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Certain Morpho-biochemical Responses of Coriander (C*oriandrum sativum* L.) to Cement Kiln Dust Pollution

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***Abstract*:** An attempt has been made to study the impact of cement kiln dust pollution on certain morphological and biochemical features of *Coriandrum sativum* plants grown in the experimental plot exposed to the simulated cement kiln dust pollution. The study of morphological features such as length of shoot and root, size of leaves, number of branches, leaves, flowers and fruits, and phytomass, root/shoot ratio, NPP reveals that there is reduction in the growth of *C. sativum* plants exposed to cement kiln dust pollution. An analysis of the epidermal features of the leaves of *C. sativum* plants exhibited decreased values of the most of the studied parameters in the plants exposed to cement kiln dust pollution. The declining trend, except for the total phenols, has also been observed in the majority of presently studied biochemical parameters of plants exposed to the cement kiln dust pollution. Besides, reduction in the levels of total phytomass and NPP of plants grown in the experimental plot substantiates the view that cement kiln dust pollution has influence on the growth and yield of *Coriandrum sativum.*

***Keywords*:** Coriander, *Coriandrum sativum*, Cement kiln dust, Phytomass, Pollution, Yield

Global increase in urbanization has led to an upsurge in cement demand. The need for availability of raw materials and local demand has resulted in the establishment of more cement plants. The most exploited topic relating to cement production is its production of cement kiln dust emission, which result in stunted growth, leaf resetting, chlorosis, brown-gray necrosis and reduced long term yield. These pollutants affect the life and wellbeing of workers, children and people in close communities as well as the flora and fauna (Adeyanju and Okeke 2019). Cement dust is a well-known particulate pollutant of the vegetation near the cement manufacturing plants and cement kiln dust emanating from the cement factories is a mixture of elements, including high levels of fluoride, magnesium, lead, cadmium, nickel, zinc, copper, beryllium and other compounds (Uysal et al 2011). Cement kiln dust affects plant growth mostly by the formation of crusts on leaves, twigs and flowers (Chaurasia et al 2013). Particles of cement kiln dust were quite alkaline making soils neighboring cement exhibit elevated pH levels which in turn affect vegetation growth, decreasing rates of photosynthesis, respiration, transpiration and growth rate of plants (Fakhry and Migahid 2011). The pollutant particles can enter the soil as dry, humid or occult deposits and can undermine the physico-chemical properties. Hence contaminated soil can adversely affect plant survival and growth (Addo et al 2013). Cement kiln dust affected soils are said to be rich in calcium and potassium, but poor in nitrogen and phosphate (Shukla and Shukla 1996). Their deposits on plants interfere with the biosynthesis of chlorophyll and damage leaf cells, resulting in a reduction in photosynthesis (Shah et al 2020). An increase in the heavy metal levels, pH, electrical conductivity, and bulk density of the soil, while decreasing the water-holding capacity, as well as the moisture, organic carbon, and total nitrogen contents of the soil were observed due to Cement kiln dust (Lamare and Singh 2020). Cement dust is thought to be the most toxic environmental factor that physically blocks stomata and affects plant growth and development (Shah et al 2019). The cement particulate matter has a profound influence on the biochemical, morphological, and physiological responses of plants (Shah et al 2020). Pierce (1909, 1910), who studied the possible effect of cement dust on plants for the first time, observed that it is harmful to vegetation. Chaurasia et al (2013) is of the opinion that the harmful effects of cement kiln dust are due to the formation of crust in the presence of free moisture. Koperuncholan et al (2014) demonstrated that the cement kiln dust injures the leaf, but the degree of injury is related to the chemical composition of the dust and its size and deposition rate. However, there is a common belief that the particulate matter does not cause widespread plant injury. Contrary to this, information regarding the effects of particulate matter of cement kiln dust pollution on the growth, phytomass, net primary productivity (NPP) and yield of some economically important plants is available from the works of Lone (2010), Uysal et al (2011), Chaurasia et al (2013) and Shah et al 2020). A perusal of literature, however, reveals that attempts of this kind on vegetable yielding plants, particularly on green leafy vegetable and /or spice plants are very meager. Thus the present investigation has been undertaken with a view to assess the effect of cement kiln dust pollution on the morpho-biochemcial features of *Coriandrum sativum,* one of the important minor spices grown in India.

MATERIAL AND METHODS

The seeds of *Coriandrum sativum* were procured from the local market and seedlings were raised in the University Botanical Garden in a plot of 8-sq. m. The methods adopted to assess the morpho-biochemical and epidermal features of *Coriandurm sativum* were earlier described by Uma et al (1994) and Uma and Rao (1996), while phytomass was calculated from dry weight of plant sample. The primary productivity was determined based on the ratio between the phytomass and age of the plant (Kevt et al 1971). An analysis of elemental composition of soil from the control as well as experimental plots and also the cement kiln dust was done by using CAMECA Electron Probe Analyzer (Allen et al 1986). The pH and the physical properties of the soil in the control and experimental plots and cement kiln dust were analyzed as per the method described by Jackson (1962). All estimated results are the mean of three replicates. Data were examined with Duncan's multiple-range test (DMRT) for the evaluation of the significant difference between means ($p < 0.05$). SD is depicted using the average of the three replicates.

RESULTS AND DISCUSSION

The cement kiln dust polluted plants of coriander showed 14. 2% reduction in their shoot length, while 8.5% in their root length. The percent reduction in the number of branches (18), number of leaves (6.81), size of leaves (4.9), number of internodes (4.95%) and inter nodal distance (3. 58%)of polluted coriander plants than the plants grown in control. Further the cement kiln dust polluted plants of coriander had 20. 4% reduction in their net primary productivity (NPP) and reduced root/shoot (R/S) ratio to the level of 19% in comparison to that of control plants (Table 1). Decrease in the R/S ratio was also recorded in the cement kiln dust polluted plants of *Vigna mungo* and *Lycopersicon esculentum* L. were they reported to have increase in their R/S ratio (Iqbal et al 2020; Enespa and Dwivedi 2013). The plant growth and development form have a notable outcome on the root-shoot ratio (Askari et al 2017). This root-shoot ratio then shows the plant health conditions and sensitivity to stress (Agathokleous et al 2018).Phytomass in polluted coriander

Table 1. Morphological features of control and dusted plants of *Coriandrum sativum*

Age of the plant (days)		Shoot length (cms)	Root length (cms)	No. of Branches	No. of leaves	Size of leaves (cms)	No. of inter-nodes	Size of inter-nodes (cms)	No. of flowers	No. of fruits	Phyto-mass (g)	Root/shoot ratio	NPP (g/day)
20	C	8.62±1.04^{a}	6.82±1.37^{a}	-	8.35±0.02^{a}	0.524±0.001^{a}	1.53±0.004^{a}	4.862±0.13^{a}	-	-	0.791±0.10^{a}	0.643±0.01^{a}	0.032±0.01^{a}
	D	7.18±1.86^{a}	5.73±0.13^{a}	-	6.98±0.02^{b}	0.497±0.002^{b}	1.24±0.002^{b}	3.257±0.03^{b}	-	-	0.798±0.15^{a}	0.519±0.01^{b}	0.025±0.01^{a}
40	C	19.4±1.38a	10.74±0.14^{a}	4.15±0.13^{a}	36.479±1.35^{a}	1.638±0.024^{a}	2.98±0.024^{a}	18.649±1.24^{a}	3.82±0.14^{a}	13.8±0.03^{a}	0.551±0.01^{a}	1.824±0.01^{a}	0.045±0.03^{a}
	D	16.5±1.14b	10.15±1.09^{a}	3.25±0.12^{b}	29.864±2.55^{b}	1.142±0.028^{b}	2.75±0.031^{b}	17.536±1.48^{a}	2.03±0.19^{b}	9.52±0.05^{b}	0.604±0.02^{b}	0.986±0.02^{b}	0.024±0.01^{a}
60	C	53.2±1.20^{a}	30.9±1.03^{a}	8.43±1.26^{a}	50.738±2.65^{a}	1.985±0.026^{a}	4.628±0.149^{a}	24.695±2.37^{a}	24.63±12.57^{a}	10.521±1.26^{a}	0.580±0.01^{a}	2.031±0.18^{a}	0.033±0.01^{a}
	D	50.1±1.02^{b}	29.4±1.138^{a}	4.73±1.18^{b}	47.395±1.82^{a}	1.738±0.025^{b}	3.856±0.294^{b}	22.548±1.76^{a}	19.285±2.15^{a}	9.27±1.12^{a}	0.588±0.13^{a}	1.957±0.03^{a}	0.032±0.01^{a}
80	C	62.5±2.18^{a}	39.6±1.34^{a}	10.2±1.25^{a}	68.497±5.37^{a}	2.164±0.035^{a}	4.935±0.218^{a}	38.657±1.12^{a}	58.932±1.38^{a}	42.536±5.78^{a}	0.633±0.01^{a}	3.578±0.08^{a}	0.044±0.02^{a}
	D	56.8±1.36^{b}	32.5±1.28^{b}	7.46±1.35^{b}	59.781±4.65^{b}	2.018±0.046^{b}	4.162±0.253^{b}	36.734±1.28^{b}	44.359±1.26^{b}	40.15±4.18^{a}	0.572±0.01^{b}	2.139±0.02^{b}	0.026±0.01^{a}
100	C	64.9±2.57^{a}	37.6+2.04^{a}	14.8±2.13^{a}	88.643±10.25^{a}	2.287±0.048^{a}	5.036±0.284^{a}	44.581±2.16^{a}	63.257±1.42^{a}	79.536±8.69^{a}	0.593±0.02^{b}	4.893±0.01^{a}	0.048±0.01^{a}
	D	56.3±2.57^{b}	35.9±1.84^{a}	10.3±1.81^{b}	80.786±10.45^{a}	2.159±0.026^{b}	4.928±0.265^{a}	42.735±2.47^{a}	51.49±2.67^{b}	48.517±10.74^{b}	0.633±0.01^{a}	3.45±0.02^{b}	0.034±0.01^{b}
120	C	69.5±1.38^{a}	36.9+1.26^{a}	15.24±1.08^{a}	92.863±10.54^{a}	1.857±0.034^{a}	4.832±0.265^{a}	43.769±1.50^{a}	29.348±4.33^{a}	100.35±12.49^{a}	0.568±0.01^{a}	5.281±0.16^{a}	0.044±0.01^{a}
	D	59.6±1.24^{b}	34.6+1.48^{b}	12.49±1.12^{b}	86.537±12.69^{a}	1.765±0.048^{b}	4.659±0.276^{a}	41.586±2.48^{a}	18.715±1.29^{b}	99.486±10.57^{a}	0.580±0.15^{a}	4.273±0.13^{b}	0.035±0.01^{a}

C = Control; D= dusted; Values (mean ± SD) followed by dissimilar letters in each column are significantly different at $p \leq 0.05$

plants was reduced to just 2 % only (Table 1), which makes these plants to be considered as resistant in this regard, in comparison with a remarkable influence of cement kiln. Similar reduction in the phytomas was reported by Uysal et al (2011) in *Vicia faba* and Raajasubramanian et al (2011) in *Arachis hypogaea*. Increased concentration of cement dust pollutants causes visible injuries such as closure of leaf stomata, a marked reduction in growth and invisible injuries like progressive decline in the physiological process such as photosynthetic ability and respiration rate of leaves (Raajasubramanian et al 2011).

Fe occurs relatively less (8.51) in the cement kiln dust as compared to that of control soil (18.45) (Table 2). The deficiency of Fe, which is an essential activator for enzyme catalyzing reactions and is required by plants in high amounts, causes interveinal chlorosis as well as inhibition in protein synthesis. Thus lack of Fe may be a reason for some of the morpho-biochemical changes in Coriander. The reduction in plant growth in dusted plants was attributed to the fact that they interact with the environmental pollution stress, which in turn leads to a decreased photosynthesis in unit leaf area and / or enhanced leaf senescence (Nanos and Ilias 2007, Tripathi and Gautam 2007, Belmokhtar et al 2019). A significant variation has been found in the biochemical characters of dust polluted plants in comparison to that of control plants (Table 3). The reduction in the amount of chlorophyll 'b' was more in the dust polluted plants of *C.sativum.* However, this observation differs from the reports of Thambavani and Kumar (2011) who stated that chlorophyll 'a' content was more susceptible than chlorophyll 'b' content to pollutants in *Ficus religiosa* L. *Pongamia pinnata* L. and *Polyalthia longifolia* L.but he found that in *Azadirachta indica* L the chlorophyll 'a' content gets less degraded than

Table 2. Elemental analysis of control and cement kiln dust polluted soils and cement kiln dust (in atomic percentage) *

Elements detected	In control soil	In cement kiln dust polluted soil	In cement kiln dust alone
Mg	00.29	00.64	1.33
Al	08.15	09.06	06.45
Si	66.41	63.86	16.41
S	--	--	01.69
Cl	--	--	00.69
K	03.82	02.35	--
Ca	02.15	02.55	67. 74
Fe	18. 45	18.43	08.51
Ti	01.25	01.95	--

*Average of two replicates

Table 3. Biochemical parameters of control and cement kiln dust polluted plants of *Coriandrum satium* (mg/g)

Age of the plant (days)		Chlorophyll 'a'	Chlorophyll 'b'	Total chlorophylls	Total sugars	Amino acids	Starch	Lipids	Total phenols	Total proteins
20	C	0.894±0.024^{a}	0.746±0.038^{a}	1.640±0.014^{a}	9.64±0.973^{a}	3.568±0.914^{a}	17.863±2.481^{a}	1.948±1.053^{a}	3.248±1.102^{a}	2.587±0.1026^{a}
	D	0.632±0.028^{b}	0.593±0.024^{b}	1.225±0.017^{b}	4.872±0.584^{b}	2.735±0.836^{a}	14.658±1.736^{a}	2.187±1.483^{a}	2.356±1.0124^{a}	2.139±0.2010^{b}
40	C	1.370±0.024^{a}	0.994±0.014^{b}	2.364±0.148^{a}	12.793±1.385^{a}	5.738±0.736^{a}	24.748±2.356^{a}	2.526±1.143^{a}	4.156±1.228^{a}	9.284±1.107^{a}
	D	1.256±0.014^{b}	1.043±0.014^{a}	2.299±0.120^{a}	10.865±1.054^{a}	3.645±0.124^{b}	21.369±2.562^{a}	2.148±1.316^{a}	3.457±0.742^{a}	7.139±1.024^{b}
60	C	1.725±0.104^{a}	1.274±0.148^{a}	2.999±0.137^{a}	7.635±2.013^{a}	6.483±0.146^{b}	37.314±2.586^{a}	4.782±1.431^{a}	5.248±1.109^{a}	16.743±1.128^{a}
	D	1.538±0.178^{a}	1.392±0.178^{a}	2.934±0.158^{a}	0.524±2.135^{b}	7.542±0.184^{a}	31.297±2.014^{b}	3.146±1.284^{a}	4.376±1.248^{a}	12.259±1.0246^{b}
80	C	1.643±0.589^{a}	1.289±0.816^{a}	2.932±0.153^{a}	35.978±3.452^{a}	7.349±1.504^{a}	59.637±2.142^{a}	5.348±1.04^{a}	6.583±0.732^{a}	24.586±2.124^{a}
	D	1.526±0.731^{a}	1.435±0.812^{a}	2.961±0.274^{a}	30.184±2.036^{a}	6.382±1.104^{a}	52.318±2.041^{b}	4.068±1.149^{a}	5.627±1.103^{a}	21.473±1.26^{b}
100	C	1.482±0.863^{a}	1.047±0.265^{a}	2.529±0.856^{a}	43.86±2.846^{a}	5.948±1.128^{a}	68.472±2.561^{a}	5.28±1.014^{a}	5.846±1.124^{a}	33.478±2.659^{a}
	D	1.364±0.582^{a}	1.258±0.628^{a}	2.622±0.568^{a}	59.128±2.236^{b}	4.356±1.034^{a}	63.249±2.178^{b}	4.351±1.034^{a}	4.853±1.275^{a}	31.482±2.375^{a}

C= Control; D= dusted; Values (mean ± SD) followed by dissimilar letters in each column are significantly different at $p \leq 0.05$

chlorophyll 'b' due to cement dust pollution. Further, a declining trend has also been noticed in the total chlorophyll content of Coriander plants exposed to cement kiln dust, which is in accordance with the several earlier published reports (Lepedus et al 2003, Thambavani and Kumar 2011, Giri et al 2013, Alavi 2017). Alavi et al (2014), who reported considerable loss in the total chlorophyll content of *Plantago lanceolata*, and attributed the loss of total chlorophyll in the dust polluted plants due to the absorption of a portion of cement kiln dust into leaf tissue and its consequent damage to the chloroplasts. Thus, one may infer that the cement kiln dust not only affects the synthesis of carbohydrates but also the whole cellular metabolism.

The quantitative analysis of bio-molecules of coriander plants from control as well as experimental plots revealed that there was reduction in the proteins to the extent of 51.6% in the cement dust polluted plants, while the amount of amino acids reduced to 3.19% only, but lipids, starch and sugars reduced to 17.7, 5.4, 25% respectively in the dust polluted plants of coriander (Table 3). The total phenol content in dusted plants of *C. sativum* was 17.6%. Shah et al (2020) observed the higher level of cement kiln dust pollution may considerably decrease the growth, metabolites and activities like photosynthesis and respiration. The reduction in protein content might be due to stressed conditions which enhanced the rate of protein denaturation and breakdown of existing protein to amino acid which ultimately causes reduction in protein content (Tripathi and Gautam 2007).

Epidermal features: The epidermal features of Coriander leaves exposed to cement kiln dust pollution exhibit decrease in the number of epidermal cells frequency (24%), stomatal frequency (11.4%), trichome frequency (1.5%), Epidermal cell size (8.59%), trichome size (3.2%) and stomatal pore size (9.3%). The stomatal index varied by 10.8% in dusted plants in comparison with that of plants grown in the control plot (Table 4).

Elemental analysis: When the soils from the control and experimental plots and cement kiln dust were analyzed separately for their elemental composition by using Energy Dispersive Analysis of X - rays (EDAX), soils in the control and experimental plots were found to contain Si as a major component with 66.41% in control and 63.83% in experimental plot, while Mg as a minor constituent with 0.29% in the control plot and 0.64 % in the experimental plot. In contrast, the cement kiln dust had Ca as a major element with 67.74% and Cl as a minor element with 0.68% (Table 2).

It is evident from the elemental analysis of soils in the control and polluted plots that 2.11% of calcium was present in the soil of the former plot, while the latter one had calcium to the tune of 3.06%, which may be due to the addition of

Table 4. Epidermal features of control and cement kiln dust polluted plants of *Coriandrum sativum*

Age of the plant (days)		Epidermal cell frequency	Stomatal frequency	Trichome frequency	Epidermal cell size (µm)	Guard cell size (µm)	Trichome size(µm)	Stomatal pore size (µm)	Stomatal index
20	C	32.561±1.439^{a}	9.31±0.125^{a}	0.492±0.015^{a}	2.063±0.142^{a}	0.623±0.014^{a}	2.375±0.164^{a}	0.426±0.051^{a}	22.23±1.852^{a}
	D	30.783±1.542^{a}	8.98±0.149^{b}	0.428±0.026^{b}	2.015±0.108^{a}	0.616±0.025^{a}	2.286±0.049^{a}	0.412±0.048^{a}	22.583±1.650^{a}
40	C	36.249±1.103^{a}	10.764±0.532^{a}	0.584±0.002^{a}	2.124±0.048^{a}	0.742±0.012^{a}	2.625±0.014^{a}	0.648± 0.012^{a}	22.895±1.124^{b}
	D	33.158±1.146^{b}	9.852±0.469^{b}	0.473±0.010^{b}	2.086±0.153^{a}	0.737±0.154^{a}	2.583±0.021^{a}	0.615±0.021^{b}	29.712±1.256^{a}
60	C	42.361±2.154^{a}	11.738±0.214^{a}	0.618±0.004^{a}	2.575±0.036^{a}	0.987±0.148^{a}	2.875±0.026^{a}	0.855±0.029^{a}	21.700±1.048^{b}
	D	39.514±1.268^{a}	10.356±0.125^{b}	0.603±0.002^{b}	2.186±0.028^{b}	0.965±0.246^{a}	2.694±0.012^{b}	0.278±0.016^{b}	26.208±1.536^{a}
80	C	47.825±1.078^{a}	12.964±0.518^{a}	0.659±0.024^{a}	2.575±0.012^{a}	1.062±0.318^{a}	3.025±0.016^{b}	1.015±0.024^{a}	21.326±1.843^{a}
	D	41.937±1.864^{b}	10.853±0.649^{b}	0.618±0.025^{b}	2.056±0.024^{b}	0.987±0.426^{a}	3.148±0.025^{a}	0.998±0.016^{a}	21.633±1.521^{a}
100	C	53.48±1.562^{a}	15.782±1.126^{a}	0.768±0.019^{b}	2.584±0.020^{a}	1.375±0.248^{a}	3.351±0.024^{a}	1.067±0.015^{a}	22.785±2.563^{a}
	D	46.568±1.476^{b}	15.246±0.153^{a}	0.872±0.028^{a}	2.165±0.012^{b}	1.125±0.206^{a}	3.268±0.015^{b}	0.987±0.014^{b}	24.664±2.221^{a}
120	C	59.759±1.368^{a}	18.679±1.266^{a}	0.793±0.024^{a}	2.625±0.136^{a}	1.268±0.539^{a}	3.468±0.012^{a}	1.195±0.013^{a}	23.813±1.649^{a}
	D	45.346±1.729^{b}	16.532±1.486^{a}	0.781±0.023^{a}	2.487±0.531^{a}	1.159±0.463^{a}	3.356±0.024^{b}	1.083±0.021^{b}	26. 712±1.348^{a}

C = Control; D= dusted; Values (mean ± SD) followed by dissimilar letters in each column are significantly different at $p \le 0.05$

cement kiln dust to the latter one (Table 2). According to Lamare and Singh (2020) the deposition of dust onto the soil surface enriches the soil with Ca^{++} ions. Cement dusts contain calcium and when it comes in contact with phosphorus forms chelate resulting in reduction of phosphorus availability in the soils (Jain and Jain 2006). Besides, Adebiyi et al (2021) found variations in the other soil nutrient properties; carbon, nitrogen, phosphorus, potassium, sodium, calcium, magnesium, cation exchange capacity and organic matter arising from the effect of cement dust.

pH values and physical properties: pH of the soil ranges between 7.0 to 7.5 in the control plot and 8.5 to 9.2 in the dust polluted soil, the cement kiln dust was found to have the pH ranging between 10 to 11.5 (Table 5). According to Lamare and Singh (2020) due to deposition of cement dust on the soil near the cement plants, this caused a change in soil pH to the alkaline side. May be due to such a composition the cement dust kiln dust is found harmful to vegetation. Moreover, Rawat and Katiyar (2005) opined that the dust makes the soil alkaline and consequently reduces the microbial activity releasing less nitrogen. Abdel-Rahman and Ibrahim (2012) reported that cement dust accumulation caused an increase in pH of soil solution, salinity, calcium carbonate, electrical conductivity, total alkalinity and sulphate contents beside the disturbance of soil texture and that may eventually it may lead to reduce the yield.

Among the control and dust polluted soils of the present investigation, the dust polluted soil showed increase in the apparent density and absolute specific gravity, while the percentage pore space and maximum water holding capacity were found to decrease (Table 5). In view of the changes that occur in the physical and chemical properties of the soil due to cement kiln dust pollution, it is but natural that plants grown under such an environment get subjected to stress. In the present study, cement kiln dust is found to accumulate on both the surfaces of the leaves of plants exposed to cement kiln dust pollution and accumulation was found to be more on their adaxial surfaces. The settled dust in combination with mist or light rain forms a relatively thick crust on the upper surface. Chaurasia et al (2013) studied the effect of cement kiln dust on plants and observed the formation of crusts on leaves, twigs and flowers. The accumulation of cement kiln dust was more in the older plants. The crust is formed because some portion of the settling dust consists of the calcium silicates, which are typical of the clinker from which cement is made. When this dust is hydrated on the leaf surfaces, a gelatinous calcium silicate hydrate is formed, which later crystallizes and solidifies to a hard crust (Kabiru et al 2015).

On the analysis of the physical properties of control and cement kiln dust polluted soils it was observed that that the percentage of pore size was more in the control soil (70.18) than that of the dust polluted soil (51.73). In contrast, the control soil had less apparent density (1.09) than that of dust polluted soils (1.26). Other physical properties of the soil in the control and experimental plots such as absolute specific gravity and maximum water holding capacity are given in Table 5.

Table 5. Physical priorities of control and cement kiln dust polluted soils*

Property	Control soil	Cement kiln dust polluted soil
Apparent density	01.09	01.26
Absolute specific gravity	02.95	03.64
Percentage pore space	70.18	51.73
Maximum water holding capacity	59.45	33.58

CONCLUSIONS

Most of the morphological, epidermal and biochemical parameters of *Coriandrum sativum* elucidated under the present investigation got affected due to the cement kiln dust pollution, which eventually affects the growth and yield of the coriander crop.

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