

GLOBAL JOURNAL OF ADVANCED ENGINEERING TECHNOLOGIES AND SCIENCES**RELATIVE ANALYSIS ON CHLOROPHYLL ESTIMATION IN RESPONSE TO AUTOMOBILE POLLUTION OF SELECTED WEED PLANT SPECIES AT DIFFERENT ROADSIDES IN MEERUT, U.P.****Shiv Kumari*, Ila Prakash**

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ABSTRACT

Air pollution is the presence in the outdoor atmosphere of one or more contaminants, such as dust, fumes, gas, mist, odour, smoke or vapors in quantities and for durations such as to be injurious to human, plant or animal life or property or to interfere unreasonably with the comfortable enjoyment of life and property. Chlorophyll is an important sensitive and reliable indicator to air pollution. For present study selected plant species such as *Cassia occidentalis L.*, *Cassia obtusifolia L.*, *Sida veronicaefolia* and *Abutilon indicum G. Don.*, at different roadsides (as University road, Delhi road, Railway road and Garh road). Reduction in chlorophyll contents were found to be depends on pollution concentration. An increase significant reduction was observed at highly polluted sites due to high concentration of automobile pollution. Chl a, Chl b and total Chl content were reduced. Due to much concentration of pollutants plants also showed chlorosis and necrosis on their leaf surface. Increasing order of polluted study sites: University Road < Railway road < Garh road < Delhi road.

KEYWORDS: Chlorophyll, Automobile pollution, Chlorosis and Necrosis.**INTRODUCTION**

During past few decades, rapid industrialization and urbanization, technological advancement, introduction of modern agricultural and transportation techniques, deforestation, and furthermore, proliferation of population have intensified the magnitude of environmental pollution. Pollution is known to be the introduction into the environment (air, water or land) of contaminants, the quantities, characteristics and duration of which are likely to be injurious to human, animal or plant life. The effects of air pollution on plants have been studied by many workers. The macroscopic effects include foliar injury, appearance of chronic spots on leaves, Chattopadhyay (1996), Rath *et al.* (1996), Fedorkov (1997), Saquib and Khan (1999). Coker (1967) reported that higher concentrations of SO₂ resulted in the breakdown of chlorophyll into phaeophytin and Mg⁺⁺ ions. Avadhani and Osmond (1970) and Sij and Swanson (1974), observed that the rate of photosynthesis is affected even before any reduction in chlorophyll is detected. Losses incurred in chlorophyll a were relatively higher than chlorophyll b in SO₂ exposed leaves of *Euphorbia hirta* (Gupta and Ghouse, 1987). Chapla and Kamalkar (2004) reported that ozone inhibit the production of necessary enzymes required for chlorophyll synthesis. Verma and Agarwal (2001), Goswami *et al.* (2002), Wagela *et al.*, (2002), Agarwal *et al.* (2003), Jeyakumar *et al.*, (2003), Joshi *et al.* (2004). Mandal (2006), Rajput and Agarwal (2004), Rani *et al.* (2006), Qayoommir, *et al.*, (2008) and Wath *et al.* (2006) was observed that plants along at roadside with heavy traffic and markets are affected by vehicular emissions. Which cause a significant decrease in total Chlorophyll. Similar findings were observed in *Oryza sativa* (Prakash *et al.*, 2008). Diwedi, Tripathi and Sashi (2008): observed effect of ambient air SO₂ on sulphate accumulation in plants.

MATERIALS AND METHODS

Fully mature fresh leaves were collected in morning hours from the selected plants at different study sites. For this purpose 100 mg of fresh leaf tissue was homogenized in 80% acetone with and a pinch of sodium bicarbonate. After centrifugation at 5000 rpm for 5 min., the supernatant was collected and the final volume was made up to 10 ml with acetone. The absorbance was measured at 663 nm and 645 nm on a systronic spectrophotometer using 80% acetone as blank. Chlorophyll a, b and total chlorophyll were calculated by using the following formulae: (Arnon, 1949).

$$\text{Chl a (mg/g f.wt)} = \frac{[12.7(A_{663}) - 2.69 (A_{645})] \times V}{1000 \times W}$$

$$\text{Chl b (mg/g f.wt)} = \frac{[22.9(A_{645}) - 4.68 (A_{663})] \times V}{1000 \times W}$$

$$\text{Total (mg/g f.wt)} = \frac{[22.2(A_{645}) + 8.02 (A_{663})] \times V}{1000 \times W}$$

Where, A = Absorbance at specific wavelength, V = Final volume (ml) of chlorophyll extract with 80% acetone, W = Weight (g) of leaf tissue. All the data were subjected to statistical analysis to find out Critical Difference at (CD) 5% and 1% level (Fisher 1951), is superscripted with single star (*) and double star (**) respectively.

OBSERVATION AND TABLES: CHANGES IN CHLOROPHYLL CONTENT

A reduction was observed in total Chl content in all the four plants at polluted sites and it was maximum at Delhi road. The decrease in the value of Chl a was found to be higher than Chl b. It was 36.353% at Delhi road and 29.074%, 28.601%, 7.945% followed by Garh road, Railway road and University road in plant *Cassia occidentalis*. Reduction in chl b was 38.250%, 17.659%, 12.344% and 4.022% at Delhi road followed by Garh road, Railway road and University road in *Cassia occidentalis* and reduction in total chl was 39.974%, 23.331%, 21.215% and 4.360% at Delhi road, Garh road, Railway road University road respectively (fig.1). Reduction percentage in chl a in *Cassia obtusifolia* was 80.053%, 35.202%, 11.733%, 4.937% and chl b was 79.710%, 33.776%, 9.445%, 8.665% and total chl was 74.308%, 33.047%, 6.284% and 5.944% followed by Delhi road, Garh road, Railway Road and University road (Fig.2). In plant *Sida veronicaefolia* the reduction percentage in chl a was 52.918%, 41.664%, 18.985%, 1.731% and chl b was 42.469%, 19.814%, 10.621%, 4.060% and reduction in total chl was found 45.952%, 41.103%, 23.827%, 2.559% at Delhi road followed by Garh road, Railway road, University road (Fig.3). Plant *Abutilon indicum* also showed reduction in chl a, chl b and total chl. It was 26.420%, 22.190%, 18.555%, 11.829% and chl b was 24.496%, 16.610%, 14.239%, 13.516% and total chl content was 25.832%, 21.791%, 20.432%, 16.140% at Delhi road, Garh road, railway road, and University road respectively (fig.4).

DISCUSSION

Chlorophyll content of plants signifies its photosynthetic activity as well as the growth and development of biomass. It is well evident that Chlorophyll content of plant varies from species to species age of leaf and also with the pollution level as well as with other biotic and abiotic conditions. Degradation of photosynthetic pigment has been widely used as an indication of air pollution (Ninave *et al.*, 2001). Maximum reduction in pigment concentrations was observed at Delhi road. Much reduction in chl a and chl b was observed in *Cassia obtusifolia* 80.0% and 79.7 % chlorophyll b respectively followed by *Cassia obtusifolia*, *Sida veronicaefolia*, *Cassia occidentalis* and *Abutilon indicum*. Reduction in total chlorophyll was also maximum in *Cassia obtusifolia*. It was 74.3% in *Cassia obtusifolia* at Delhi road. Air pollutants are known to cause reduction in Chlorophyll pigments (Katz and Shore; 1955, Agrawal *et al.*, 1991). Present study revealed that chlorophyll content in all plants varies with the pollution status of the area i.e higher the pollution level in the form of vehicular exhausts lower the chlorophyll content. It also varies with the tolerance as well as the sensitivity of the plants i.e. higher the sensitive nature of the plants lower the chlorophyll content. Tripathi and Gautam (2007) also suggest that high levels of automobile pollution decreases chlorophyll content in higher plants near roadsides. Significant decrease in total Chl a and protein was observed with reduced leaf area (Wath *et al.*, 2006; Moh. Kuddus and P.W. Ramteke, 2011; Yogesh and Devi Prasad 2014; Bisht *et al* 2016). Different weed plants growing under the impact of auto exhaust pollution suffered damage in form of reduced growth and foliar injury in the form of chlorosis, necrosis. Due to chlorophyll loss all plants also showed visible chlorosis and necrosis spots on leaf surface. This was also in sensitivity or tolerance order i.e. much chlorosis necrosis with the much loss of chlorophyll contents. In all plant species reduction percentage was found to be higher at Delhi road. It concluded that due to higher concentration of pollutants on roadsides, plants showed reduction in Chl a, Chl b and total Chlorophyll content. Plant *Abutilon indicum* and *Cassia occidentalis* was relatively tolerant as compared to *Sida veronicaefolia* and *Cassia obtusifolia*. The site wise reduction in chlorophyll value was Delhi road > Garh road > Railway road > University road > Control.

Sensitivity order in study plants: *Cassia obtusifolia* > *Sida veronicaefolia* > *Cassia occidentalis* > *Abutilon indicum* and less sensitive but tolerant and the order of tolerance: *Abutilon indicum* > *Cassia occidentalis* > *Sida veronicaefolia* > *Cassia obtusifolia*.

It can be concluded that chlorophyll pigments are significant in understanding the plant-environment interactions. Therefore, these aspects can be used as bio indicators for air pollution monitoring. Comparison in all plant species also provides the information about air pollution tolerant plant species which can be selected for development of green belt and air pollution control in road sites and highways.

ACKNOWLEDGEMENT

The author is thankful to centre for the study of D. N. College laboratory, Meerut, U.P. India to providing me all the facilities for experimental work. Author is also thankful to **supervisor Dr. (Smt.) Ila Prakash, Head, Department of Botany, D. N. College, Meerut** who guided and motivated me to carry out my work with full interest and enthusiasm.

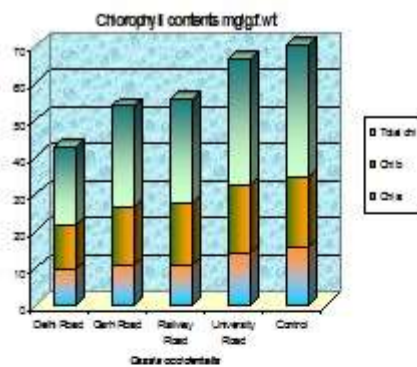


Fig:1

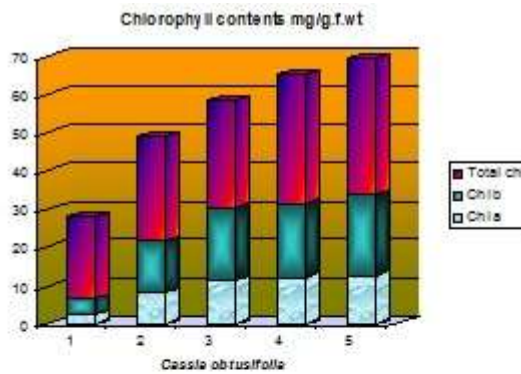


Fig:2

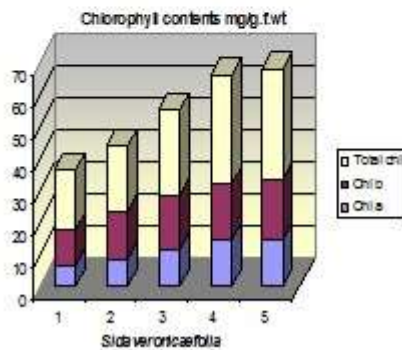


Fig:3

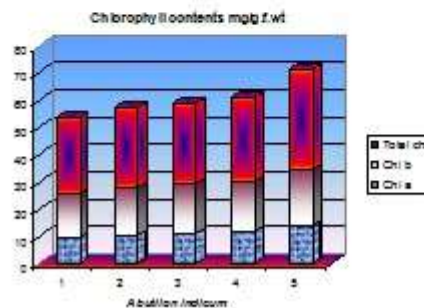


Fig:4



Plate 20: Chlorotic and necrotic spots visible in the leaves of *Cassia obtusifolia* in response to automobile pollution.



Plate 18: Chlorotic and necrotic spots visible in the leaves of *Cassia occidentalis* in response to automobile pollution.

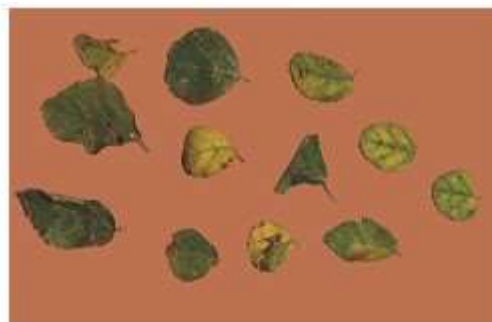


Plate 21: Chlorotic and necrotic spots visible in the leaves of *Sida veronicaefolia* in response to automobile pollution.



Plate 19: Chlorotic and necrotic spots visible in the leaves of *Cassia occidentalis* in response to automobile pollution.



Plate 22: Chlorotic and necrotic spots visible in the leaves of *Abutilon indicum* in response to automobile pollution.

Table. 1 Chlorophyll a (mg/g/f/wt) in different plant species at different study site in Meerut city.

Chlorophyll a (mg/g.f.wt)	Different Study Sites						
	Control	Delhi Road	Garh Road	Railway Road	University Road	CD5%	CD1%
<i>Cassia occidentalis</i>	15.5038 ± 1.1528	9.8677* ± 4.4675	10.9962* ± 5.6898	11.0695* ± 6.0363	14.272 ± 1.2905	3.366	8.023
<i>Cassia obtusifolia</i>	12.7376 ± 0.2263	2.5407** ± 1.3437	8.2537** ± 3.2277	11.2430* ± 0.8657	12.1087 ± 0.8657	0.660	1.575
<i>Sida veronicaefolia</i>	14.5235 ± 1.7145	6.8379* ± 1.4196	8.4723* ± 5.6867	11.7662 ± 4.3068	14.272 ± 1.2905	5.006	11.932
<i>Abutilon indicum</i>	13.7558 ± 10.3677	10.1215 ± 4.0663	10.7033 ± 3.1351	11.2033 ± 3.7124	12.1285 ± 3.2117	30.273	72.159

Values are mean ± Standard Error. Values are statistically significant at * <CD5% and ** <CD1%

Table. 2. Chlorophyll b (mg / g / f / wt) in different plant species at different study site in Meerut city.

Chlorophyll b	Different Study Sites						
	Control	Delhi Road	Garh Road	Railway Road	University Road	CD 5%	CD 1%

<i>Cassia occidentalis</i>	18.9860 ± 0.4510	11.7237* ± 2.8477	15.6332** ± 2.0244	16.6423* ± 1.9260	18.2223 ± 1.6125	1.316	3.318
<i>Cassia obtusifolia</i>	21.2307 ± 2.0287	4.3075** ± 0.9001	13.6351* ± 3.4181	19.2254 ± 0.1656	19.391 0.1656	5.923	14.119
<i>Sida veronicaefolia</i>	18.9936 ± 1.2833	10.9303** ± 5.6260	15.2301* ± 2.8898	16.9762 ± 1.4607	18.2223 ± 1.6125	3.747	8.931
<i>Abutilon indicum</i>	21.0840 ± 4.9536	15.9191 ± 1.3035	17.5818 ± 1.0064	18.0818 ± 0.429	18.2341 ± 0.4340	14.464	34.477

Table. 3 Total chlorophyll content (mg/g/f/wt) in different plant species at different study site in Meerut city.

Total chlorophyll content (mg/g.f.wt)	Different Study Sites						
	Control	Delhi Road	Garh Road	Railway Road	University Road	CD 5%	CD 1%
<i>Cassia occidentalis</i>	35.4676 ± 0.4395	21.2897** ± 9.4560	27.1923** ± 5.0617	27.9430** ± 6.3667	33.9211 ± 2.25180	1.283	3.058
<i>Cassia obtusifolia</i>	34.4475 ± 2.9295	8.8501 ± 0.5823	23.0633 ± 6.1206	32.2827 ± 1.0158	32.3985 0.9449	8.554	20.389
<i>Sida veronicaefolia</i>	34.8122 ± 1.9344	18.8150** ± 1.350	20.5032** ± 0.3943	26.5173* ± 9.9589	33.9211 ± 2.2518	5.648	13.463
<i>Abutilon indicum</i>	36.7954 ± 15.5005	27.2904 ± 5.4601	28.7770 ± 2.7044	29.2770 ± 3.2817	30.8564 ± 3.9195	45.261	107.883

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