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Effect of vehicular pollution on pigments of some road side trees at Raipur

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Abstract

The present study was undertaken to work out the impact of vehicular pollution on the pigment content of four plant species, namely *Cassia fistula, Eucalyptus citriodora, Ficus religiosa* and *Mangifera indica* growing along the road side of highways at Raipur. For study, leaf samples from different sites of the above referred species were collected and analyzed for chlorophyll a, b, and carotenoids content. Leaves were sampled from all the four directions and from almost equal heights of the plants. Primary air pollutants (SO_2, NO_x, SPM and RSPM) were also assessed at three different study sites. It was observed that chlorophyll 'a' and chlorophyll 'b' content varied from 0.98 mg/g to 1.72 mg/g and 0.54 mg/g to 1.10 mg/g respectively at the studied sites. Carotenoid content ranged from 1.02 mg/g to 1.62 mg/g at the study sites. Results clearly indicate that the pigment content is affected & reduce with the increase in air pollution.

Key words: Air pollutants, Carotenoid, Chlorophyll, Traffic load, Vehicular pollution.

Introduction

Urban pollutions have increased dramatically in India over the past few decades with consequent increases in number of vehicles and industries[1]. It is estimated that, in all the big cities in the country about a million tons of pollutants are being released into the atmosphere every day and out of which about 75% contribution is from automobiles[2]. Automobiles produce volatile organic compounds (VOC), suspended particulate matter (SPM), oxides of sulphur (SO_x), oxides of nitrogen ((NO_x) and carbon monoxide (CO), which have adverse effects on surrounding ecosystem. Recently, impact of vehicular emissions on roadsides herbs has been studied by Tiwari and Gupta[3] and on roadside trees by Gupta *et al*.,[4]. In the present study, effect of vehicular emissions has been worked out in case of selected road side trees at Raipur.

Table 1. Primary air pollutants recorded from selected sites during the study period (2011-2012)

Site	SO_2 (μg^{m-3})			NO_x (μg^{m-3})			SPM (μg^{m-3})			RSPM (μg^{m-3})		
	Winter	Monsoon	Summer	Winter	Monsoon	Summer	Winter	Monsoon	Summer	Winter	Monsoon	Summer
Site I	10.08	9.96	11.46	16.64	18.12	17.14	410.24	388.06	401.24	131.56	112.24	132.24
Site II	6.67	8.14	10.08	14.26	15.24	14.20	384.20	356.14	386.52	118.42	88.18	121.20
Site III	4.96	6.40	9.12	10.78	12.78	12.56	298.36	310.28	370.45	95.60	75.20	116.56

Where : RSPM = Respirable particulate matter, SPM = Suspended particulate matter
Site I = Mahasamudra, Site II = Razim, Site III = Arang

Table 2. Variation in the pigment content (mg/g) due to air pollutants in four species at three study sites of Raipur, (2011-12).

Pigment	Cassia fistula			Eucalyptus citriodora			Ficus religiosa			Mangifera indica		
	Site I	Site II	Site III	Site I	Site II	Site III	Site I	Site II	Site III	Site I	Site II	Site III
Chlorophyll 'a' (mg/g)	1.72 ±0.08	1.42 ±0.04	1.40 ±0.02	1.38 ±0.04	1.26 ±0.06	1.05 ±0.02	1.16 ±0.03	1.02 ±0.06	0.98 ±0.04	1.50 ±0.04	1.28 ±0.06	1.14 ±0.03
Chlorophyll 'b' (mg/g)	1.02 ±0.03	0.96 ±0.04	0.82 ±0.01	0.96 ±0.02	0.78 ±0.04	0.64 ±0.06	0.88 ±0.08	0.65 ±0.06	0.54 ±0.01	1.10 ±0.01	0.94 ±0.03	0.86 ±0.06
Total Chlorophyll (mg/g)	2.74 ±0.14	2.38 ±0.11	2.22 ±0.14	2.34 ±0.012	2.04 +0.08	1.69 ±0.12	2.04 ±0.12	1.67 ±0.14	1.52 ±0.08	2.60 ±0.02	2.22 ±0.04	2.00 ±0.03
Carotenoid (mg/g)	1.44 ±0.04	1.36 ±0.07	1.28 ±0.08	1.62 ±0.07	1.48 ±0.12	1.24 ±0.04	1.28 ±0.03	1.16 ±0.06	1.02 ±0.01	1.60 ±0.06	1.46 ±0.08	1.32 ±0.02

All the values are averages of three replicates.
± Standard Deviation

Materials and Methods

The assessment studies were conducted on *Cassia fistula, Eucalyptus citriodora, Ficus religiosa* and *Mangifera indica* during 2011-12. Three study sites were selected namely Mahasamundra (I), Razim (II) and Arang (III) at Raipur and the roadside dominant trees were examined. The concentration of chlorophyll a and b (mg/g^{-1} fresh leaf) were obtained using the formula given by Maclachlan and Zalik[5]. Carotenoid was determined by the method of Duxbury and Yentseh[6].

Before pigment estimation, air quality monitoring of gaseous pollutants viz. SO_x, NO_x, was carried out using the method of West and Gaeke[7] and Jacob and Hochheiser[8] respectively.

Results and Discussion

Variations in primary pollutant concentration are given in Table 1. The SO_2 concentration varied from 11.46 to 4.96 μg^{m-3}; NO_x, from 18.12 to 10.78 μg^{m-3}; SPM from 410.24 to 298.36 μg^{m-3} and RSPM from 132.24 to 75.20 μg^{m-3} respectively. Variations in pigment concentration of the selected tree species exposed to vehicular emissions are given in Table 2.

The concentration of Chlorophyll 'a' varied from 1.38 to 1.72 mg/g; 1.05 to 1.38 mg/g; 0.98 to 1.16 mg/g and 1.14 to 1.50 mg/g for *C. fistula, E.citriodora, F.religiosa* and *M. indica* respectively. Chlorophyll 'b' ranged from 0.82 to 1.02 mg/g; 0.64 to 0.96 mg/g; 0.54 to 0.88 mg/g and 0.96 to 1.10 mg/g respectively. The carotenoid content was found to vary from 1.28 to 1.44 mg/g; 1.24 to 16.2 mg/g; 1.02 to 1.28 mg/g and 1.32 to 1.60 mg/g for the three species respectively.

The chlorophyll 'a', chlorophyll 'b' and total chlorophyll content in the plants growing at polluted location has been found to decrease as also reported by Raina and Sharma[9]. Dusted or encrusted leaf surface is responsible for reduced photosynthesis and thereby causing reduction in chlorophyll content. Carotenoid protects chlorophyll from photoxidative destruction[10]. A decrease in chlorophyll has been used as an indicator of pollution injury[11]. Low NO_2 dose is also believed to be toxic or inhibitory to some plants[12]. Tomer and Parkash[13] reported that the exposure of SO_2 adversely affected the chlorophyll 'a', chlorophyll 'b' and seeds weight of *Brassica Camprestis*.

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