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Asian Journal of Plant Science and Research, 2015, 5(1):1-3

ISSN : 2249-7412
CODEN (USA): AJPSKY

A study on the effect of cement dust pollution on certain physical and biological parameters of *Sessamum indicum* plant

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ABSTRACT

Ariyalur, known as cement city is surrounded by cement factories and limestone mines. These act as the sources of dust and particulates in and around the living place. To know about the extent of dust pollution, a common plant sessamum indicum was found to be one of the plants which are higher in number. The chlorophyll a, Chlorophyll b, total chlorophyll, and carotenoid content of the leaves have found to decrease in the leaves of the plant grown in areas exposed to dust when compared with control plant, grown in unpolluted areas. Similarly the other components such as calcium, sodium, manganese magnesium, zinc got increased in the affected plant sessamum indicum. Certain parameters such as alkaloids, flavonoids, tannin, and lignin have got decreased in its quantity in case of affected plant sessamum indicum. It is clear that the cement dust affect certain biochemical components.

Key words: Cement dust, chlorophyll, *Sessamum indicum*, carotenoid.

INTRODUCTION

Cement industry caused environmental pollution problems, and the pollutants of the cement industry produced the undesirable impact on air water and land. Cement industry is the one of the 17 most pollutant industries listed by central pollution control board. During the last decades the emission of dust from cement factories has been increased alarmingly due to expansion of more cement plant to meet the requirement of cement materials for construction of building.

Ariyalur is known for limestone bed rocks of cretaceous period (Chadrasekaran and Ramkumar, 1994). The raw material for the cement production, limestone, is the locality of TANCEM ariyalur which covers an area of 2325 sq.km (Edwin Chandrasekaran 1995; Chandrasekaran *et al*., 1995).

Fly ash comprises divided particles of ash entrained in flue gases arising from combustion of coal. The size of fly ash particles may vary from 0.02µ m to over 300µm. it contains incompletely burned coal and the carbon content of fly ash may vary from 5 to 20%, though some samples may contain as high as 50%.also a large number of minerals, originally present in the coal, may also occur in fly-ash (Thangarasu, 2002).

Increasing concentration of cement dust pollutant causes in visible injuries like progressive decline in physiological process such as photosynthetic ability and respiration rate of leaves. Hence, the present investigation was undertaken to study the effect of structural and functional aspects of selected crop plant *Sessamum indicum* in the field condition under natural exposure to Cement dust pollution. In the field condition under natural exposure to Cement dust pollution.

MATERIALS AND METHODS

The TANCEM Cement industry is located at Ariylaur district, Tamil Nadu and situated 250 km south east of madras and 65 km north east of Trichy.

The chlorophyll is the essential components for photosynthesis, and occurs in chloroplasts as green pigments in all photosynthetic plant tissues. They are bound loosely to proteins but are readily extracted in organic solvents such as acetone and ether. Chemically, each chlorophyll molecule contains a porphyrin (tetrapyrol) nucleus with a chelated magnesium atom at the centre and a long chain hydrocarbon (phytyl) side chain attached through a carboxylic acid group. The study area was confined around the cement factory.

Estimation of Chlorophyll

The plant *Sessamum indicum* selected for field study. The plants samples were collected from 0.5, 1.0 and 2.0 km distance from cement factory. Control site was selected 15 km away from cement factory. The plant samples of all the three species were collected from both control and polluted site. PIAEE (2013) methodology was used to estimate the chlorophyll contents. The photo synthetic pigment were extracted from leaves in 80% acetone and centrifuged at 3000 RPM for 15 minutes to remove the debris. The volume of clear extract was made up to 100 ml by the addition of 80% acetone and its absorbance at 645 and 663 nm measured with a spectrophotometer.

Chlorophyll a and b were determined using the formulae given by Arnon, 1949. The total Chlorophyll content was obtained by addition chlorophyll a and b values.

Some calculations were listed as follows:

mg chlorophyll a /g tissue = 12.7 (A663) – 2.69 (A645) × 1000 × W / V

mg chlorophyll b /g tissue = 22.9 (A645) – 4.68 (A663) × 1000 × W / V

and

mg chlorophyll/g tissue = 20.2 (A645) + 8.02 (A663) × 1000 × W / V

where A = Absorbance at specific wavelengths,

V = Final volume of chlorophyll extract in 80 % acetone, and

W = Fresh weight of tissue extracted.

Phyto chemical analysis was determined followed by Indian Pharmacopeia (1966).

RESULTS AND DISCUSSION

The TANCEM Cement industry is located at Ariylaur District, Tamil Nadu and situated 250 km. South East of Madras and 65 km. North East of Trichy. Ariyalur is known for limestone bed rocks of cretaceous period (Chadrasekaran and Ramkumar, 1994). The raw material for the cement production, limestone, is the locality of TANCEM ariyalur which covers an area of 2325 sq.km (Edwin Chandrasekaran 1995; Chandrasekaran *et al*., 1995).

The tolerant crop selected among the plants growing in the cement dust affected area is *sessamum indicum*. The chlorophyll a, chlorophyll b, total chlorophyll and carotenoid leavels of the sampled plants were estimated and the results are tabulated in (table - 1). The amount of total chlorophyll in affected leaves was 4.9996 mg/g and that of control leaves was 5.7220 mg/g.

Similarly in the various biochemical components of the control and affected leaves of *sessamum* indicum was tabulated (Table-2). Marked change is seen in the total phosphorus, total alkaoids & tannin content. A marked increase is seen in the content of total calcium, sodium, zinc & copper content.

A similar conversion of chlorophyll to phaeophytin can occur with acids where Mg^{++} in the chlorophyll molecule is replaced by two atoms of hydrogen, thereby changing the light spectrum characteristics of chlorophylls (Rao, 1971). A considerable loss in total chlorophyll in the leaves of plants exposed in severe air pollution supports the argument that the chloroplast is the primary site of attack by air pollutants which make their entrance into the tissues through the stomata and cause partial denaturation of the chloroplast and decreases pigment content in the cells of polluted leaves.

The reduced photosynthetic potential of dusted plants as affected by decreased absorption of light (Peirce, 1910; Czaja, 1962), internal damage to leaf tissue (Rehman and Mohamed, 2012; Sadhana et al. 2013), interruption in CO2 exchange (Czaja, 1962; Darley, 1966), reduced photo synthetic area.

Similarly certain parameters such as alkaloids, flavonoids, tannin, lignin have got decreased in its quantity in case of affected plants. Thus the effect of cement dust on one of the commonest plant *Sessamum indicum* has been studied. It is clear that the cement dust affacts certain biochemical components.

Table -1. Chlorophyll Estimation of *Sessamum indicum* in the study area

samples	Chlorophyll a (mg/g)	Chlorophyll b (mg/g)	Total Chlorophyll (mg/g)	Cartenoids (g/lit)
Control leaf	1.901±0.024	3.821±0.146	5.722±0.170	2.3262±0.124
leaf sample 1 Area (0.5 km.)	1.624±0.047	2.965±0.147	4.589±0.194	2.146±0.014
leaf sample 2 Area 1(1.0 km.)	1.586±0.245	2.854±0.457	4.440±0.702	2.204±0.245
leaf sample 3 Area 1(2.0 km.)	1.318 ±0.148	3.681±0.425	4.999±0.573	2.211±0.145

Table -2. Biochemical analysis of *Sessamum indicum* in the study area

SI.NO	Name of the parameter	SAMPLE DETAAILS *Sessamum indicum*	
		affected	control
1.	Ash (%)	2.08	2.19
2.	Organic carbon (%)	3.19	2.18
3.	Total nitrogen (%)	0.89	0.87
4.	Total phosphorus (%)	0.25	0.37
5.	Total potassium (%)	2.79	2.54
6.	Total sodium (%)	0.12	0.09
7.	Total calcium (%)	3.42	3.01
8.	Total magnessium (%)	1.92	1.61
9.	Total sulphur (%)	0.12	0.15
10.	Total zinc (ppm)	2.79	2.48
11.	Total copper (ppm)	0.19	0.16
12.	Total iron (ppm)	16.78	19.49
13.	Total manganese (ppm)	4.29	4.19
14.	Total boron (ppm)	0.06	0.04
15.	Total molybenu (ppm)	0.02	0.02
16.	Total alkaloids (mg kg $^{-1}$)	0.58	0.64
17.	Total flavonoids (mg kg $^{-1}$)	0.15	0.19
18.	Tannin (mg kg $^{-1}$)	0.29	0.34
19.	Lignin (mg kg $^{-1}$)	0.15	0.19
20.	Glycosids (mg kg $^{-1}$)	0.09	0.09
21.	Serpentines (mg kg $^{-1}$)	0.06	0.06

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