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EFFECT OF CEMENT DUST POLLUTION ON CERTAIN PHYSICAL AND BIOCHEMICAL PARAMETERS OF CASTOR PLANT (*Ricinus communis*)

P. Premalatha[*1], C. Sivasubramanian[1], P Satheeshkumar[1], M. Jeganathan[2] and M. Balakumari[2]

[1]*Department of Environmental and Herbal Science, Tamil University, Thanjavur - 613 010, Tamil Nadu, India.*
[2]*Designed Environment Academy and Research Institute, Trichy - 621 213, Tamilnadu, India.*
E.mail: jegann1978@gmail.com

Abstract

Cement kiln dust is one of the sources of air pollution in our country and as a consequence the people living in and around such kilns suffer from chronic bronchitis, asthma, emphysema, headache and even lung cancer. Cement kiln dust released to the environment along with smoke contains many particulate, gaseous and liquid pollutants which act as potential cytotoxic and mutagenic agents causing chromosomal damage leading to the formation of various types of chromosomal abnormalitities. Cement kiln dust is a serious air pollutant and several researches have been carried out to study the effect of cement kiln on crop yield, morphological, anatomical, biochemical and reproductive changes in various plants.

Key words: Cement klin dust, Pollution, Castor plant, Physical parameters and Biochemical parameters.

1. Introduction

Ariylaur is considered as one of the important places in Tamilnadu since, it is a major centre for cement production. There are many limestone mines and many cement factories located in and around Ariyalur, right from British Rule. It may be recalled that the area near Ariyalur, witnessed an unusual phenomenon of increasing of the sea about 120 million years ago. The un wanted area extending over one lakh hectores comprised, what is the presently called, Jayakondam, Andimadam, Karai, Kolakkanatham, Dalmiapuram, Sathanur, Kunnam, Utathur, Ariyalur and Keezhapalur villages, Inexplicably the sea, withdrew from the area after 40 million years ago. The billions of shells of sea animals such as oysters, mollusks clams and branchiopods formed the mightily sedimentary limestone rocks in the area, which are the basic raw materials for the giant cement plants in the religion.

These limestone deposits and fossils embedded in successive layers of rocks were to paleontologists like the printed pages of Nature's own book of the history of the earth. While the fleshy parts of the buried marine creatures rot away quickly, the hard part, such as the bones and shells remain for years without suffering much damage, the pores and empty spaces are partially or totally impregnated with mineral deposits from the seeping sea water and in course of time, these structures has got hardened to form fossils. These fossils are now protected under the core of the Geological survey. Preliminary steps were also being taken to establish a fossil museum in Ariyalur besides creating an area in the mines to give students, researchers, and Tourists a clean

Corresponding author*: **P. Premalatha
E-mail: jegann1978@gmail.com
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idea of the formation of sedimentary limestone in the area and also of fossils.

Land of Fossils

Ariyalur district administration is taking positive steps to establish a fossil, museum in Ariyalur region considered to be the land of fossil. The recent identification of fossil obtained in the region religion was about 15 years ago, which was identified as a dinosaur's egg.

Location

Ariyalur is located 250 kilometers South West of Chennai and 60 kilometers from Trichy towards northeast.

Population

The population of Ariyalur is about 5 lakhs.

Weather

In day the temperature ranges between 30^{o} C to 38^{o}C during summer and winter day the temperature ranges between 20^{o}C to 27^{o}C. Rain fall per year in 807 mm.

Area

Ariyalur covers about 2 lakhs hectares of Tamilnadu.

Altitude

Ariyalur is 900 meters above the sea level. This work is important because, this work can also be attended to study the ambient air quality in ariyalur area. This work can also be attended to study the atmospheric pollution to effect on plants in and around Ariyalur.

2. Materials and Method

Plant Materials

Ricinus communis growing around the TANCEM cement plant Ariyalur, are constantly subjected to the deposition of cement kiln exhausts. The control plants are situated on the relatively unpolluted area.

Estimation of Chlorophyll

Arnon methodology was used to estimate the chlorophyll contents (Arnon 1949). Leaf tissue weighing 200 mg of the controlled and affected leaves was homogenized in 80% pre chilled acetone in diffused light using a mortar & pestle. The pellet was homogenized once again in acetone and centrifuged the process was repeated until the pellet turned non-green. The supernatants were pooled and the volume was measured, and the absorption at 663 nm and 645 nm were read on a spectrophotometer. The amount of chlorophyll was calculated. The amount of chlorophyll present in the leaf extract in mg chlorophyll per g tissue was calculated using following equations.

mg chlorophyll a/g tissue = 12.7 (A_{663})-2.69 (A_{645}) x V/(1000 x w)

mg chlorophyll b/g tissue = 22.9 (A_{645})-4.68(A_{663}) x V/(1000xw)

mg chlorophyll total time = 20.2 (A_{645})+8.02(A_{663})x V/(1000xw)

Where,

A = Absorbance at specific wave lengths

V = Final volume of chlorophyll extract in 80% acetone

w = fresh weight of the tissue extracted.

Carotenoid analysis

The total carotenoid content was also measured from the previous extractions of chlorophylls at 473 nm using an extinction co efficient value of 2500 as an average value. (Goodwin, 1954)

(OD645) – (0.114) (OD663) – (0.638)

Glassware & Chemicals

Borosil glassware were given a through detergent wash, followed by acid wash and were rinsed in Double Deionized water (DDW) (or) RO water. After over drying they were used. Sterile, Double Deionized water (DDW) was used for preparing all the reagents.

3. Result and Discussion

The meterological parameters required by Gaussian air quality models are hourly estimates of wind speed, wind direction, ambient temperature, and rain fall. The temporal of weather and the corresponding short-term changes in meterology are the single largest factor in controlling changes in the magnitude and distribution of air quality condition. In order to forecast air quality and develop effective emission control and personal protection strategies, it is critical that the meterological aspects of transport, diffusion, deposition and radioactive transfer be effectively characterized and subsequently predicted.

The analysis of the crops in response to foliar injury, plant, height, number of leaves, leaf area, were carried out and leaf injury percentage were calculated. The Arial parts of the crops in the field at 2 km distance from the cement plant were completely covered by a more or less continuous crust of cement dust and hence these crops seem to be grayish white in appearance. Frequent small quantities of precipitation have resulted in partial visible leaf injuries (Chlorosis and necrosis) due to by the alkaline dust.

The tolerant crop selected among the plants growing in the cement dust affected area is *Riccinus communis*.

Table – 1: Meteorological conditions of Ariyalur, in the vicinity of a cement plant associated with wind - rose during - January 2014 - December 2014

Month (2014)	Temperature		Rainfall (24 hrs) (mm)	Rainy Days (24hrs) (mm)	Relative humidity		Average wind speed (24hrs)		Predominant wind direction	
	Max ^{o}C	Min ^{o}C			08.30 hrs (%)	17.30 hrs (%)	AM (kmh^{-1})	PM (kmh^{-1})	AM	PM
January 31days	27.06	26.81	Nil	Nil	91.00	72.88	16.74	15.31	NE	NE
February 28days	39.61	32.14	3.18	5	89.81	64.57	14.17	21.61	ENE	ENE
March 31days	36.67	27.59	Nil	Nil	79.12	56.97	19.67	18.19	NE	NE
April 30days	38.86	31.64	Nil	Nil	75.61	58.17	12.06	20.78	ENE	ENE
May 31days	39.61	28.87	2.87	4	73.63	64.58	20.69	21.70	WSW	WSW
June 30days	39.83	33.00	3.50	4	69.31	54.78	29.71	21.83	W	W
July 31days	37.69	28.41	0.65	3	70.53	65.00	29.84	30.63	W	WNW
August 31 days	36.59	28.87	1.26	3	86.14	75.60	20.17	18.47	W	W
September 30days	35.17	26.00	5.13	7	82.19	79.37	23.51	17.42	WNW	WNW
October31days	33.61	29.33	4.53	11	86.19	80.11	15.61	14.10	WNW	WSW
November 30days	32.11	28.11	1.75	7	92.00	84.20	13.26	11.00	ENE	NE
December 31days	28.11	29.19	0.35	2	86.00	81.81	11.49	12.68	NE	ENE

Values are mean of total number of days of a month.

Table – 2: Chlorophyll estimation

Samples	Chlorophyll a (mg/g)	Chlorophyll b (mg/g)	Total Chlorophyll (mg/g)	Carotenoids (g/lit)
Control leaf	1.9113	3.6512	5.5604	2.4137
Affected leaf	1.9125	3.1753	5.0860	2.0596

The chlorophyll a, chlorophyll b, total chlorophyll and caroknoid levels of the sampled plants were estimated and the results are tabulated in Table - 2. The amount of total chlorophyll in affected levels was 5.08 mg/g and that of control leaves was 5.56 mg/g. Similarly in Table – 3, the various biochemical components of the control and affected leaves of *Ricinus communis* was tabulated. Marked change is seen in the total phosphorus, total sulphur, total alkaloids & tannin content. An marked increase is seen in the content of total calcium, sodium, zinc & copper content.

Table – 3: Biochemical analysis of control & affected leaves

S. No.	Name of the parameter	Sample details	
		Ricinus communis	
		Effected	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	0.31
5.	Total Potassium (%)	2.79	2.54
6.	Total Sodium (%)	0.12	0.09
7.	Total Calcium (%)	3.15	2.98
8.	Total Magnesium (%)	1.89	1.57
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 Molybenum (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.	Glycosides (mg kg^{-1})	0.09	0.09
21	Serpentines (mg kg^{-1})	0.06	0.06
22.	Heavy Metals	Nil	Nil

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 0.02 μm to over 300 μm. 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).

Cement manufacturing industries have found to contribute substantially to the air pollution problem as point source of emission. Fallout of cement factory emission is determined by several factors. Such as variations in cement manufacturing process, efficiency of emission control devices, and meteorological and topographical conditions, vegetation and soil are also important sinks for air borne pollutants. In India, high dust fall rates around cement factories have been reported by several workers (Agarwal, 1997). On comparing the biochemical compounds of the leaf material of *Riccinus communis* grown in control & affected area, it is very clear that the chlorophyll content a, b, total chlorophyll & carotenoid content have got reduced due to the deposition of the particulate matter emitted from the cement plant.

4. Conclusion

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 *Ricinus communis* was found to be one of the plant which is higher in number. The chlorophyll a, chlorophyll b, total chlorophyll & 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. Certain parameters such as alkaloids, flavonoids, tannin, lignin have got decreased in its quantity in case of affected plant. Thus, the effect of the cement dust on one of the commonest plant *Ricinus communis* has been studied. It is clear that the cement dust affects certain biochemical components and physical characteristics of shoot length, root length, leaf area and yield of the plant.

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