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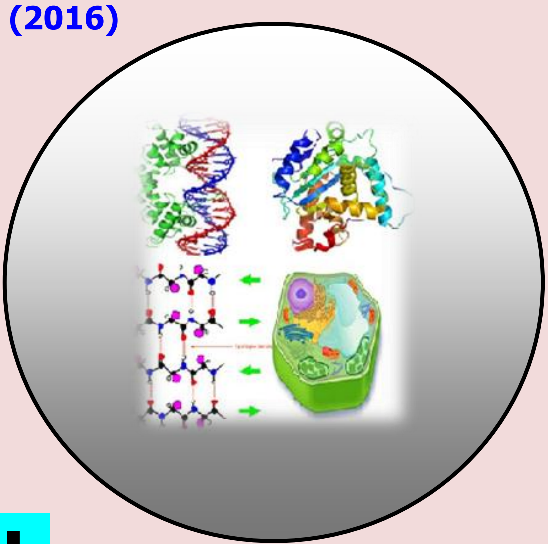

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RESEARCH PAPER

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Effects of Cement Dust on Anti-oxidative Enzymes, Proline and Malondialdehyde Content of Mung Bean (*Vigna radiata*) Plants

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ABSTRACT

The impact of cement dust on catalase-peroxidase activity, proline and malondialdehyde (MDA) content of mung bean (V. radiata) plants was investigated under this study. Plants treated with different doses (50g/5Kg, 100g/5Kg, 150g/5Kg, 200g/5Kg, 250g/5Kg) of cement dust exhibited significant increase in all the above mentioned parameters in comparison to control plants. The observation of present study reveals that cement dust pollution has caused adverse effects on the enzyme activity, proline and MDA content of the plants. It severely affects the plant growth by causing stress conditions for plant growth.
Keywords: Cement Dust, Proline, Malondialdehyde and Stress Conditions.

INTRODUCTION

Cement industry is recognized as one of the 17 most pollutant industries listed by central pollution control board. The emission of dust from cement factories has been increased alarmingly in last few decades due to expansion of more cement plant to meet the requirement of cement materials for construction of building. Increasing concentration of cement dust pollution in the atmosphere exceeds its settlement on plant and soil surface which causes progressive decline in physiological process such as photosynthetic ability and respiration rate of leaves. Due to immobility of higher plants, it need a greater protection against several stresses, including low and high temperature, water stress, salinity, metal toxicity and others. Cement factories are major source of pollutants for the surrounding areas (Stratmann and Van Haut, 1966). The problem of air pollution in the form of particulates has become a threat to the survival of plants and the reduction of the integrity of soils in the industrial areas (Gupta and Mishra, 1994; Bilen, 2010). Dust falling on the soil caused a shift in the pH level to the alkaline side. It was found that dust deposition affect photosynthesis, stomatal functioning and productivity (Santosh and Tripathi, 2008). Cement dust can spread over large areas through wind or rain and are accumulated in and on soil or plants and have the potential to affect animal and human health adversely (Bayhan *et al* 2006; Demir *et al.,* 2005). Dust from cement factories adversely affects the forest ecosystem, soil enzymes, fungi and bacteria population within the vicinity of cement factory (Khosla and Palmer, 2012).

The present study was carried out to assess the impact of cement dust on mung bean plants Effect of cement dust on anti-oxidative enzymes, proline and malondialdehyde content was studied.

MATERIALS AND METHODS

A soil pot culture experiment was undertaken to find out the effects of cement dust pollution on morphological and biochemical parameters of mung bean (*V. radiata)* plants*.* Experiment was carried out under glasshouse conditions. Different doses (50g/5Kg, 100g/5Kg, 150g/5Kg, 200g/5Kg, 250g/5Kg) of cement dust were mixed well with properly dried and sieved virgin garden soil. Cement dust free pots were treated as control. The experiment was performed in triplicate. The activity enzymes *viz.* catalases and peroxidases were measured in the fresh leaf tissue extracts prepared in glass distilled water in the proportion of 1 g fresh material in 10 ml water. Finely chopped plant material was ground in a pre-chilled pestle and mortar. The extracts were filtered through two fold muslin cloth and stored at 5 ^{0}C temperature in refrigerator prior to assay of enzyme. The activity of the different enzymes was assayed within two hours of extraction. Catalase was measured by the method of Bisht (1972), modified method of Euler and Josephson (1927). Peroxidase was assayed by the modified method of Luck (1963). Proline content was estimated by the method of Bates *et al.,* 1973. The level of peroxidation in the leaf tissue was measured in terms of malondialdehyde (MDA, a product of lipid peroxidation) content determined by thio-barbutric acid reactive substances (TBARS) according to the method of Heath and Packer (1968). Data were analyzed statistically. Average mean and standard error (Mean ± SE) was calculated. Least significant difference LSD (*) at $P \leq 0.05$ and highly significant (**) $P \leq 0.01$ levels to determine the significant differences and percentage decrease over control were also calculated.

RESULT

Enzyme activity was found to be enhanced with the increasing doses of cement dust at 30th, 60th, 90th day. Catalase activity was recorded as 337.2, 406.9 and 342.3µmol H_2O_2 decomposed mg^{-100} FW in control plants at 30th, 60th, 90th day. Maximum significant increase in CAT activity was observed as 14.29, 9.17 and 8.91 % at 250g/5kg treatment over control at 30th, 60th, 90th day. Peroxidase activity was recorded as 20.8, 26.4 and 22.8 mg^{-100} FW in control plants at 30th, 60th, 90th day. Maximum significant increase in POD activity was observed as 187.02, 133.33 and 105.26 % at 250g/5kg treatment over control at 30th, 60th, 90th day respectively.

Proline and MDA content in Mung bean plants were found to be increased with the increasing doses of cement dust. Proline and MDA content was recorded as 3.40 and 9.89 nmol g^{-1} FW in control plants. Maximum significant increase in proline and MDA content was observed as 52.94 and 109.30 % at 250g/5kg treatment over control.

DISCUSSION

Catalse and peroxidase activity showed positive correlation with the cement dust pollution. This might have caused to mitigate and repair the damage caused by ROS as plants have been reported to evolved complex antioxidant systems (Ali *et al.,* 2011) including CAT and POD responsible for the conversion of H_2O_2 to H_2O and O_2. Catalase and POD activities being higher in plants from heavily dusted sites, suggesting that these plants were subjected to oxidative stress. An increase of these molecules in response to cement dust confirmed the positive correlations between CAT and POD. In this direction, the co-operative action of the anti-oxidant enzymes could be considered as an adaptive mechanism to the plants that serves to maintain the ROS at a steady state level (Wu *et al.,* 2010).

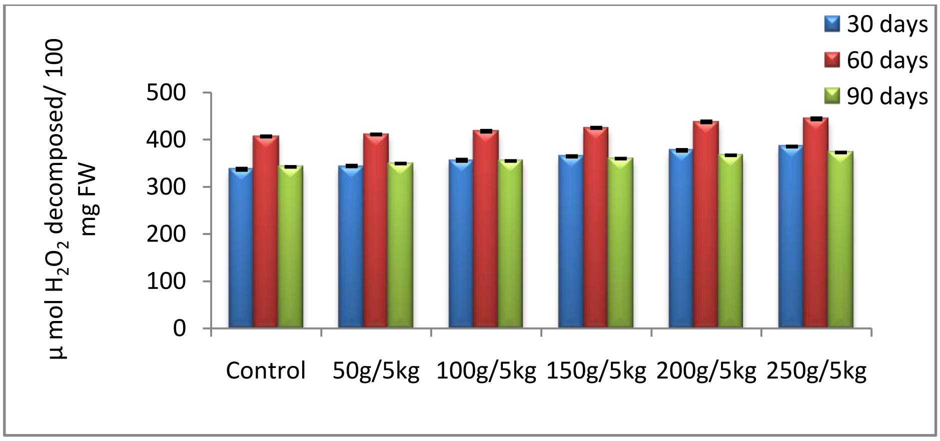

Figure 1. Effect of different doses of cement dust pollution on activity of Catalase of Mung bean (*V. radiata)* plants.

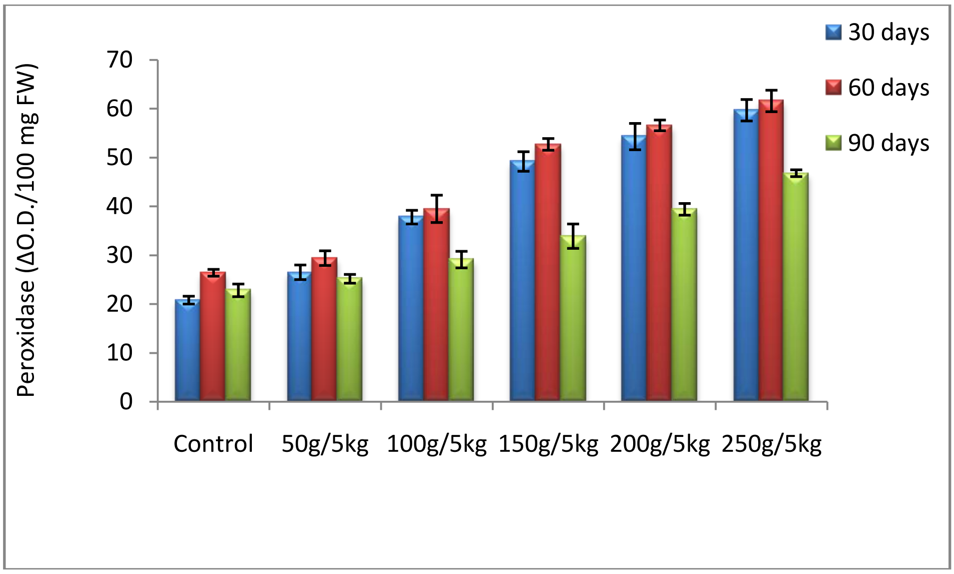

Figure 2. Effect of different doses of cement dust pollution on activity of peroxidase of Mung bean (*V. radiata)* plants.

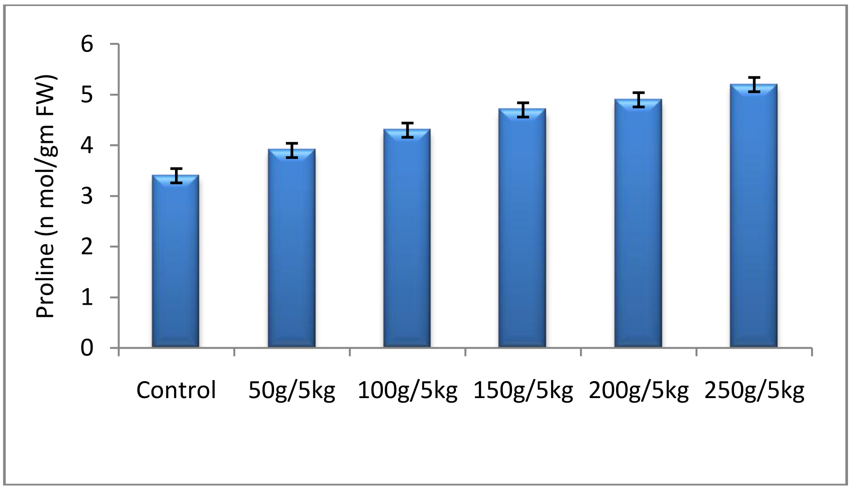

Figure 3. Effect different doses of cement dust on Proline content of Mung bean (*V. radiata)* plants.

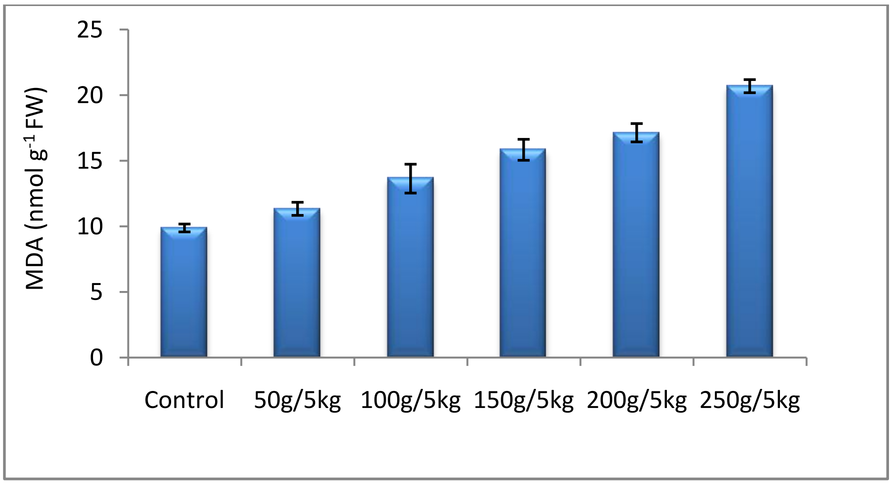

Figure 4. Effect of different doses of cement dust on MDA content in leaf tissue of Mung bean (*V. radiata)* Plants.

Malondialdehyde (MDA) content was increased with the increasing doses of cement dust. It is very often used as a suitable bio-marker for lipid peroxidation, which is an effect of oxidative damage (Dewir *et al.,* 2006). Plants susceptible to dusts were subjected to enhanced oxidative stress presumably *via.* generation of ROS and lipids which are the primary cellular targets of oxidative stress. Evidence for the cement dust induced oxidative stress has been recently reported in some hydrophytes as *Lemna minor*, *Ceratophyllum submersum* and *Potamogeton natans* (Erdal and Demirtas, 2010). Wannaz *et al.,* (2003) also found that air pollutants increased MDA content in *S. areira* leaves.

Enhanced proline activity was observed in the present study. Proline accumulation was observed in several plants in response to the varied abiotic stresses (Choudhary *et al.,* 2007). The role of proline is corroborated in the protection of plants against abiotic stress (Giannakoula *et al.,* 2008). Sometimes, a strong analogy exists between the total chlorophyll contents and proline contents, which appear contradictory, since these two metabolites are in competition for their common precursor, the glutamate (Roosens *et al.,* 1999). Proline accumulation might be an injury result in plant rather than an adaptive metabolic response (Qian *et al.,* 2001).

It accumulates heavily in several plants under stress providing plants protection against damage by ROS and plays an important role in osmo-regulation (Roosens *et al.,* 1999), protection of enzymes (Paleg *et al.,* 1984), enhance anti-oxidant defense systems in plant responses to oxidative stresses **(**Banu *et al.,* 2009**)** and scavenging of free radicals (Smirnoff and Cumbes, 1989).

CONCLUSIONS

The outcome of the present study highlights that atmospheric pollutant cement dust causes stress conditions for the survival of mung bean plants which is clearly reflected by the significantly increased activation of anti-oxidative enzymes (CAT- POD), proline and MDA level. Cement dust seems to cause substantial changes to soil and plant physiology, possibly leading to enhanced reactive oxygen species generation. To avoid such contamination from cement factories there is an urgent need to examine such technologies together with all possible methodologies that reduce pollution. Stringent environmental measures in controlling and monitoring emissions from the plant and other emission sources must be applied. Environmental impact assessment studies are recommended especially for future industrial settlement of any such industries.

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