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BIO-CHEMICAL ASSAY OF PHOTOSYNTHETIC PIGMENTS IN BLACK GRAM (*VIGNA MUNGO* L.) EXPOSED TO CEMENT DUST POLLUTION

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Abstract: The current research quest has been carried out, to infer the effect of various extent of cement dust on the biochemical contents of photosynthetic pigment such as: chlorophyll a, chlorophyll b, total chlorophyll, carotenoid. Chlorophyll ‘a’, chlorophyll ‘b’ and total chlorophyll showed a gradual decline with increase of cement dust pollution.

Keywords: Chlorophyll, Carotenoid, Environment, toxins, Pollutant and Cement Dust.

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INTRODUCTION

Edaphic is nature's boon to nurture the plants, which intern nourishes the biotic community thus ecosystem. Now a day's this soil as become puddle for various, toxins, syntactic non degradable chemicals, heavy metals etc. Soil has been polluted in all possible means, polluted water being reservoirs of chemicals heavy metals lets this chemical percolate into the soil. Polluted air caring all the toxin dust depositing on the soil, Human population explosion, rapid industrialization, increased deforestation, unplanned urbanization, scientific and technological advancement etc. have further hyped all kinds of pollution (Raajasubramanian et al., 2015)

Air, land and water are the most basic amenities for living organisms. Once, these amenities were pure, virgin, undisturbed, uncontaminated and basically most hospitable for living organisms. But nowadays, the environment has become undesirable and contaminated by environmental pollution and therefore harmful for the health of fauna and flora. Pollution is an undesirable change in the physico-chemical and biological characteristics of water, air or land that will be or may be, inimical to human and other forms life, industrial processes, living condition and cultural assets and virtue (Odum, 1975). Population explosion, rapid industrialization, increased deforestation, unplanned urbanization, scientific and technological advancement etc. are main causes for all kinds of tainting.

To meet the ever growing demands, more and more cement industries are established in our country. The first Indian cement factory was established in 1914 at Porbundar in Gujarat. At present, there are 155 major cement industries (160 million tonnes per annum) and 300 mini cement plants (9 million tonnes per annum) in India. There are nearly 20 major cement industries located in Tamil Nadu. The main industries such as Alagappa cements (Pudupalayam), Ariyalur Cement Works (Kallankurichi), Chettinad cements (Keelapazhur), Dalmia cements (Thamaraikulam), Dharani cements (Veenakaikatti), Grasim cements (Reddiarpalayam), Ramco cements (Govindapuram) and Sankar cements (Thalavai) are located in and around ariyalur. They produce enormous amount of dust and pollute the surrounding environment. Among them, Ariyalur Cement Works, Ariyalur was established in 1979. It produces as much as 1500 MT/day employing dry process method. During production, it releases a stalk emission of 1,60,000 MT/hr. The emitted dust is carried out to surrounding areas and deposited over the vegetation and soil.

MATERIAL AND METHOD

Seed material

The seeds of blackgram (Vigna mungo L. Hepper var. Vamban 3) were procured from National Pulse Research Station, Regional Research Station of Tamil Nadu Agricultural University located at Vamban, Pudukkottai district, Tamil Nadu, India. The healthy seeds were chosen and used for both laboratory and field experiments.

Biochemical analyses

Photosynthetic Pigments

The photosynthetic pigments such as chlorophyll "a", chlorophyll "b" and total chlorophyll and carotenoid and the biochemical contents such as protein, amino acid, proline and sugars (reducing, non-reducing and total sugar) were estimated in the seven day old seedlings grown in the laboratory conditions.

Chlorophyll (Arnon, 1949)

Five hundred mg of fresh leaf material was ground with a mortar and pestle with 10 ml of 80 per cent acetone. The homogenate was centrifuged at 800 rpm for 15 minutes. The supernatant was saved. The residue was re-extracted with 10 ml of 80 per cent acetone. The supernatant was saved and the absorbance values were read at 645 and 663 nm in a UV-Spectrophotometer (Hitachi U-2900). The chlorophyll 'a', chlorophyll 'b' and total chlorophyll contents are expressed in mg g-1 fr wt basis.

Chlorophyll 'a' = $(0.0127) \times (\text{O.D } 663) - (0.00269) \times (\text{O.D } 645)$

Chlorophyll 'b' = $(0.0229) \times (\text{O.D } 645) - (0.00488) \times (\text{O.D } 663)$

Total chlorophyll = $(0.0202) \times (\text{O.D } 645) + (0.00802) \times (\text{O.D } 663)$

Carotenoid (Kirk and Allen, 1965)

The same tissue extract used for chlorophyll estimation was used for carotenoid estimation. The acetone extract was read at 480 nm in a UV-Spectrophotometer (Hitachi U-2900). The carotenoid content was calculated by using the following formula and it is expressed in mg g-1 fr wt basis.

Carotenoid = $(\text{O.D } 480) - (0.114) \times (\text{O.D } 663) - (0.638) \times (\text{O.D } 645)$.

Field preparation

The field was thoroughly ploughed three times before sowing. The entire field was irrigated with bore well water for two days before sowing. Black gram seeds were sown with a spacing of 20 × 20 cm. Field management were employed under normal agronomical practices.

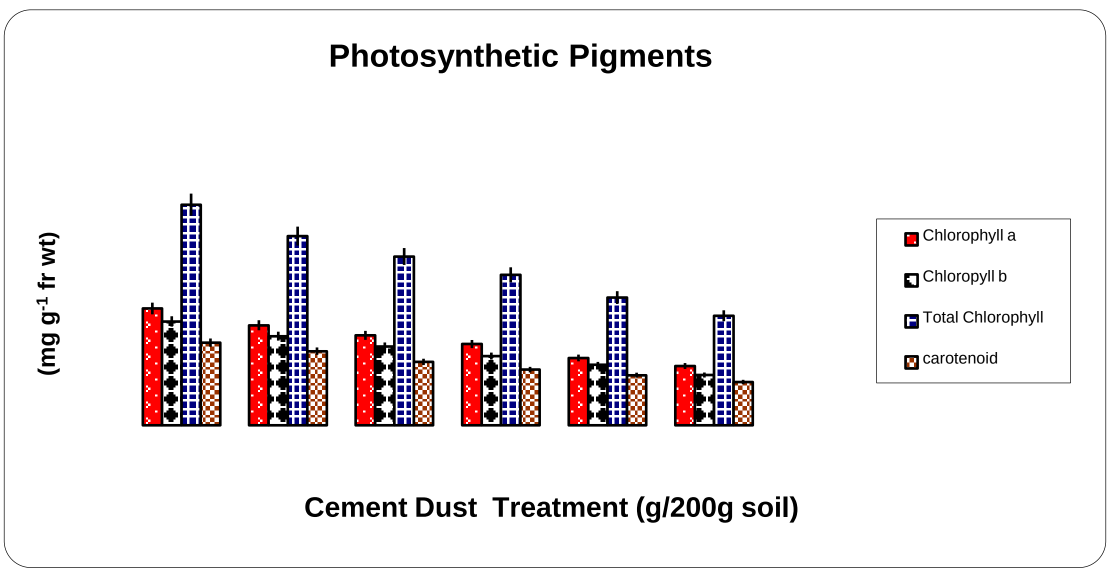
Cement dust treatment

Different amounts (5, 10, 15, and 20 g m-2 day-1) of cement dust application were done daily on the aerial parts of the experimental crops. The crops grown without cement dust were treated as control. Biochemical constituents such as chlorophyll 'a', chlorophyll 'b', total chlorophyll and carotenoid were estimated.

RESULT

The impact of cement dust on biochemical contents of blackgram seedling is presented in Fig. 1, expressed in mg g-1 fr wt basis. The highest chlorophyll content (chlorophyll a 0.739, chlorophyll b 0.657 and total chlorophyll 1.396 mg g-1 fr wt) carotenoid (0.523 mg g-1 fr wt), The lowest chlorophyll content (chlorophyll a 0.375, chlorophyll b 0.318 and total chlorophyll 0.693 mg g-1 fr wt) carotenoid (0.274 mg g-1 fr wt).

Fig. 1: Effect of cement dust on photosynthetic pigment (chl. a, chl. b, total chl. and carotenoids (mg g^{-1} fr wt) of blackgram seedlings.



Photosynthetic pigments

The effect of various amounts of cement dust on chlorophyll ‘a’, chlorophyll ‘b’, total chlorophyll and carotenoid content of blackgram was shown in Fig.1. The highest content of chlorophyll ‘a’ (0.692, 0.789, 0.895 and 0.765 mg g-1 fr wt), chlorophyll ‘b’ (0.557, 0.639, 0.708 and 0.599 mg g-1 fr wt), total chlorophyll (1.249, 1.428, 1.603 and 1.364 mg g-1 fr wt) and carotenoid content (0.525, 0.627, 0.697 and 0.561 mg g-1 fr wt) were recorded in control plants at 15, 30, 45 and 60 DAS respectively. The lowest values of chlorophyll ‘a’ (0.316, 0.428, 0.507 and 0.336 mg g-1 fr wt), chlorophyll ‘b’ (0.259, 0.301, 0.402 and 0.241 mg g-1 fr wt), total chlorophyll (0.575, 0.729, 0.909 and 0.557 mg g-1 fr wt) and carotenoid content (0.234, 0.335, 0.408 and 0.273 mg g-1 fr wt) were recorded in the 20 g m-2 day-1 cement dusted plants at 15, 30, 45 and 60 DAS respectively.

DISCUSSION

The presence of pollutants in the soil caused deteriorating effect on the biochemical aspects of plant grown on them. The biochemical contents such as chlorophyll and carotenoid. Chlorophyll is an integral component of plant pigments and play a vital role in the process of photosynthesis. Chlorophyll estimation is one of the important biochemical parameters which is used as an index of production capacity. In the present study, Chlorophyll ‘a’, chlorophyll ‘b’ and total chlorophyll showed a gradual reduction with increase of cement dust pollution. A considerable loss in total chlorophyll content in the leaves of plants exposed to severe air pollution support the argument that the chloroplast is the primary site of victim by air pollutants that make their entrance into the tissues through stomata and cause partial denaturation of the chloroplast and decreases pigment content in the cells of polluted leaves. Shukla et al. (1990) reported high alkaline nature of cement dust might have degraded the chlorophyll molecules. Chlorophyll content might be reduced due to chloroplast damage by incorporation of cement kiln dust over the surfaces of leaf tissue and may be responsible for alteration of leaf pH (Singh and Srivastra, 2002).

Decrease in total chlorophyll content in the leaves may be due to the alkaline condition created by dissolution of chemicals present in the dust particulates in cell sap which is responsible for chlorophyll degradation. Total chlorophyll content of polluted leaves is lower than that of control leaves (Mandal and Mukherji, 2000). The changes in the chlorophyll can be attributed due to the shading effects caused by the cement dust on the leaf and it damage the photosynthetic apparatus due to toxicity or increased water stress (Nanos and Ilias 2007). The decrease of chlorophyll in blackgram crop affected by alkaline cement dust may be the result of a lack of manganese (Ohki et al., 1981). The chlorophyll damage by incorporation of cement dust solution into leaf tissue caused reduction in chlorophyll concentration of dusted leaves

(Singh and Rao, 1978). It has shown that photosystem damage may cause many changes in leaf physiological parameters (Proietti and Famiani, 2002).

Carotenoid

Carotenoid acts as an accessary pigment in higher plants and plays an important role in the photosynthetic processes. They have been also potential biochemical indicator of cement dust pollutants. Carotenoid content was higher in the plant samples collected from the control site when compared with polluted sites (Mandre and Tuulmets, 1997). The reduction may be attributed to the adverse impact on the biosynthetic processes under the influence of alkaline cement dust (Lone, 2010). Iron deficiency causes several biochemical and ultrastructural damages, which may lead to an enhancement in reactive oxygen species production, which irreversibly damage living macromolecule (Scandalios, 1990). Reactive oxygen species production might be enhanced as a consequence of the alteration in the reduction of carotenoid biosynthesis caused by iron deficiency (Abadia, 1992).

REFERENCE

1. Raajasubramanian Devarajan , Krishna Ram Hanumappa and NarendraKuppan 2015. The study of change in physico-chemical properties of soil due to cement dust pollution-an hazardous terrorization to ecosystem; Canadian Journal of Pure and Applied Sciences Vol. 9, No. 1

2. Odum, P and Eugene, 1975. In: Ecology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

3. Arnon, D.I., 1949. Copper enzymes in isolated chloroplasts phenol oxidase in Beta vulgaris. Plant Physiol., 24: 1-5.

4. Kirk, J.T.O and R.L. Allen, 1965. Dependence of chloroplast pigment synthesis on protein synthetic effects of acetilione. Biochem. Biophys, Res. Cann., 27: 523-530.

5. Shukla, J., J.V. Pandey, S.N. Singh, M. Yunus, N. Singh and K.J. Ahmad, 1990. Effect of cement dust on the growth and yield of Brassica campestris L. Environ. Poll., 66: 81-88.

6. Singh, R.B and A.K, Shrivastava, 2002. Cytotoxic effect and biological damages in Clitoria ternatic by cement dust Nat. Environ. Pollu. Res., 1: 457-461.

7. Mandal, M and S. Mukherji, 2000. Changes in chlorophyll context, chlorophyllase activity, Hill reaction, photosynthetic CO_2 uptake, sugar and starch contents in five dicotyledonous plants exposed to automobile exhaust pollution. J. Environ. Biol., 21: 37–41.

8. Nanos, GD and IF. Ilias, 2007. Effects of Inert Dust on Olive (Olea europeaea L.). Leaf Physiological Parameters. Env. Sci. Pollut. Res., 14: 212–214.

9. Ohki, K., D.O. Wilson and O.E Anderson, 1981.Manganese deficiency and toxicity sensitivities of Soybean cultivars, Agron. 72: 713-716.

10. Singh, N and D.N. Rao, 1978. Effect of cement dust pollution on soil properties and wheat plants. Ind. J. Environ. Hlth., 20: 258-267.

11. Proietti, P and F. Famiani, 2002. Diurnal and seasonal changes in photosynthetic characteristics in different olive (Olea europaea L.) cultivars. Photosynthetica. 40: 171–176.

12. Lone, F.A., 2010. Growth performance of saffron (Crocus sativus L.) under the impact of alkaline cement dust pollution around an industrial complex. Acta Botanica Hungarica., 52: 363-375.

13. Scandalios, JG., 1990. Response of plant antioxidant defense genes. In: Scandalios JG, Wright T (Ed.) Genomic responses to environmental stress. Academic, New York, pp 1–41.

14. Abadia, J., 1992. Leaf responses to Fe deficiency: A review. J. Plant Nutri., 15: 1699-1713.

15. Mandre, M and J. Kloseiko, 1997. Changing carbohydrate partitioning in 6-year-old coniferous trees after prolonged exposure to cement dust. Zeitschrift fur Naturforschung, 52: 1–9.

16. Mandre, M and L. Tuulmets, 1997a. Pigment changes in Norway spruce induced by dust pollution. Water, Air and Soil Pollution, 94: 247-258.

17. Mandre, M and L. Tuulmets, 1997b. Biochemical diagnosis of forest decline. Beltic Forestry, 3: 19-25.