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Effect of cement kiln dust on sorghum and blackgram crops

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Abstract : Two pot culture experiments were conducted at Agricultural College and Research Institute, Killikulam with sorghum and blackgram as test crops on a sandy clay soil during October, 1997 to January 1998. Cement kiln dust collected from a cement factory was artificially mixed with the soil at 10 different ratios varying from 10g to 100g dust per kg of soil and the crops were grown. Results showed that uptake of nutrients generally increased in both the crops whereas leaf area index, dry matter production and grain yield showed reduced values. (***Key Words*** *: Cement dust, Leaf area index, Drymatter production).*

Cement factories are considered as a major emission source of particulate matter into the atmosphere especially cement kiln dust. In comparison to gaseous pollutants, relatively little is known and limited studies have been carried out on the effect of particulate on vegetation (Prasad and Inamdar, 1990). the present paper aimed to assess the effect of cement dust pollutant on certain growth parameters of sorghum and blackgram crops while mixing the dust with soil in different ratios.

Materials and Methods

For the pot culture experiments, bulk soil samples representing sandy clay texture were used. The soil was neutral in reaction, low in soluble salts, low in organic carbon, medium in available N, high in available P and medium in available K. Eight kg of the processed soil was filled in earthern pots and calculated quantities of the cement kiln dust were added as per the treatments given below and thoroughly mixed. Sorghum (K-8) and blackgram (ADT-3) seeds were sown in these pots. Uniform population of three plants were maintained in each pot.

Treatment details :

T_0 - Control (No dust mixing);
T_1 - 10g cement kiln dust/kg of soil;
T_2 - 20g cement kiln dust/kg of soil;
T_3 - 30g cement kiln dust/kg of soil;
T_4 - 40g cement kiln dust/kg of soil;
T_5 - 50g cement kiln dust kg of soil;
T_6 - 60g cement kiln dust/kg of soil;
T_7 - 70g cement kiln dust/kg of soil;
T_8 - 80g cement kiln dust/kg of soil;
T_9 - 90g cement kiln dust/kg of soil;
T_{10} - 100g cement kiln dust/kg of soil;

The above treatments were replicated thrice in a completely randomized block design, The crops were harvested at maturity and the yield of grain and straw in the case of sorghum crop and that of pods and haulms in blackgram were recorded. In each pot, the leaf area index was measured in the third leaf from top which has been recognised as the index leaf for the purpose. Also the girth of the plants at the central region was measured with a vernier caliper. Total N, P, K, Ca and Mg contents in the whole plant samples at the time of harvest were determined by standard procedures (Piper, 1966).

Results And Discussion

There was a significant reduction in the N and P contents of sorghum plants due to increasing doses of cement kiln dust which can be related to the reduced availability of these nutrients in the post harvest soil. K, Ca, Mg and Na contents were increased in the dusted soil. This might be due to the release of these ions from the cement kiln dust. The total uptake of N, P, K, Ca, Mg and Na were increased by dust application in sorghum crop. Reduced N and P contents of sorghum had not resulted in significant reductions in dry matter production due to a balanced nutrition of all the other essential elements (Table 1 and 2).

There was a significant reduction in the leaf area index, stem girth, grain yield and dry matter production due to cement dust addition. Calcium and aluminium hydroxides formed during the hydration of cement dust might have increased the soil pH, thereby, producing unfavorable soil conditions which led reduction in leaf area, drymatter production and grain yield. Similar results indicating on the reduction in yield in dusted soils have also been reported in sorghum (Singh and Rao, 1978) and in sorghum and maize (Oblisami *et al.* 1978).

Table 1. Effect of cement kiln dust on nutrient contents and total uptake in sorghum at harvest

Treatment	N		P		K		Ca		Mg		Na	
	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)
T_0	2.85	0.314	0.508	0.071	0.779	0.121	0.428	0.069	0.222	0.042	0.117	0.019
T_1	2.76	0.309	0.435	0.073	0.811	0.121	0.470	0.060	0.226	0.043	0.124	0.024
T_2	2.73	0.326	0.385	0.079	0.823	0.122	0.516	0.068	0.242	0.043	0.121	0.024
T_3	2.76	0.328	0.376	0.085	0.845	0.131	0.523	0.072	0.253	0.048	0.135	0.026
T_4	2.72	0.330	0.354	0.086	0.836	0.135	0.563	0.077	0.291	0.052	0.126	0.028
T_5	2.73	0.324	0.336	0.091	0.851	0.131	0.574	0.083	0.335	0.052	0.143	0.025
T_6	2.48	0.336	0.315	0.088	0.867	0.138	0.628	0.082	0.344	0.050	0.145	0.029
T_7	2.61	0.352	0.318	0.093	0.930	0.147	0.619	0.083	0.343	0.053	0.136	0.030
T_8	2.44	0.350	0.322	0.092	0.978	0.142	0.645	0.087	0.331	0.056	0.152	0.016
T_9	2.43	0.354	0.294	0.093	1.045	0.159	0.657	0.066	0.359	0.054	0.146	0.016
T_{10}	2.41	0.354	0.293	0.091	1.031	0.164	0.686	0.065	0.397	0.052	0.163	0.013
Mean	2.892	0.334	0.394	0.086	0.980	0.137	0.631	0.074	0.304	0.050	0.137	0.023
CD (0.05)	0.148	0.013	0.022	0.003	0.032	0.003	0.037	0.009	0.019	0.003	0.013	0.003

Table 2. Effect of cement kiln dust on the growth parameters and yield of sorghum

Treatment	Leaf area index (LAI)			Stem girth (cm)	Grain yield (g/pot)	Dry matter production (g/pot)
	Vegetative Stage	Flowering Stage	Harvest Stage			
T_0	5.21	6.03	6.51	1.9	5.60	13.44
T_1	5.03	5.98	6.48	1.89	5.57	13.33
T_2	4.95	5.76	6.44	1.86	5.56	13.28
T_3	4.70	5.71	6.40	1.83	5.49	13.25
T_4	4.65	5.02	6.38	1.80	5.43	13.21
T_5	4.63	4.97	5.98	1.79	5.36	13.18
T_6	4.57	4.78	5.85	1.76	5.34	13.08
T_7	4.37	4.53	5.12	1.75	5.31	12.97
T_8	4.32	4.32	4.87	1.74	5.29	12.86
T_9	4.30	4.29	4.36	1.69	5.26	12.82
T_{10}	4.25	4.19	4.14	1.61	5.07	12.64
Mean	4.63	5.05	5.68	1.78	5.39	13.10
CD (0.05)	0.038	0.019	0.021	0.009	0.011	0.008

In case of blackgram, the N content was significantly reduced in the dusted soils due to the reduced availability of this nutrient in the soil. The increased availability of K, Ca, Mg and Na in the dusted soils might have increased the contents of these nutrients in the haulms (Table 3).

Nitrogen and P uptake were reduced in blackgram haulms in the dusted soils due to the reduced availability of N as well as reduced contents of N in the grains and haulms in the dusted soil. The P accumulated in the haulms was not utilised in increasing the dry matter production probably due to some physiological inhibition in the dusted soils. The uptake of Ca, Mg, Na and K have also been increased and this could be related to the increased availability of these nutrients in the dusted soils (Table 4).

The leaf area index, dry matter production and grain yield have been significantly reduced in the dusted soils. High soil pH, increased osmotic potential and adverse soil physical conditions might have contributed to reduced yield, and dry matter production. Reduction in biomass under dust polluted environment had been reported by Prasad and Inamdar (1990) in blackgram and Satao *et al.* (1993) in cotton.

Table 3. Effect of cement kiln dust on nutrient contents and total uptake in blackgram whole plants (haulms) at harvest.

Treatment	N		P		K		Ca		Mg		Na	
	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)	Content (%)	Uptake (g/pot)
T_0	3.05	0.154	0.32	0.025	0.08	0.0068	0.250	0.0118	0.242	0.0081	0.126	0.0046
T_1	3.01	0.147	0.35	0.019	0.12	0.0072	0.253	0.0124	0.249	0.0081	0.152	0.0072
T_2	2.99	0.146	0.43	0.019	0.14	0.0085	0.300	0.0144	0.252	0.0076	0.155	0.0080
T_3	3.02	0.143	0.49	0.019	0.17	0.0099	0.303	0.0150	0.255	0.0082	0.160	0.0077
T_4	3.00	0.141	0.51	0.018	0.19	0.0119	0.306	0.0150	0.263	0.0085	0.165	0.0070
T_5	3.00	0.136	0.53	0.017	0.22	0.0134	0.308	0.0140	0.267	0.0087	0.169	0.0075
T_6	2.72	0.133	0.54	0.013	0.24	0.0140	0.318	0.0190	0.279	0.0092	0.183	0.0076
T_7	2.62	0.132	0.55	0.016	0.21	0.0150	0.329	0.0140	0.283	0.0095	0.179	0.0079
T_8	2.61	0.130	0.59	0.016	0.24	0.0166	0.395	0.0110	0.287	0.0099	0.184	0.0078
T_9	2.66	0.126	0.67	0.015	0.28	0.0169	0.414	0.0170	0.287	0.0098	0.193	0.0078
T_{10}	2.64	0.126	0.74	0.015	0.28	0.0169	0.419	0.0150	0.315	0.0110	0.197	0.0074
Mean	2.847	0.138	0.52	0.017	0.197	0.0125	0.327	0.0140	0.271	0.009	0.169	0.0073
CD (0.05)	0.066	0.003	0.048	0.003	0.024	0.004	0.007	0.0025	0.016	0.001	0.004	0.012

Table 4. Effect of cement kiln dust on the growth parameters and yield of blackgram

Treatment	Leaf area index (LAI)			Grain yield (g/pot)	Dry matter production (g/pot)
	30 DAS	45 DAS	Harvest		
T_0	2.66	3.33	3.51	2.93	11.11
T_1	2.55	3.30	3.42	2.83	10.99
T_2	2.52	3.30	3.40	2.81	10.85
T_3	2.50	3.31	3.39	2.81	10.65
T_4	2.51	3.22	3.34	2.80	10.58
T_5	2.42	3.18	3.24	2.77	10.12
T_6	2.30	3.10	3.29	2.71	9.99
T_7	2.19	3.06	3.20	2.73	9.94
T_8	2.15	2.94	3.18	2.71	9.49
T_9	2.12	2.83	3.22	2.67	9.30
T_{10}	2.05	2.78	3.15	2.66	9.18
Mean	2.36	3.12	3.30	2.76	10.2
CD (0.05)	0.088	0.110	0.076	0.050	0.098

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