlorophyll 'a' and 'b' contents in the leaf samples of *Azadiracta indica* were reported as 0.601, 0.324, 0.443, 0.259, 0.154, 0.254 mg/g at the residential, traffic and tannery area. Chlorophyll 'a' showed 47 per cent and 26 per cent reduction at the polluted sites and Chlorophyll 'b' exhibited 41 per cent and 2 per cent reduction at the polluted sites respectively. Chlorophyll ' a' and 'b' contents of *Delonix regia* at the residential, traffic and tannery area were 0.356,0.256,0.471,0.175,0.128 and 0.291 mg/g, respectively . A decrease of chlorophyll 'a' and 'b' at the traffic site were 28 per cent and 27 per cent, respectively. But, an increase of chlorophyll 'a' and 'b' at the tannery site were 32.3 per cent and 66.3 per cent, respectively.

Chlorophyll 'a' and 'b' contents of *Moringa tinctoria* were reported as 0.624,0.424,0.310,0.324, 0.212 and 0.170 mg/g at the residential , traffic and tannery sites, respectively. There was a reduction of chlorophyll 'a' and 'b' at the traffic site (32% and 35%). The tannery site exhibited the maximum reduction (50% and 48%) of chlorophyll 'a' and 'b'. Chlorophyll 'a' and 'b' contents of *Calotropis gigantea* at the residential, traffic and tannery sites were 0.465, 0.324, 0.283, 0.209,0.153 and 0.156 mg/g, respectively. A decrease of 30 per cent, 38 per cent, 27 per cent and 25 per cent were recorded in chlorophyll 'a' and 'b' at the polluted sites such as traffic and tannery area (Table 3).

Chlorophyll 'a' and 'b' contents of *Thyme rosemary* at the residential, traffic and tannery sites were 0.542, 0.310, 0.401, 0.256, 0.148, and 0.159 mg/g, respectively. Both the traffic and tannery sites exhibited the maximum reduction of chlorophyll as 43 per cent, 26 per cent, 42 per cent and 38 per cent, respectively. Chlorophyll 'a' and 'b' content of *Cynodon dactylon* at the residential, traffic and tannery sites were 0.456, 0.214, 0.261, 0.202, 0.106, and 0.109 mg/g, respectively. Chlorophyll 'a' and ' b' showed the reduction (53%, 43%,

Table 3 : Chlorophyll 'a' and chlorophyll 'b' of different species

Name of the species	Sampling station	Site number	Chlorophyll 'a' (mg/g)	% of variation	Chlorophyll 'b' (mg/g)	% of variation
Azadiracta indica	Residential	S_1	0.601		0.259	
	Traffic	S_2	0.324	46.08	0.154	40.54
	Tannery	S_3	0.443	26.28	0.254	1.930
Delonix regia	Residential	S_1	0.356		0.175	
	Traffic	S_2	0.256	28.08	0.128	26.85
	Tannery	S_3	0.471	-32.30	0.291	-66.28
Moringa tinctoria	Residential	S_1	0.624		0.324	
	Traffic	S_2	0.424	32.05	0.212	34.56
	Tannery	S_3	0.310	50.32	0.170	47.5
Calotropis gigantea	Residential	S_1	0.465		0.209	
	Traffic	S_2	0.324	30.32	0.153	26.79
	Tannery	S_3	0.283	37.93	0.156	25.35
Thyme rosemary	Residential	S_1	0.542		0.256	
	Traffic	S_2	0.310	42.80	0.148	42.18
	Tannery	S_3	0.401	26.01	0.159	37.89
Cynodon dactylon	Residential	S_1	0.456		0.202	
	Traffic	S_2	0.214	53.070	0.106	47.52
	Tannery	S_3	0.261	42.76	0.109	46.039

48%, and 46%) at the traffic and tannery sites (Table 3).

It can be observed from Table 4 that the total chlorophyll content of *Azadiracta indica* at the residential, traffic and tannery sites were 0.85, 0.475, and 0.69 mg/g, respectively. A reduction of 44 per cent and 19 per cent in the total chlorophyll content of plant samples from traffic and tannery sites as compared to residential site was recorded. Total chlorophyll content recorded for *Delonix regia* at the residential, traffic and tannery sites were 0.531, 0.384 and 0.76 mg/g, respectively. It showed the reduction of 28 per cent at the traffic site compared to residential site. Total chlorophyll content of *Moringa tinctoria* at residential, traffic and tannery site were 0.948, 0.636 and 0.480 mg/g, respectively. Total chlorophyll content exhibited the maximum reduction of 32 per cent and 49 per cent at the traffic and tannery sites, respectively. Total chlorophyll content of *Calotropis gigantea* at the residential, traffic and tannery sites were 0.674, 0.47 and 0.43 mg/g, respectively. A decrease of 30 per cent and 36 per cent was recorded in the total chlorophyll at the polluted sites, respectively as compared to control site. *Thyme rosemary* recorded the total chlorophyll content at the residential, traffic and tannery sites were 0.80 ,0.458 and 0.56 mg/g, respectively. It showed 42.8 per cent and 30 per cent reduction at the polluted sites compared to control site. Total chlorophyll content of *Cynodon dactylon* at the residential, traffic and tannery area sites were 0.66, 0.42, and 0.37 mg/g . It exhibited 37per cent and 44 per cent reduction at the traffic and tannery sites as compared to residential area (Table 4).

Perusal of results revealed that there was reduction of chlorophyll 'a' and 'b', and total chlorophyll of all the tested plant species at the polluted sites as compared to control site.

Carotenoid :

The carotenoid content of all the six plant species have been ex hibited also in Table 4. Carotenoid content of *Azadiracta indica* at the residential, traffic and tannery sites were 4.4,2.65 and 12.2 mg/g, respectively. In this case, there was reduction of 40 per cent at the traffic site but enhancement of > 100 per cent recorded at the tannery site .Carotenoid of *Delonix regia* at the residential, traffic and tannery sites were 6.8,5.5, and 13.128 mg/g. A decrease of 19 per cent at the traffic site and 93 per cent increase at that tannery site were recorded at the polluted sites as compared to residential site. Carotenoid of *Moringa tinctoria* recorded at control site was 8.5 mg/g and 5.5,10.6 mg/g at the polluted sites, respectively. There was a reduction of 35 per cent at the traffic site but there was

Table 4 : Biochemical indicators of different species at different bioindicator stations

Name of the species	Sampling station	Site number	Total chlorophyll (mg/g)	%of variation	Carotenoid (mg/g)	%of variation
Azadiracta indica	Residential	S_1	0.85		4.4	
	Traffic	S_2	0.475	44.11	2.65	39.77
	Tannery	S_3	0.69	18.82	12.2	-177.2
Delonix regia	Residential	S_1	0.531		6.8	
	Traffic	S_2	0.384	27.68	5.5	19.11
	Tannery	S_3	0.76	-43.12	13.128	-93.07
Moringa tinctoria	Residential	S_1	0.948		8.5	
	Traffic	S_2	0.636	32.19	5.5	35.29
	Tannery	S_3	0.480	49.36	10.6	-24.70
Calotropis gigantea	Residential	S_1	0.674		6.6	
	Traffic	S_2	0.47	30.26	3.5	46.96
	Tannery	S_3	0.43	36.20	7.6	-15.15
Thyme rosemary	Residential	S_1	0.80		10.3	
	Traffic	S_2	0.458	42.75	8.5	17.47
	Tannery	S_3	0.56	30	5.4	47.57
Cynodon dactylon	Residential	S_1	0.66		3.58	
	Traffic	S_2	0.42	36.36	2.58	27.93
	Tannery	S_3	0.37	43.93	9.6	-168.15

Results are significant at 0.1% ($\rho<0.001$)

a increase of 25 per cent recorded at the tannery site. Carotenoid of *Calotropis gigantea* recorded 6.6,3.5 and 7.6 mg/g at all the three sampling sites. But, it showed a decrease of 47 per cent at the traffic site and increase of 15 per cent at the tannery site. Carotenoid of *Thyme rosemary* recorded 10.3,8.5 and 5.4 mg/g at the residential and at the polluted sites, respectively. In this case ,there was a reduction of 18 per cent and 48 per cent in the carotenoid content in the leaf samples from the polluted sites as compared to control site. Carotenoid content of *Cynodon dactylon* was reported as 3.58, 2.58 and 9.6 mg/g at control and polluted sites. There was a reduction of 28 per cent at the traffic site and an increase of >100 per cent at the tannery site. It was observed that carotenoid content was reduced at the traffic area but increased at the tannery area as compared to residential area (Table 4).

Highest decreases in chlorophyll 'a', 'b', total chlorophyll and carotenoid contents of the samples collected from polluted sites in comparison with control site was thus, recorded in all the tested plant species. The concentration of chlorophyll 'a', 'b', total chlorophyll and carotenoid were always found to be lower at polluted sites as compared to control site leaves of the same age. Chauhan and Joshi (2008), Rao and Leblanc (1996) and Sarala and Sabitha (2010), have also reported reduction in chlorophyll content brought by acidic pollutants like SO_2 which causes phaeophytin formation by acidification of chlorophyll. Reductions in chlorophyll content of a variety of plant species due to NO_2, SO_2 and O_3 exposure had also been reported by Agarawal *et al.* (2003),Sarala and Saravana Kumar (2011); Lerman *et al.* (1972) has suggested that continuous application of air pollutants clog the stomata, so interfering with gaseous exchange. The carotenoid content of some plant species were found to decrease in response to SO_2 (Pandey,1978; Singh and Rao,1983; Nandi,1984). Joshi and Swami (2007); Sarala and Saravana Kumar (2011) also reported the significant reduction in carotenoid content of different plants grown at polluted sites.

Variation of assimilating pigments of selected plant species at different bioindicator stations are given in Table 5 and Fig. 1, 2 and 3.

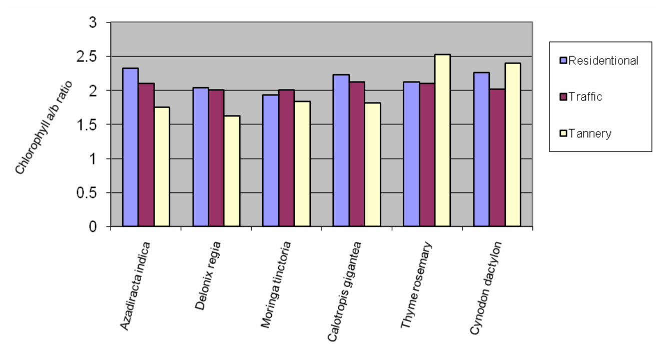

Fig. 1 : Variation of assimilating pigments of selected plant species at different bio indicator stations

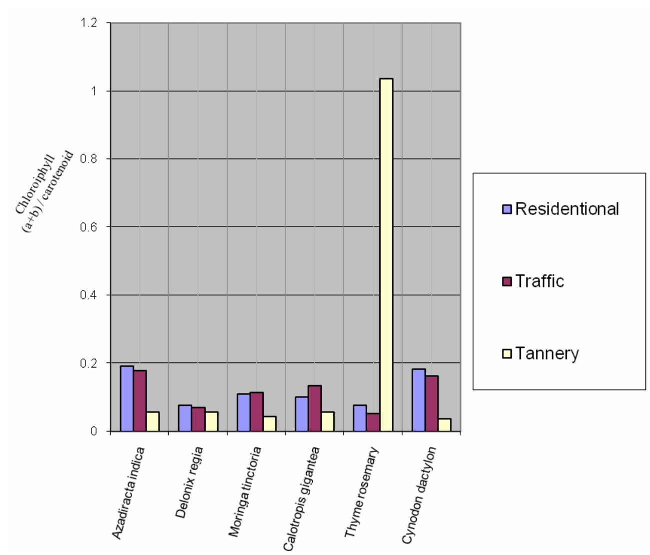

Fig. 2 : Variation of assimilating pigments of selected plant species at different bio indicator stations

Table 5 : Variation of assimilating pigments of selected plant species at different bio indicator stations

Plant species	Chlorophyll a/b ratio			Chlorophyll (a+b)/ Carotenoid			Chlorophyll (a+b) + Carotenoid		
	Residential site	Traffic site	Tannery site	Residential site	Traffic site	Tannery site	Residential site	Traffic site	Tannery site
Azadiracta indica	2.320	2.104	1.744	0.1931	0.1792	0.0565	5.25	3.125	12.89
Delonix regia	2.034	2.0	1.619	0.078	0.0698	0.05789	7.331	5.884	13.88
Moringa tinctoria	1.926	2.00	1.823	0.1115	0.1156	0.04528	9.448	6.136	11.08
Calotropis gigantea	2.224	2.117	1.814	0.1021	0.1342	0.0565	7.274	3.97	8.03
Thyme rosemary	2.117	2.094	2.522	0.0776	0.0538	1.037	11.1	8.958	5.96
Cynodon dactylon	2.257	2.018	2.394	0.184	0.162	0.0385	4.24	3.00	9.97

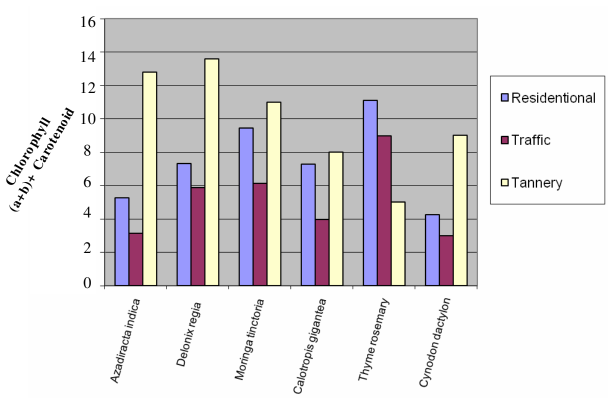

Fig. 3 : Variation of assimilating pigments of selected plant species at different bio indicator stations

The weight ratio of Chl. 'a' and Chl. 'b' (Chl a/b ratio) is an indicator of the functional pigment equipment and light adaptation of photosynthetic apparatus (Lichtenthaler *et al.*, 1981). *Azadiracta indica* has the chlorophyll a/b ratio of the residential, traffic and tannery area 2.320, 2.104 and 1.744, respectively and for *Delonix regia* it was recorded as 2.034,2.00 and 1.619, respectively.It is evident from the data that residential trees species have more chlorophyll a/b ratio compared to the trees species exposed to air pollution.Similarly *Moringa tinctoria* and *Calotropis gigantea* have more of chlorophyll a/b ratio (1.926 and 2.224) compared to the plant species exposed to tannery environment.The air pollutant from the tannery had impact on the chlorophyll ratio and hence have lesser value. But for herbs *Thyme rosemary*, *Cynodon dactylon* chlorophyll a/b ratio were found to be less in the residential compared to the plant species grown in near tannery area. Chlorophyll a+b/ carotenoid is an indicator of greens of plant. All the plant species showed the lower value of the ratio at all the three sampling sites . The ratio values of traffic and tannery area were very less compared to the residential area. The lower values of the ratio indicate the stress and the damage to the plants. Since the plants are exposed to the air pollutant chlorophyll a+b /carotenoid ratio decreased to a larger extent (Table 5 and Fig. 1, 2 and 3).

Conclusion :

The present study elucidates the changes in chlorophyll 'a', 'b', total chlorophyll and carotenoid pigments due to air pollutants from automobiles and tanneries. It is evident from the study that gaseous pollutant such as SO_2 and particulate pollutants such as SPM and RPM have the detrimental effects on the plant species. The vast changes in the biochemical parameters directly corresponded to the level of air pollutants at the selected sampling sites. The study also showed that the air pollutants emitted from automobiles and tannery adversely affecting the air quality status of the Dindigul Town and also the photosynthetic pigments of plant species. Air pollution from traffic and tannery have a significant defect on the photosynthetic pigment such as chlorophyll a, chlorophyll b and total carotenoid, chlorophyll a/b ratio, chlorophyll a+b/ carotenoid ratio being very less compared to the control area plant species. It clearly indicated that plant species were under stress and had damage due to air pollutant. Moreover, it should be noted that these toxic and poisonous air pollutants may also have adverse health impacts on human too.

Coopted Authors' :

V. PRATHIPA, Department of Chemistry, P.S.N.A.College of Engineering and Technology, DINDIGUL (T.N.) INDIA
E-mail: sptprathipa@gmail.com

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