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The Impact of Amended soil with Cement kiln dust on structure of Epidermal and Stomatal cell of *Sorghum bicolor*

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Abstract

This study was undertaken to study the effect of different amount of kiln dust mixed with soil on Sorghum bicolor. The dust was collected from a cement factory located in Beawar. Various elements such as Al, Ca, Cd, Cr, K, Ni, Pb, P, S and Zn were determined both in soil as well as kiln dust. Kiln dust was mixed with soil in pots to make six different treatment, control (no cement kiln dust added) 100g/5kg, 200g/5kg, 300g/5kg, 400g/5kg, 500g/5kg kiln dust in soil. Size of stomata, epidermal cell and stomatal index were found to be reduced on Sorghum bicolor were observed in the pots mixed highest and medium amount of cement kiln dust mixed soil.

Keywords: Soil pollution, Cement kiln dust, Heavy metals, Stomatal index, Stomata, Epidermal cell.

Introduction

The cement industries also play a vital role in the imbalances of the environment and produces air pollution hazards[1]. It also causes the pollution in soil where cement industries are situated. Cement dust is a mixture of oxides of Calcium, Potassium, Aluminium, Heavy metals Chromium, Nickel, Cadmium, Lead and Zinc etc. are also present in cement kiln dust[2].

Cement dust changes elemental concentration of soil and also changes its physico-chemical properties. Chemical analysis of soil in the industrial area of cement has been studied and it was observed that as the distance from factory increases the effect of soil pollution decreases, considerably for pH, Calcium carbonate, organic carbon and Heavy metals[3]. At present time[4,5]. The growth of plants in the cement dust polluted areas is being affected by cement dust compositions. Economically *Sorghum bicolor var.* is very important grass because it is extensively used as a fodder for livestock.

The present research paper reveals the effect of cement kiln dust amended soil on shape, number and size of stomata and epidermal cells in the leaves of *Sorghum bicolor.*

Materials and Methods

In the present study, *Sorghum bicolor s*eeds varieties were used. *Sorghum bicolor var.* were procured from Tabaji Research Institute Ajmer. The seeds were surface sterilized with 0.1% $HgCl_2$ for 10 min and then soaked for overnight before sowing. Seeds of *Sorghum bicolor* were sown mid July in the pots filled with mixture of preanalysed kiln dust and soil.

6 new pots were set up and each was filled with 5 kg of soil. Cement kiln dust mixed with soil were kept in pots in the ratio of control, 100g/5kg, 200g/5kg, 300g/5kg, 400G/5kg, 500g/5kg without treated as a control (no cement kiln dust added). A total three replicates were used for each pots. The pots were kept in open net house under natural photoperiod of day and night T^0 31-35^0 and 21-23^0 C respectively. The leaves were peeled off by tearing the leaf suddenly and with force. A thin membranous lower epidermis gets separated near the broken edges. Peels comes out by pulling these into a strip with forceps or by fingers. These uniformed peels were taken on glass slides and a drop of 1% safranin stain were added, kept for 1 minute, washed with water and then mounted in a drop of glycerin to prevent them from drying. A cover slip were placed and excess of water were blotted with the help of blotting paper. These slides were observed under (10×40) x in a microscope. Observation were taken in upper, middle and lower region of leaf lamina. Three observations were made in each region for upper and lower epidermis. Number, size of stomata, epidermal cell and stomatal index was measured with the help of occular and stage micrometer. The formula used to calculate stomatal index is as follows-

$$\text{Stomatal Index} = \frac{S}{E + S} \times 100$$

Where: I - Stomatal index, S – No. of stomatal cell per unit area, E – No. of epidermal cell per unit area

Results and Discussion

The present study on Sorghum bicolor growing at different concentration of cement kiln dust amended soil indicates that soil pollution causes significant changes in leaves structure. Size of stomata, epidermal cell and stomatal index was found to be

reduced in *Sorghum bicolor* growing at cement kiln dust amended soil.

Reduction in length of epidermal cell was seen in upper surface (length 36.75 µm) and lower surface (length 28.35 µm and breadth 9.45 µm) of *Sorghum bicolor* leaves which grow at high concentration (500g/5kg) cement kiln dust mixed soil.

Reduction in length and breadth of stomata was seen in upper surface (length 12.75µm and breadth 8.4 µm) and lower surface (length 12.25 µm and breadth 8.4 µm) of *S. bicolor* leaves which grow at high concentration (500g/5kg) of cement kiln dust amended soil.

Reduction in Stomatal index upper (14%) and lower (24%) stomata was seen in *S. Bicolor.* The stomatal index reduced considerably on both the lower and upper surface of leaves. Similar result has been obtained by Tawari Shweta[5]. In some plants exposed to air pollution.

Distorted shape of stomata were observed on adxial surface of *Sorghum bicolor* which grow in high concentration (400g/5kg) of cement kiln dust amended soil. According to Gupta Suruchi and Sharma Sarika heavy metals present in cement dust on soil and plants. Heavy metals toxicity results in reduction in plant height, burning of leaf margins and tips, slow leaf growth on plants. When plant grows in cement kiln dust amended soil, heavy metals are also present in very high concentration which effect stomatal structure and function on *Sorghum bicolor.* Similar result has been obtained by Mukhtar Naila et.al[8] and Ghelich Sima and Zarinkamar Fatemeh[9] in some plants exposed to heavy metals Cadimun and Lead toxicity.

Table-1
Response of epidermal size (Upper and Lower) in different concentration of cement kiln dust on *Sorghum bicolor*

Concentration of cement kiln dust in soil (gm)/5kg	Length of epidermal cell (µm)		Breadth of epidermal cell (µm)	
	Adxial surface of leaves	Abxial surface of leaves	Adxial surface of leaves	Abxial surface of leaves
Control	74.55	50.9	8.4	10.5
100	50.4	47.1	8.4	10
200	49.35	40.5	7.35	9.45
300	47.25	35.25	8.4	8.9
400	39.9	33.1	7.35	8.5
500	36.75	28.35	10.5	9.45

Table-2
Response of stomatal size (Upper and Lower) in different concentration of cement kiln dust on *Sorghum bicolor*

Concentration of cement kiln dust in soil (gm)/5kg	Length of stomatal cell (µm)		Breadth of stomatal cell (µm)	
	Adxial surface of leaves	Abxial surface of leaves	Adxial surface of leaves	Abxial surface of leaves
CONTROL	16.8	16.2	10.5	10.5
100	15.75	15.75	10.5	10.5
200	14.7	14.7	10.5	10.5
300	13.65	13.65	8.4	10.5
400	13.65	14.7	7.35	12.6
500	12.75	12.25	8.4	8.4

Table-3
Response of stomatal index (Upper and Lower) in different concentration of cement kiln dust on *Sorghum bicolor*

Stomatal index (%) of *Sorghum bicolor*		
Concentration of cement kiln dust in soil(gm/5kg)	**Adxial surface of leaves**	**Abxial surface of leaves**
Control	27.5%	28.3%
100/5kg	25.6%	26.1%
200/5kg	25.3%	25%
300/5kg	19.6%	25.5%
400/5kg	19.4%	24.7%
500/5kg	14%	24.4%

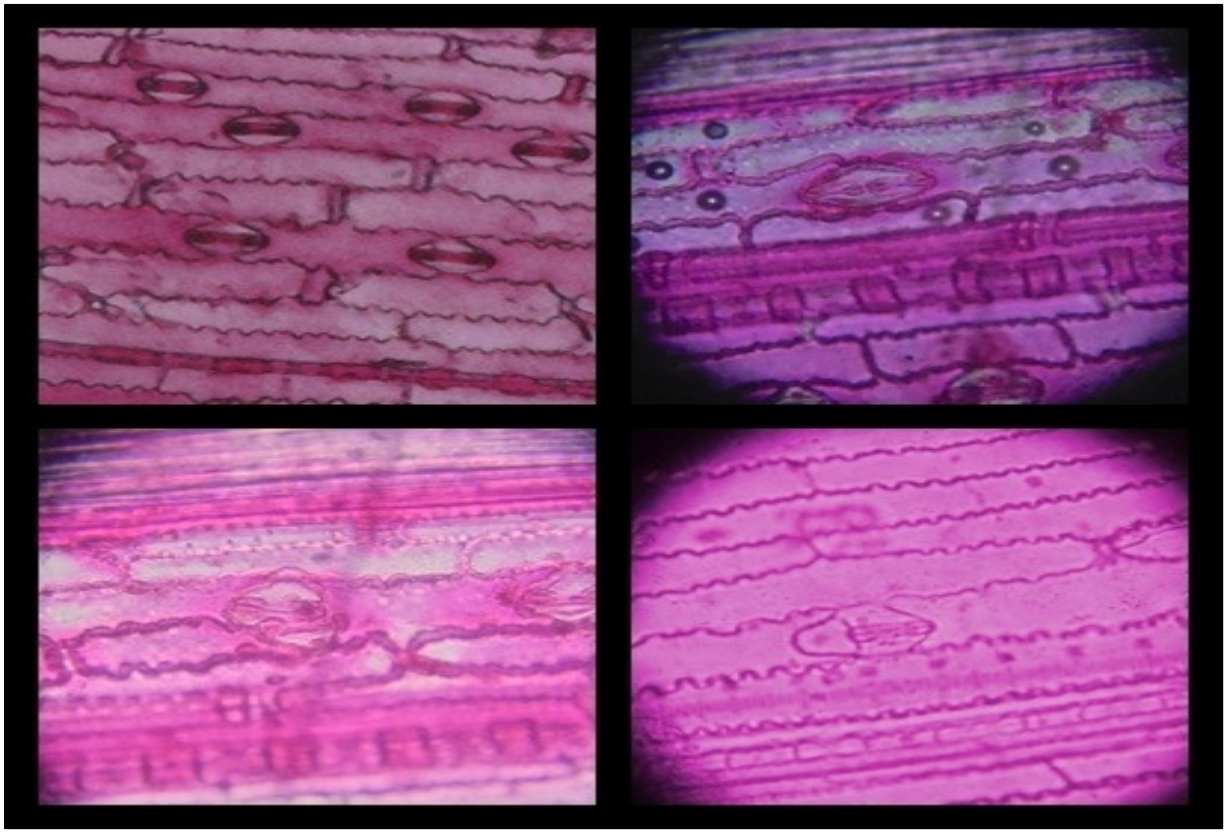

Figure-1
(i) Normal stomatal cell on *Sorghum bicolor* plant leaves which grow in normal (no cement kiln dust added) soil. (ii, iii) fusion of two stomatal cell and (iv) Distorted shape of stomata were observed on adxial and abxial surface of *Sorghum bicolor* which grow in high concentration of cement kiln dust amended soil

Conclusion

It is evedent that cement kiln dust contains high concentration of heavy metals are also present which causes reduction of epidermal and stomatal cell size, modification in the structure of stomatal cell. These modifications somehow effects the life cycle of plants.

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