Impact of Cement Dust Deposition on Vegetation around Birla Cement factory, Satna, Madhaya Pradesh.

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ABSTRACT
Air pollution is an additional stress on plants since they often respond to atmospheric contamination in the same way as they respond to drought and other environment stress. Effect of cement dust pollution on the plant species including Glycine max and *Cicer arietinum* was studied for one year time period (April- October 2022) around Birla Cement factory in Satna Madhaya Pradhesh. The parameter Cholophyll a was analyzed showed a remarkable increase as the distance from the pollution source increased. The pH of leaf wash of plants in the vicinity of factory was strongly alkaline as compared to the plants growing at the reference site. The dust deposition (mg/cm2) on the leaves of all plant species was highest near the factory where as the dust load on leaves of plant species growing at the reference site was almost negligible.

Key words: Cement dust pollution, Glycine max , dust deposition, total chlorophyll etc

INTRODUCTION
Pollution of the environment is one of the major effects of human technological advancement. It results when a change in the environment harmfully affects the quality of human life including effects on animals, microorganisms and plants as well as soil ecosystem (Marinescu et al., 2010). Most of Indian cities are affecting with the presence of high concentrations of gaseous and particulate pollutants due to industrialization, badly maintained poor roads, poor maintenance of vehicles, use of fuels with poor environmental performance and lack of awareness (Joshi and Chauhan, 2008). Rapid industrialization and addition of the toxic substances to the environment are responsible for altering the ecosystem (Sarala Thambavani and Saravanakumar, 2011; 2012). The Cement industry plays a vital role in the imbalances of the environment and produces air pollution hazards (Stern, 1976; Sarala Thambavani and Saravanakumar, 2011). Industries are emitting toxic substances which adversely affect man's food supply by polluting nearby growing plants. One of the most studies of these stresses is dust accumulation, which provokes severe damage in the photosynthetic apparatus (Santosh and Tripathi, 2008). Plants provide an enormous leaf area for impingement, absorption and accumulation of air pollutants to reduce the pollution level in the air environment (Escobedo et al., 2008). Removal of pollutants by plant from air by three processes, namely deposition of particulates, absorption by leaves and aerosols over leaf surface (Prajapati and Tripathi, 2008). Cement dust is a mixture of Ca, K, Si and Na which often include heavy metals like As, Al, Cd, Pb, Zn, Fe, and Cr. Majority of these elements in excess amounts are potentially harmful to the biotic and abiotic components of the environment (Gbadebe and Bankole, 2007). The objective of the present study was to analyse the effects of dust pollutants on chlorophyll ‘a’, ‘b’, total chlorophyll, pheophytin „a‟, „b‟, total Pheophytin, carotenoid, dust content, leaf wash pH of selected plant species around Birla cement factory, one of the leading cement factory in Satna, with a daily production of 1200 tons. Plants around the cement factory were selected for bio-physical analysis. Also, plants from pollution free site were taken as reference for comparison.

MATERIAL AND METHODS Satna city
The Satna district lies in the central part of the state of Madhya Pradesh, covering an area of 6287.45 Sq Km. (As per Statistical Book) It lies between North latitude 24°16'30" and 25°11'15" and east longitude 81°03'15" and 82°18'45". It is located in the north-eastern comer of the State, and bounded by Rewa district in the West, Sidhi district in the South & the State of Uttar Pradesh in the North & East. The two dominant available cultivated plant species including Glycine max and *Cicer arietinum* were selected at four different locations (distance wise) from a cement factory in the studying area. Locations (1, 2, 3 and 4) were about 0 km, 1 km, 2 km and 10 km from the factory respectively in the below mentioned table 1. Selected plant species were collected randomly from the four locations covering the study area from April-October 2022

Table 1

S/NO.	Sampling site	Location from Cement production unit	Category
1	Site-1	0 km	Most Polluted area
2	Site-2	1 km	Polluted area
3	Site-3	2 km	Polluted area
4	Site-4	10 km	Reference area

The studies were conducted on Glycine max and *Cicer arietinum* plants growing under natural conditions. The leaves were carefully removed and collected from the plants at all sites, using a snapper blade. The dust deposition on leaf surface was calculated by dry technique recommended by Das and Patanayak (1977). The leaf wash pH was determined following Pawar et al, (1988). Chlorophyll was extracted in 80% acetone and estimated according to the method of Strain et al. (1971), Vernon (1960) and Duxbury and Yentesch (1956) respectively using ELICO SL-171 spectrophotometer. Photosynthetic Pigments were extracted in 80% acetone. 2 ml of 10% plant leaf homogenate was mixed with 8 ml of acetone in 10 ml volumetric flask. After shaking the material was well transferred in centrifuge tubes and centrifuged at 10,000 rpm for 10 minutes at 4^o C. The colour intensity of supernatant was measured at different wavelengths like 480nm, 510nm, 649nm, 655nm, 665 nm and 666nm. Using the absorption coefficient, the amount of pigment was calculated. Chlorophyll content was measured according to the following equation (Strain et al, 1971) Chlorophyll a (µg/ml) = 11.63 × A665 – 2.39 × A649 Chlorophyll b (µg/ml) =20. 11 × A649
– 5.18 × A665 Total Chlorophyll (µg/ml) =6.45× A665+ 17.72× A649

RESULTS AND DISCUSSION

Chlorophyll is an index of productivity of plant (Raza & Murthy, 1988). The chlorophyll pigments are essential component for photosynthesis which occur in chloroplast as green pigment in all photosynthetic plant tissue and are called as photoreceptors; hence any alteration in the chlorophyll concentration may change the morphological and physiological behaviour of the plant. Air pollution is known to affect the total chlorophyll content and reduce the photosynthetic activity. Of all the plant parts, the leaf is the most sensitive part to air pollutants and several other such external factors (Lalman and Singh, 1990). When plants are exposed to the environmental pollution above normal physiologically acceptable range, photosynthesis gets inactivated. Chlorophyll 'a' content increased as the pollution load decreased with the lowest value of 0.65 µg/ml for *Glycine max* in the month of April at site I and the highest value as 18.85 µg/ml for *Cicer crietinum* in September at site IV (Table.2). In the present study, dust accumulation altered the chlorophyll and carotenoid contents in all plants in the polluted location (near the cement factory) compared with plants far from the factory at reference site. The total chlorophyll content decreased in the plants growing in the vicinity of the cement factory. The amounts of chlorophyll „a", chlorophyll „b", total chlorophyll and carotenoid contents of cement dust treated samples were always lower than that of control plants in the present study. Reduction in chlorophyll content as a result of cement dust deposition has been reported for *Helianthus annuus* (Borkha, 1980), *Triticum aestivum* (Singh & Rao 1981), *Zea mays*, *Amaranthus viridus* . Singh and Rao (1981) noted that changes associated with chlorophyll content in a cement-polluted environment, were associated with a decrease in the levels of stomatal and cuticular transpiration of encrusted leaf surfaces. Decrease in chlorophyll content might be due to chloroplast damage by incorporation of cement kiln dust into leaf tissues (Singh and Srivastava, 2002). For Pheophytins, the same trend was observed for the different study sites during the study period.

Table-2: Monthly estimation of Chlorophyll 'a' (µg/ml) of different plant species during the study period at the four study sites.

Plant species	Sites	April	May	June	July	Aug.	Sep.	Oct.	Mean	S.D.
Glycine max (Soya bean)	Site1	0.655	0.746	4.86	5.21	2.87	7.22	2.98	3.50	2.41
	Site2	2.99	3.89	6.11	8	4.61	7.96	3.75	5.33	2.0
	Site3	3.97	4.17	7.47	8.06	5.64	8.72	12.07	7.15	2.85
	Site4	4.27	5.14	8.59	8.94	12.1	11.93	--	8.49	3.29
Cicer arietinum (Chana)	Site1	2.04	3.13	8.76	9.96	2.64	9.61	3.3	5.63	3.60
	Site2	2.06	3.41	10.13	14.18	2.65	16.18	11.78	8.62	5.86
	Site3	6.67	5.7	12.19	--	5.27	16.18	16.57	10.43	5.23
	Site4	7.04	7.13	15.0	18.1	6.16	18.85	18.82	13.03	6

CONCLUSION

On the basis of this study, it could be concluded that the vegetation of the area was found to be affected by cement dust, which might be due to the presence of varied pollutants in the cement dust of the study area. From the observations made during the study it appeared that the cement factory is responsible for the substantial amount of dust in the atmosphere resulting in damage not only to the air quality but also to soil and vegetation. The need for appropriate device installation and development of green belts in the area is highly recommended in the area to mitigate the increasing dust emission from cement factories.

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