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Changes in Growth, Pigments and Carbohydrates of Soybean and Rosemary Agroecosystem in Response to Soils Treated with Ceramic Dust in Egypt

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Abstract: The use of pollution as a soil amendment was highly demand for all scientific researchers to face its side effect on the Egyptian ecology. Three replicates of 90 pots culture experiments were conducted at the Faculty of Science, Zagazig University during 2001-2002 to evaluate the impact of ceramic dust as a source of pollution on the growth of soybean (***Glycine max*** L. cv. Crawford) and rosemary (***Rosmarinus officinalis*** L.) grown singly and in combination. We take 1 kg from three different kinds of soils (Delta soil, Desert soil and Sahl El-Tean soil) to be under high control. Ceramic dust was handily mixed with these soils at five rates varying from 0 to 200 g dust kg^{-1} of soil. The seeds of the two plants were sown on these soil as follow: One soybean only, one soybean+one rosemary, two soybean+one rosemary, three soybean+one rosemary, one soybean+two rosemary and one soybean+three rosemary. With Delta soil treatments, ceramic dust at 5 and 10% caused significant increase in plantation success, plant height, yield, pigments and carbohydrates of soybean and rosemary as compared to control. On the other hand, non-significant difference were obtained at 15 and 20% of the rest of applications. The results indicated that best significant responses showed especially with desert soil. One plant soybean+one plant rosemary are resistant to ceramic dust pollution and we are recommended this kind of cultivation for growing plants in polluted sites.

Key words: Pollution, cement-dust, ceramic-dust, growth, carbohydrates, pigments, soybean and rosemary, competition

Introduction

This research is intended for those who have a vested interest in one of industrial residues could be useful for our life and uniquencess in this field. The famous one known is the ceramic dust. Generally, the ceramic industrial residues “dust” is a some kind of ceramic rappish i.e. the dust in the first steps of industrial process. It is produced as a result of ceramic raw materials mixing or mixing and grinding. Ceramic raw materials has no any abnormal chemical structure. It is a natural raw material. The main components of ceramic industrial residue is SiO_2 = 62.6%, Al_2O_3 = 17.55%, Fe_2O_3 = 1.42%, CaO = 4.28%, MgO = 0.21%, SO_3 = 0.41%, O_2= 1.74%, Na_2O = 0.45%, TiO_2 = 0.88%, MnO_2 = 0.03%, P_2O_3 = 0.57% and Cl^- = 0.06%. Due to the lack of available scientific research about ceramic dust, we will depend on any work done on cement dust which similar to ceramic dust but the chemo-physical analysis shows that ceramic dust is better than cement dust.

Many studies have demonstrated the harmful effect of cement dust on plant characteristics (Mandre ***et al.***, 2000; Potkile ***et al.***, 1999 a,b; Mandre ***et al.***, 1999 a,b; Mandre and Ots, 1999; Topic, 1999; Durge and Phadnawis, 1998; Saravanan and Appavu, 1998; Moretti ***et al.***, 1998 and Saralobai and Vivekanandan, 1995). The long-term impact of high dust pollution from a cement industries on growth, carbohydrate content and nutrient composition was studied in 6-year-old Norway spruce (***Picea abies***), white spruce (***P. glauca***), black spruce (***P. mariana***), Scots pine (***Pinus sylvestris***) and Douglas fir (***Pseudotsuga menziesii***) planted in field experiments at Kunda, northeastern Estonia (Mandre ***et al.***, 2000; Mandre ***et al.***, 1999a; Bacic ***et al.***, 1999; Rauk ***et al.***, 1998). Also, Two year old seedlings of ***Picea abies***, ***P. glauca*** and ***P. mariana*** were planted in a sample plot subjected to high concentrations of cement dust and in an unpolluted (control) area in NE Estonia in 1990. Old trees were dug up in the pre-budbreak period for morphological assessment, biomass and growth factors (Mandre and Ots, 1999).

Research on ceramic dust application to the soils and their relation to productivity had largely been studied (Iqbal and Shafig, 2001; Misra ***et al.***, 2000; Subha and Dakshinamoorthy, 2000; Zargar ***et al.***, 1999; Du ***et al.***, 1998). In a field experiment in Maharashtra, wheat cv. Kalyansona was treated with 0, 1, 3 or 5 g m^{-2} of soil, cement or kiln dust 30 days after sowing. Dust application decreased grain yield. The yield reduction was greater under cement or kiln dust than soil dust. The yield reduction was related to the decrease in spikes m^{-2}, spikelets/spike, grains/spike and 1000-grains weight (Durge and Phadnawis, 1998). The impact of long term dust pollution emitted from a cement works at Kunda, Estonia, on the growth, nutrients content and allocation in conifers was investigated during 1990-97. Seedlings of 5 species were planted at distances of 34 (control) and 0.5 km from the works (Mandre ***et al.***, 1999b). The germination behavior of green gram (***Vigna radiata***) and sorghum were studied in red soil mixed with cement kiln dust in various proportions (Saravanan and Appavu, 1998).

Some studies on the effects of increasing doses of ceramic dust on certain plants on partitioning have been demonstrated a good relationship with soil. In Rao and Narayanan (1998) pot experiment, rice cv. IR 64 was dusted with 0 or 50 g cement kiln dust/m^2 at pre-flowering, pre-flowering+flowering, or pre-flowering+flowering+post-flowering growth stages. Plant growth and yield were decreased by cement dust, particularly when applied at all 3 growth stages. Effects on growth parameters, weight of different plant organs, yield components and mineral content are tabulated. Rice growth was assessed 0.5 or 5 km from the Madras Cement Factory, Krishna district andhra Pradesh. Rice in the polluted area displayed decreased plant growth, reduced accumulation of phytomass and reduction in grain yield as compared to controls. Grain quality and soil properties also suffered in the polluted area (Rao and Narayanan, 1998).

Rosmarinus officinalis is evergreen shrub or sud shrub plant, but ***Glycine max*** is an annual herb plant. Soybean plays an important role as source for high protein for man and cattle too, while resemary has a significant medicinal value. These two plants have a positive influence on chemical and physical properties of their surrounding soil giving rise to fertile soil islands under the canopy of individual plants in the midst of bare soil surfaces. Because these fertile soil islands are closely linked to plant morphology and plant components improvement of soil structure is relative according to the species (Adams ***et al.***, 2000). Interactions among individual plants (like rosemary and soybean) and soil properties have bean described by many authors for patchy communities of arid and semi-arid regions (Abusteit, 1993; Hawang, 1990). They have suggested that the plants of such environments locally improve the chemical micro-climatic and physical properties. The Mg, K, Na, S as greater cation exchange capacities, lower value of pH and carbonate are usually found under the canopy of individual plants than in the bare inter-plant areas and semi- arid ecosystems.

The basic effective factor in agriculture is the soil where it had deep effect in plant yields. This effect depends on its chemical and physical properties. These chemical and physical properties can be controlled according to our aims in special states. In general we classified the soils according to its nature chemical and physical properties and our change is very limited by leashing to get out salts or adding some fertilizer to increase ots needed nutrient elements according to cultivated needed plants. The main objective of the present work is to study the effect of different soil application rates of ceramic industrial residues on growth, pigments and carbohydrates of two competitive plants (soybean and rosemary) grown on a Delta (clayey), Desert (sandy) and Sahl El-Tean (loamy) soils.

Materials and Methods

Experimental design and treatments

A pot experiment was carried out during 2001-2002 growing seasons at the experimental site of the Faculty of Science, Zagazig University. To study the impact of ceramic dust on soybean and rosemary, we use three kinds of soils; Delta (clayey), Desert (sandy) and Sahl El-Tean (loamy) soils. Delta soil collected from a village near Zagazig city called Taroot far about 75 km from Cairo. Desert soil collected from area near farms in El Asher far about 60 km from Cairo with no cultivation for it except only few wild plant growth in it. Sahl El-Tean soil was collected from Sinai near East-Kantra far from the city by 10 km to the direction of north of Egypt and far from Cairo about 145 km. Its soil passed through many steps to remove its salts and show the future of this soil to be recultivated.

A randomized complete block with three replicates was used. Five different treatments were imposed. We add ceramic dust to these soils by percentage (wt/wt) 5, 10, 15, 20% ceramic dust and control. One kg of soils was used for cultivation to be under high control and showing and change fast and clearly (control= pure 1 kg of soil, 5% = 950 g of soil+50 g of ceramic dust, 10% = 900 g of soil+100 g of ceramic dust, 15% = 850 of soil+150 g ceramic dust, 20% = 800 g of soil+200 g of ceramic dust). The ceramic dust was mixed carefully with soils and prepared for cultivation. The main components of ceramic industrial residue is SiO_2 = 62.6%, Al_2O_3= 17.55%, Fe_2O_3=1.42%, CaO= 4.28%, MgO= 0.21%, SO_3= 0.41%, O_2= 1.74%, Na_2O= 0.45%, TiO_2= 0.88%, MnO_2= 0.03%, P_2O_5= 0.57% and Cl^-= 0.06%.

The seeds of soybean and rosemary were sown on these soils as follow: one soybean only, one soybean+one rosemary, two soybean+one rosemary, three soybean+one rosemary, one soybean+two rosemary and one soybean+three rosemary. Six vegetative parts of rosemary (from

Faculty of Pharmacy, Zagazig University) and four soybean seeds were planted per pot during the second week of February and third week of April for two plants respectively. After emergence, seedlings were thinned to two plants per pot. During rosemary plantation air temperature ranged between 24 and 18°C and it ranged between 35 and 27°C during plantation of soybean. Irrigation was applied three times per week for Desert soils and two times for Sahl El-Teen and Delta soils. Soil moisture was kept at 90% water holding capacity through the period of experiment.

Plant growth measurements

All plant growth measurements of seeds and above ground parts including seed germination of soybean and cutting propagation success of rosemary, height of both plants, yield of soybean and crown volume of rosemary were undertaken during different growth stages.

Estimation of chlorophyll

The photosynthetic pigments (chlorophyll a, chlorophyll b and carotenoid) were determined seasonally, according to (Metzner ***et al.***, 1965). A known fresh weight (0.05) of the studied plants was ground in a mortar with 85% acetone. This was achieved by the addition of sand and then filtered through what man filter paper No. 1. The diltrate was completed to 10 ml by aqueous acetone. The optical density of the extracted pigments was then measured sepectrophotometerically at three different wavelengths 452.5, 644 and 633 nm. The concentration of pigment faction (chl. a, chl. b and carotenoid) was determined as mg/g, using the following equations:

mg chl "a"/g tissue= $(10.3\ D_{663} - 0.918\ D_{644})$ XV/1000 XW

mg chl "b"/g tissue= $(19.7\ D_{644} - 3.87\ D_{663})$ XV/1000 XW

mg carotenoid/g tissue= $4.2\ D_{452.5}$ XV/1000/W - (0.0264 chl.a+0.426 chl.b).

Where: D= the optical density, V= the final volume of 85% acetone chlorophyll extract, W= the fresh weight of the plant leaf.

Estimation of direct reducing value (D.R.V.) (Monosaccharide) (Nelson, 1944 as modified by Naguib, 1964)

Five ml of the filtrate were neutralized using 1 N NaOH in the presence of phenol red as indicator and then cleared using basic lead acetate (137 g/L). The excess of lead acetate was precipitated by adding sodium monohydrogen phosphate (M/3). The precipitated lead phosphate was filtered off and neutralized using 1N NaOH without using phenol red, and clear solution was made up to a know volume (40 ml). Three ml of the cleared extract were mixed with 3 ml of modified Nelson' solution (solution A). The mixture was kept in a boiling water tap water and 3 ml of aresnomolybdate solution (solution B) were added. The mixture was shaken till effervescence disappearance. The resulting colored solution was diluted to 10 ml. The intensity of the developed colors was measured spectrophotometrically at 700 nm against blank.

Modified Nelson's solution

Six grams of $CuSO_4.5H_2O$ and 36.8 g potassium oxalate were completely dissolved in a known volume of distilled water, after cooling 25 g of Na_2CO_3, 25 g of Rochelle salt and 20 g of $NaHCO_3$ were added. The solution made up to 2 liter was left for 24 h followed by filtration. The cleared solution was then kept in dark.

Arsenomolybdate solution

It was made by dissolving 26 g of ammonium molybdate in 450 ml distilled water to which 21 ml concentrated H_2SO_4 and 3 g of disodium hybrogen arsenate were added, the volume was made up to 500 ml and the solution was stored in a brown bottle and left for 24 h before use.

Estimation of total reducing value (T.R.V.) (Naguib, 1964)

Four ml of the filtrate were hydrolyzed with equal volume of 1N HCL (4 ml) at 60°C for 30 minutes (total mortality of the mixture was 0.5 N). The test tube containing hydrolystate was cooled, then neutralized by using 1N NaOH in the presence of phenol red as indicator, then cleared using basic lead acetate (137 g/L), then deleted using sodium monohydrogen phosphate (M/3) and made up to known volume. The process was completed as in case of direct reducing value.

Carbohydrate analysis

The 0.3 g of plant powder of each studied plants was mixed with 5 ml of 2% phenol solution and 10 ml of 30% trichloracetic acid (T.C.A.). The mixture was shaken and kept overnight in a refrigerator, then filtered. The filtrate containing soluble sugars (monosaccharides and disaccharides was made up to a known volume with distilled water (20 ml). The residue containing insoluble sugars (polysaccharide) was collected and dried down at 80°C till constant weight was obtained. Direct reducing value (D.R.V.) was estimated according to the method of Nelson, 1944 as modified by Naguib, 1964. Total reducing value (T.R.V.) was estimated according to the method of Naguib, 1964.

Statistical analysis

ANOVA was used for statistical analysis and applied using F-test to determine significant interactions and probability test $P < 0.05$ for comparison means using the SPSS® BASE 10.0 (SPSS Inc., Chicago, IL) packages. After testing for homogeneity of variance, combined ANOVA involving years, treatments, soil kind, replication and plant type were conducted.

Results

Differences for all measured traits were observed for two years for seed germination success of soybean and cutting propagation success of rosemary, long of soybean and rosemary, seed weight of soybean and rosemary, total chlorophyll of soybean and rosemary and total carbohydrates of soybean and rosemary (Fig. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10).

Table 1: Summary of significant ANOVA mean squares for soybean and rosemary characteristics over years, ceramic dust treatments, plant competition and soil kind

Source	Plantation success	Plant height	Plant production	Leaf pigment	Leaf carbohydrate
Yr	*	*	*	*	*
Tmts	**	**	**		**
Tmts × Yr					
SK	**	**	**	*	
Tmts × SK	*	*	**	**	**
Tmts × SK × Yr	*	*	*		*
Tmts × SK × Yr × Rep	*	**	**	*	
PC	**	**	**		**
PC × Yr		*	*		
PC × Tmts	**	**	**		
PC × Tmts × SK	*	**	***	*	*
PC × Tmts × SK × Yr		**	**		

PC = Plant Competition, Tmts = Soil Treatments, SK = Soil Kind, Yr = Year, Rep = Replicate

(*) Means significant at $p < 0.1$, (**) Means significant at $p < 0.05$, (***) Means significant at $p < 0.01$.

Plantation success

Seed germination success of soybean and cutting propagation success of rosemary on different kinds of soils treated with different concentrations of ceramic industrial residue were illustrated in Fig. 1 and Fig. 2. The seed germination of soybean plant at soil treatments of 5 and 10% was significantly greater than that of the soils applied with 15 and 20% ceramic dust (Fig. 1). Generally these two applications were greater among all competition between soybean and rosemary growing in desert soils, while insignificantly differed in the Sahl El-Teen soil, but Delta soil had insignificant between all treatments. In addition, Desert soil is the best between all soils type for ceramic dust applications (Fig. 1). Another characteristics, such as cutting propagation success of rosemary, may have affected in Desert and Delta soils (Fig. 2). Desert and Delta soils did not significantly differ among most all soils treatments. On average, the 5, 10 and 15% ceramic dust produced significant increase than that of 20% application but at the same time insignificant with control. All soils treatments indicating the greater potential of the all soils type takes the same manner.

Plant height

The relationships among the growth analysis characteristics and different kinds of soils treated with concentrations of ceramic industrial residue are shown in Fig. 3,4. Soybean length tended to be greater in the 5, 10 and 15% of ceramic dust than the 20% of ceramic dust and control of Delta soil, even though the 15 and 20% ceramic dust were in a lower than 5 and 10% of Desert soils. On average, the Sahl El-Teen soil under all treatments produced insignificant values (Fig. 3). Length of rosemary plants indicating the greater potential of the Sahl El-Teen soil (Fig. 4). The interaction of two plants with dust stress with respect to height is shown slight difference. Averaged over treatments, the Delta soil and Desert soils exhibited the same responses to the different concentrations of ceramic residue stress. The soybean cultivated

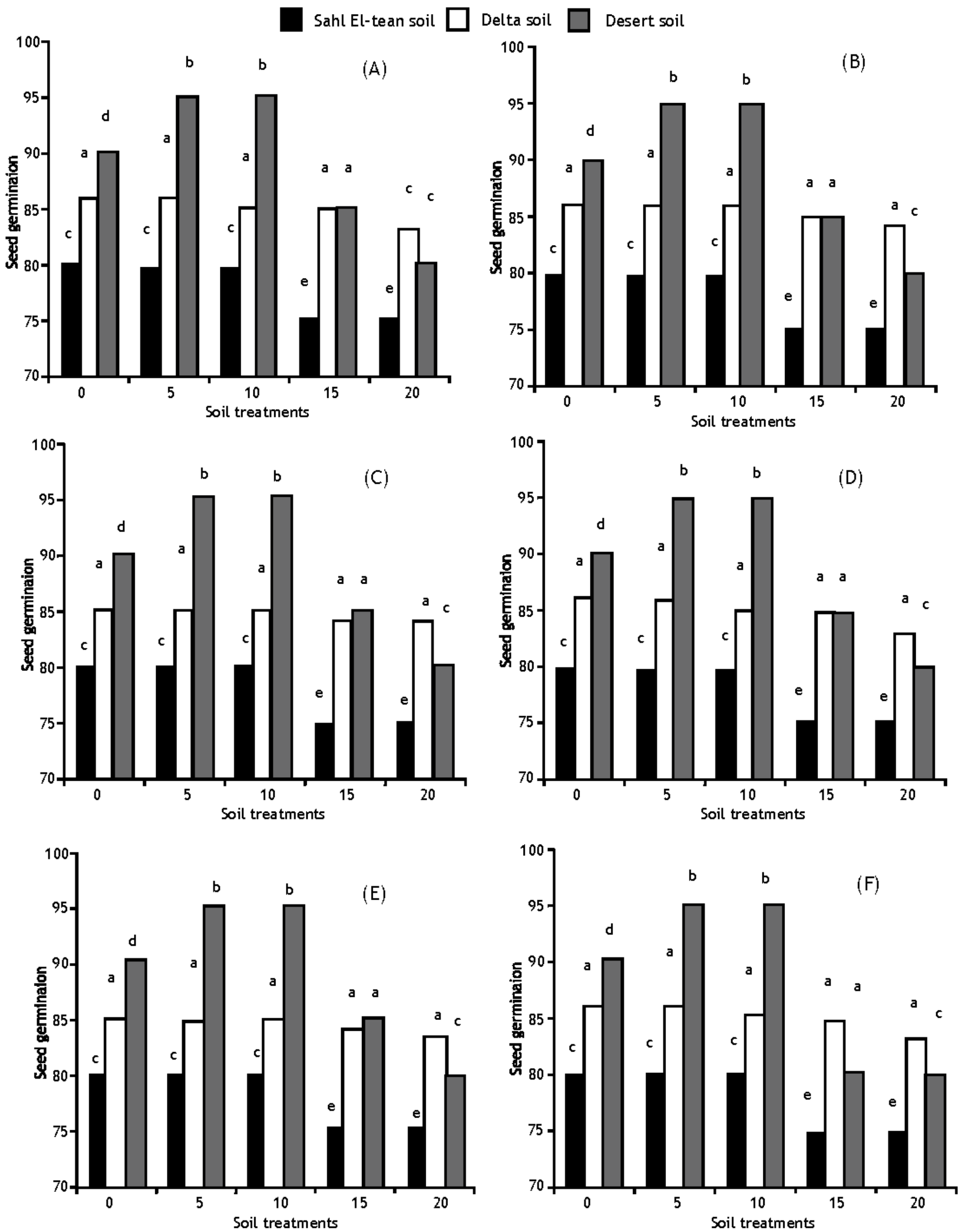

Fig. 1: Means of seed germination rate (%) success of soybean grown in differentkinds of soils treated with different concentrations of ceramic industrial residue (%).
(A) One plant soybean
(B) One plant soybean + One plant rosemary
(C) Two plants soybean + One plant rosemary
(D) Three plants soybean + One plant rosemary
(E) One plant soybean + Two plants rosemary
(F) One plant soybean + Three plants rosemary
(Columns have the same letter are insignificant at $p < 0.05$)

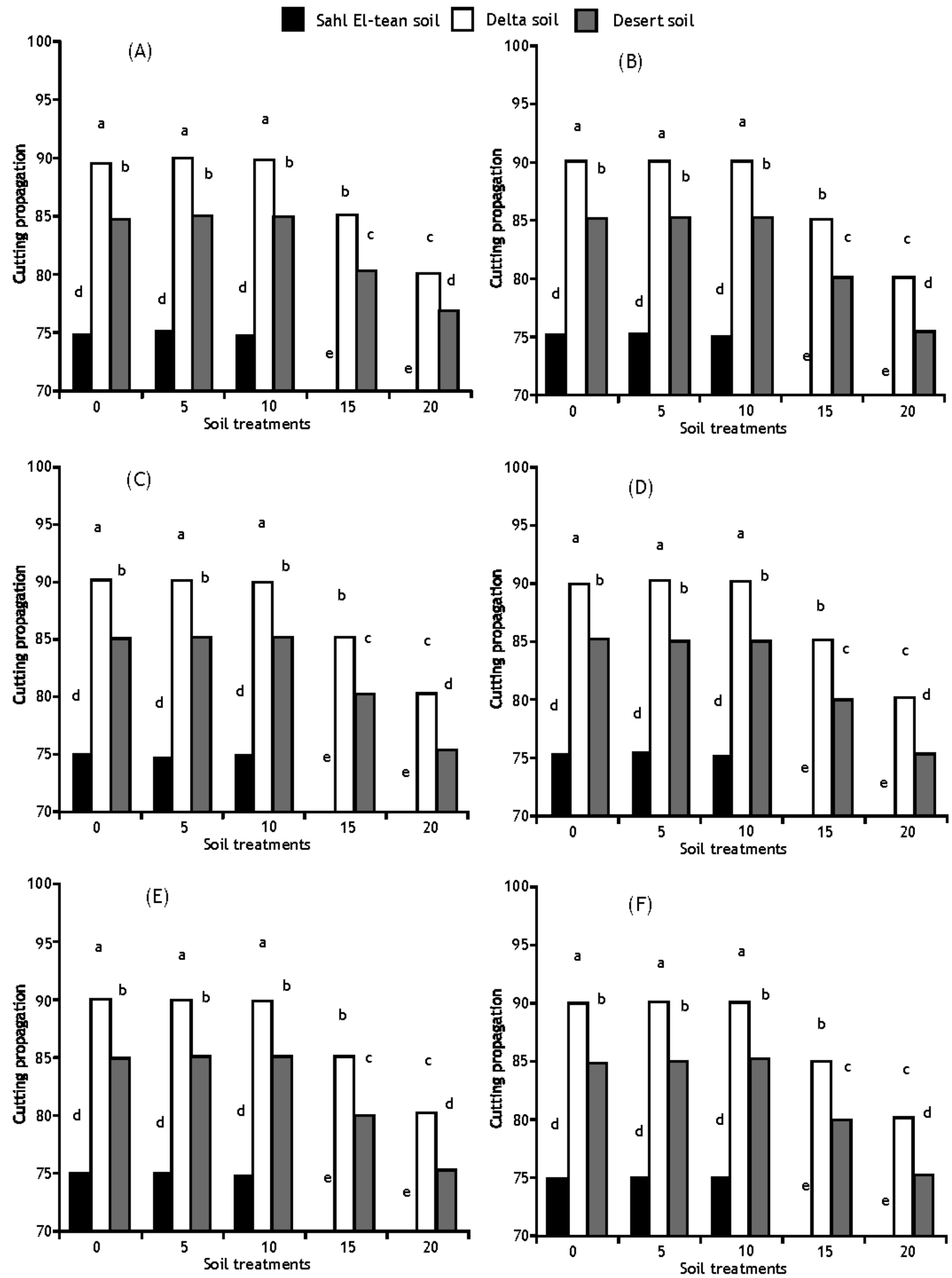

Fig. 2: Means of cutting propagation rate (%) success of rosemary grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%).
(A) One plant rosemary
(B) One plant rosemary + One plant soybean
(C) Two plants rosemary + One plant soybean
(D) Three plants rosemary + One plant soybean
(E) One plant rosemary + Two plants soybean
(F) One plant rosemary + Three plants soybean
(Columns have the same letter are insignificant at $p < 0.05$)

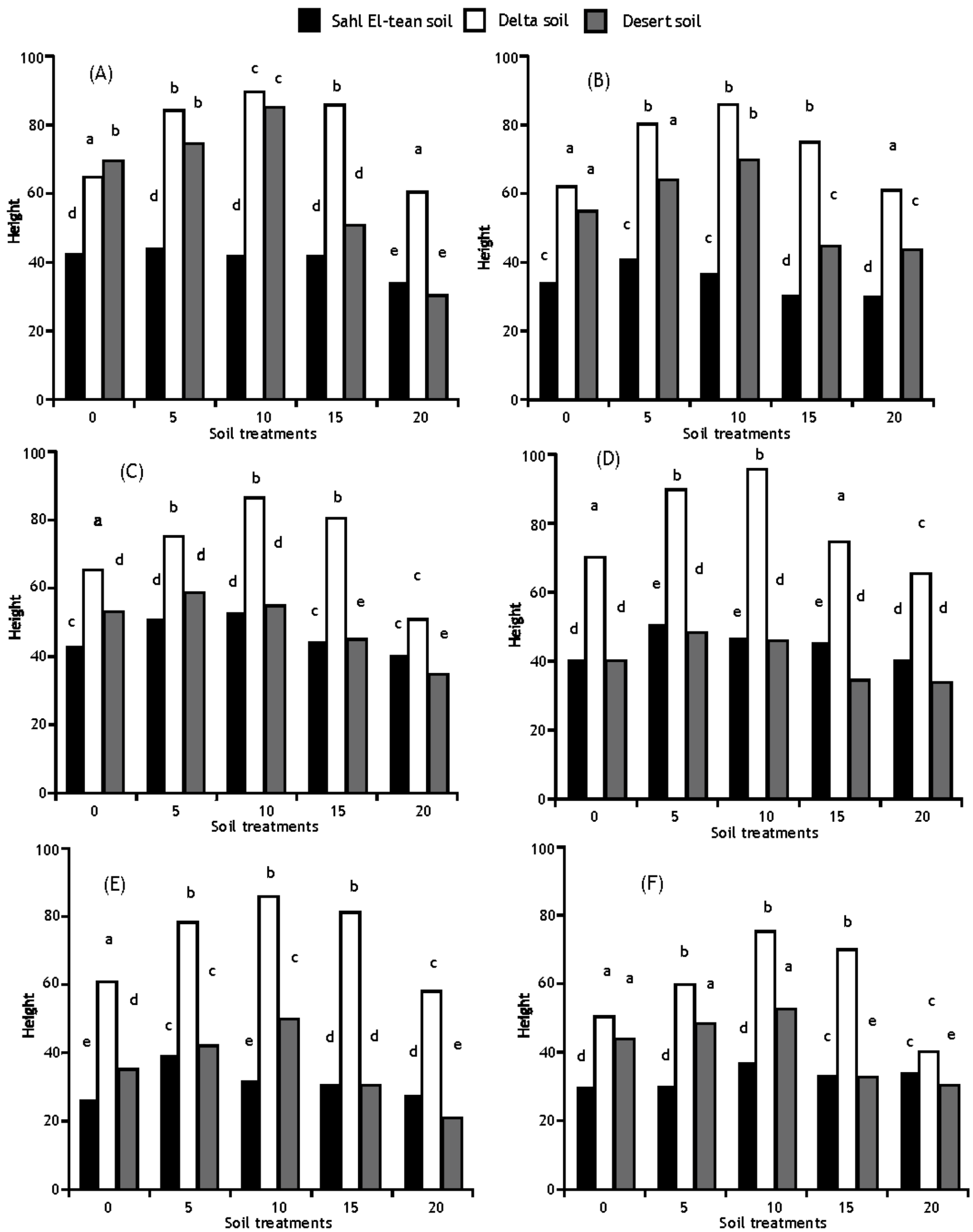

Fig. 3: Means of height of soybean plant (cm) grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%)
(A) One plant soybean
(B) One plant soybean + One plant rosemary
(C) Two plants soybean + One plant rosemary
(D) Three plants soybean + One plant rosemary
(E) One plant soybean + Two plants rosemary
(F) One plant soybean + Three plants rosemary
(Columns have the same letter are insignificant at $p < 0.05$)

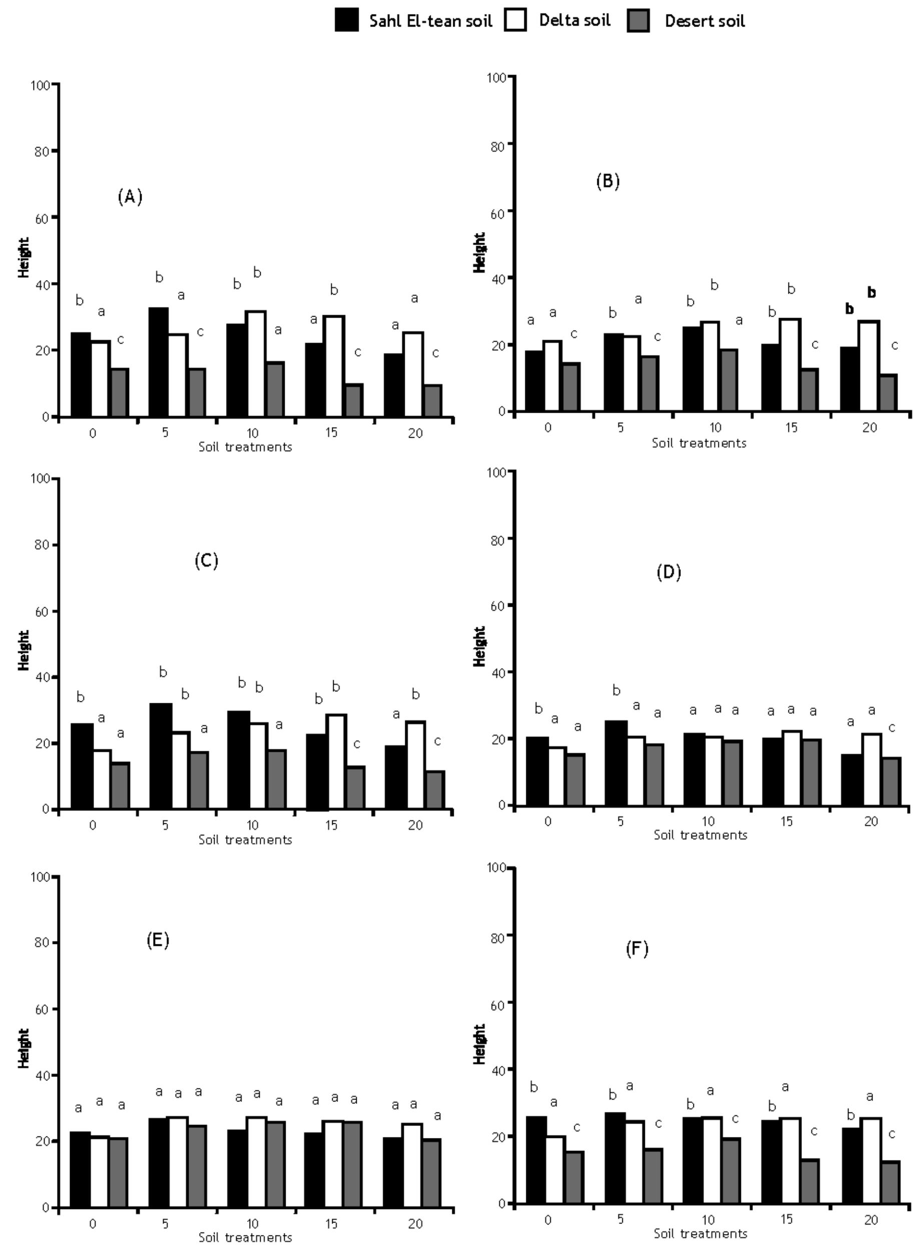

Fig. 4: Means of height of rosemary plant (cm) grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%)
(A) One plant rosemary (B) One plant rosemary + One plant soybean
(C) Two plants rosemary + One plant soybean (D) Three plants rosemary + One plant soybean
(E) One plant rosemary + Two plants soybean (F) One plant rosemary + Three plants soybean
(Columns have the same letter are insignificant at $p < 0.05$)

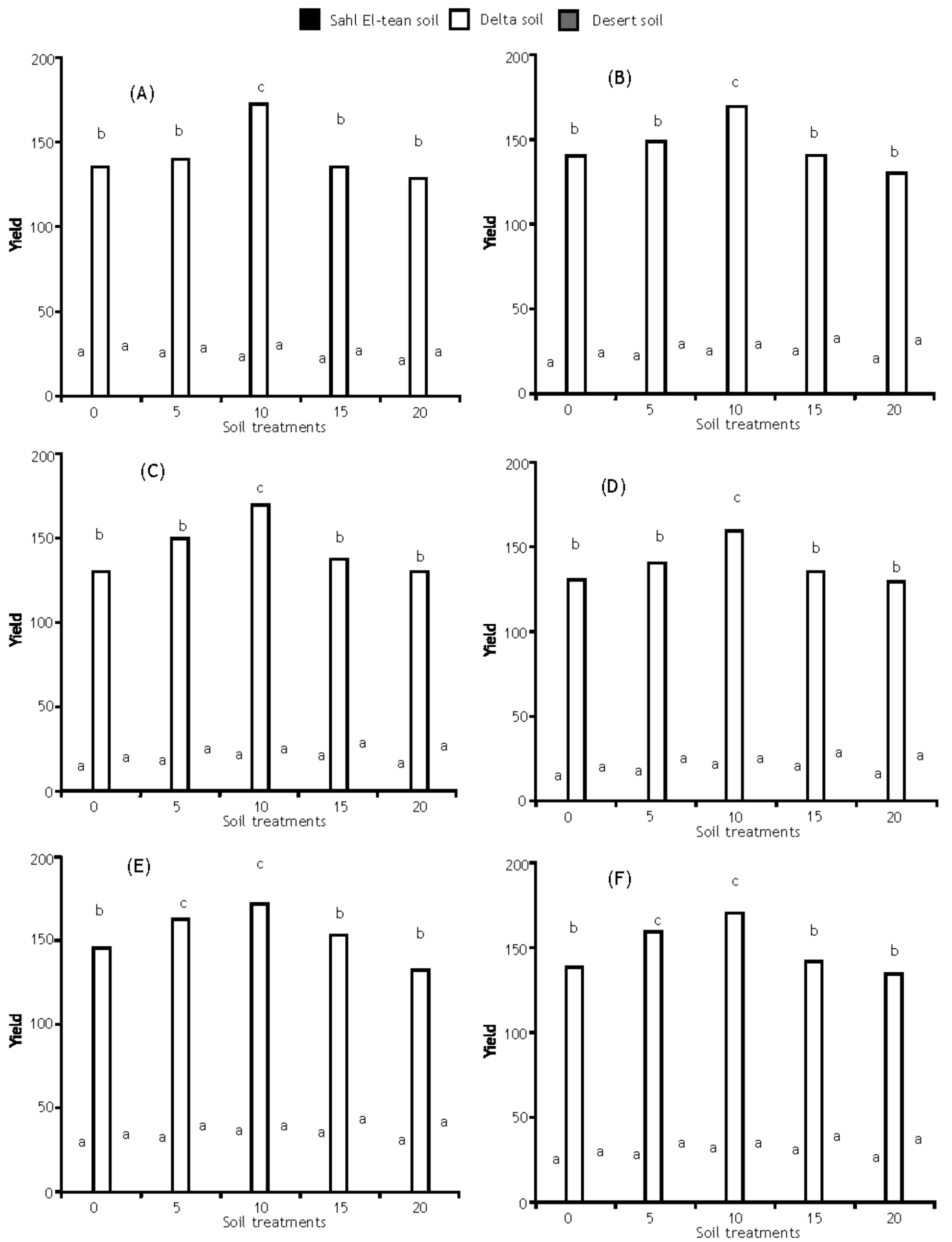

Fig. 5: Means of yield of soybean plant (mg/palnt) grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%)
(A) One plant soybean (B) One plant soybean + One plant rosemary
(C) Two plants soybean + One plant rosemary (D) Three plants soybean + One plant rosemary
(E) One plant soybean + Two plants rosemary (F) One plant soybean + Three plants rosemary
(Columns have the same letter are insignificant at $p < 0.05$)

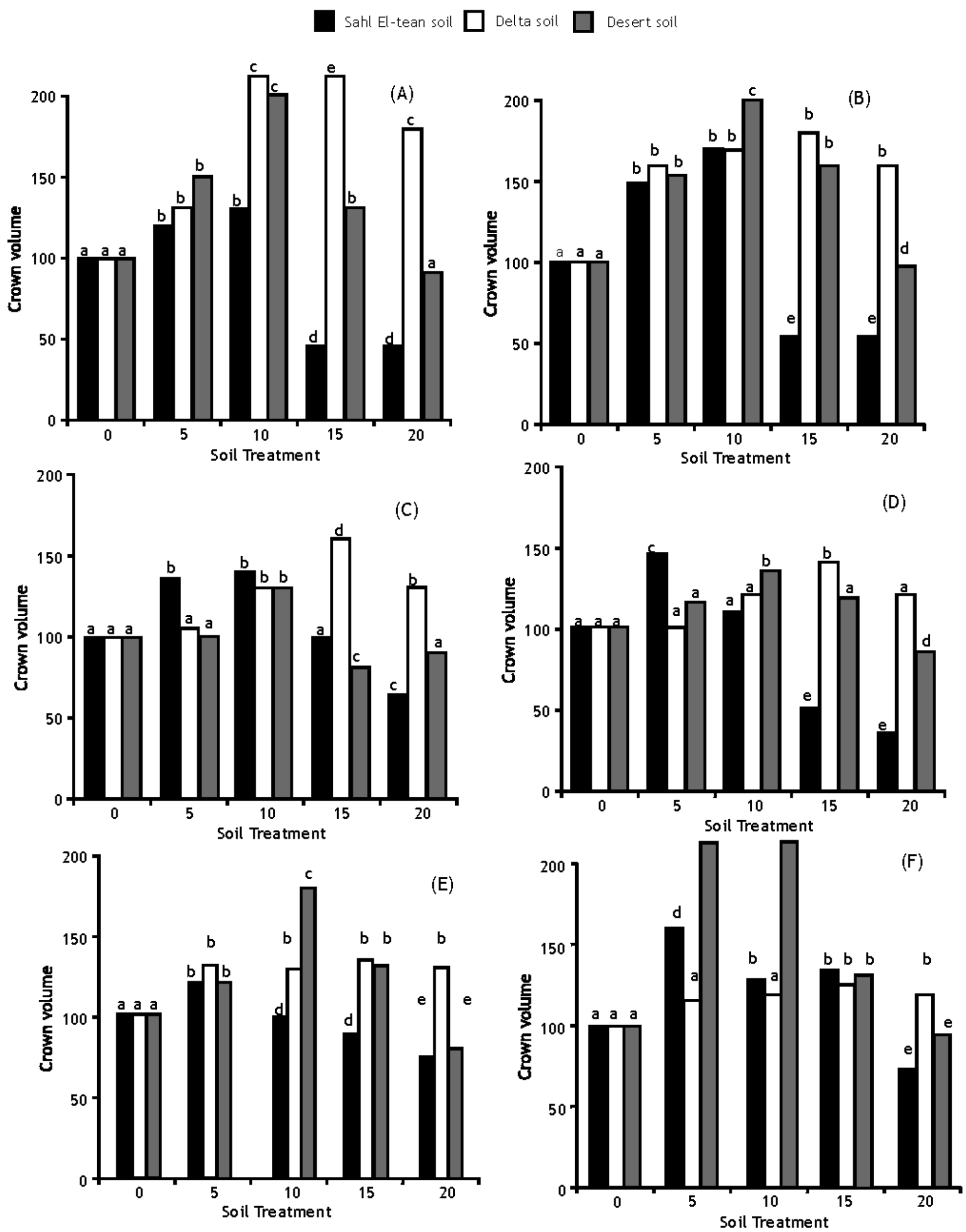

Fig. 6: Means of crown volume (cm3) of rosemary grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%)
(A) One plant rosemary (B) One plant rosemary + One plant soybean
(C) Two plants rosemary + One plant soybean (D) Three plants rosemary + One plant soybean
(E) One plant rosemary + Two plants soybean (F) One plant rosemary + Three plants soybean
(Columns have the same letter are insignificant at $p < 0.05$)

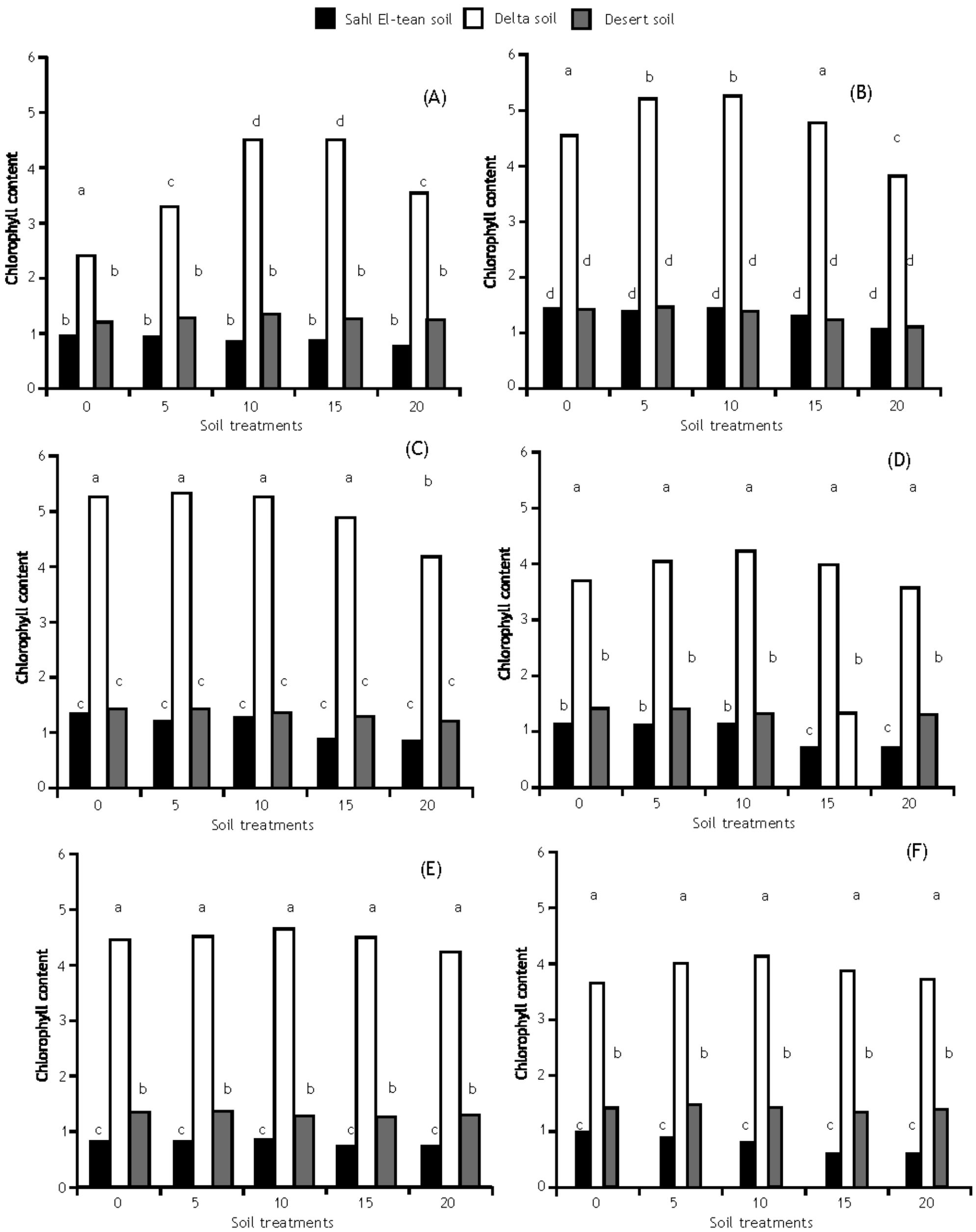

Fig. 7: Means of Chlorophyll content for soybean plant (mg/g fresh leaf) grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%)
(A) One plant soybean (B) One plant soybean + One plant rosemary
(C) Two plants soybean + One plant rosemary (D) Three plants soybean + One plant rosemary
(E) One plant soybean + Two plants rosemary (F) One plant soybean + Three plants rosemary
(Columns have the same letter are insignificant at $p < 0.05$)

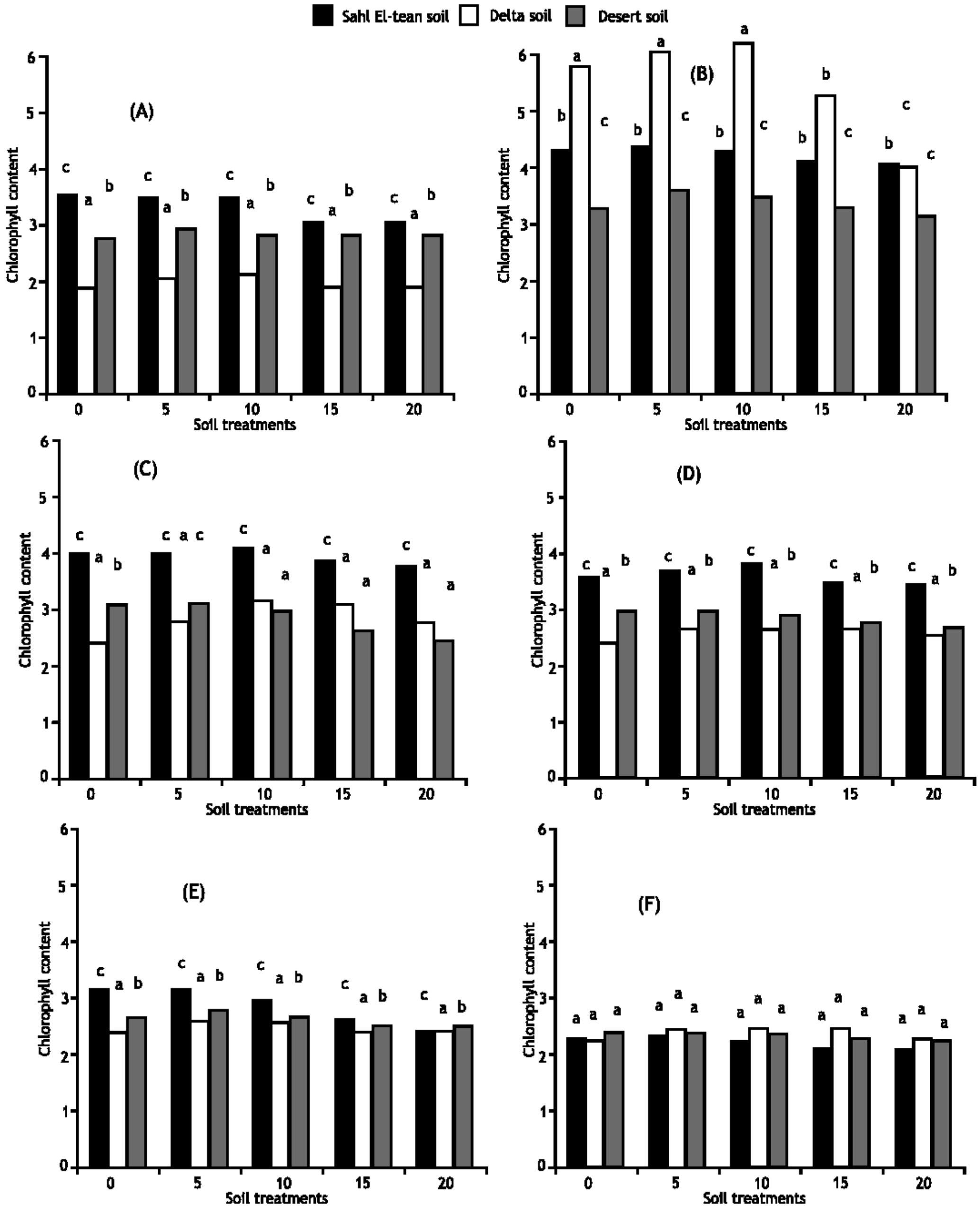

Fig. 8: Means of chlorophyll content for rosemary plant (mg/g fresh leaf) grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%)
(A) One plant rosemary (B) One plant rosemary + One plant soybean
(C) Two plants rosemary + One plant soybean (D) Three plants rosemary + One plant soybean
(E) One plant rosemary + Two plants soybean (F) One plant rosemary + Three plants soybean
(Columns have the same letter are insignificant at $p < 0.05$)

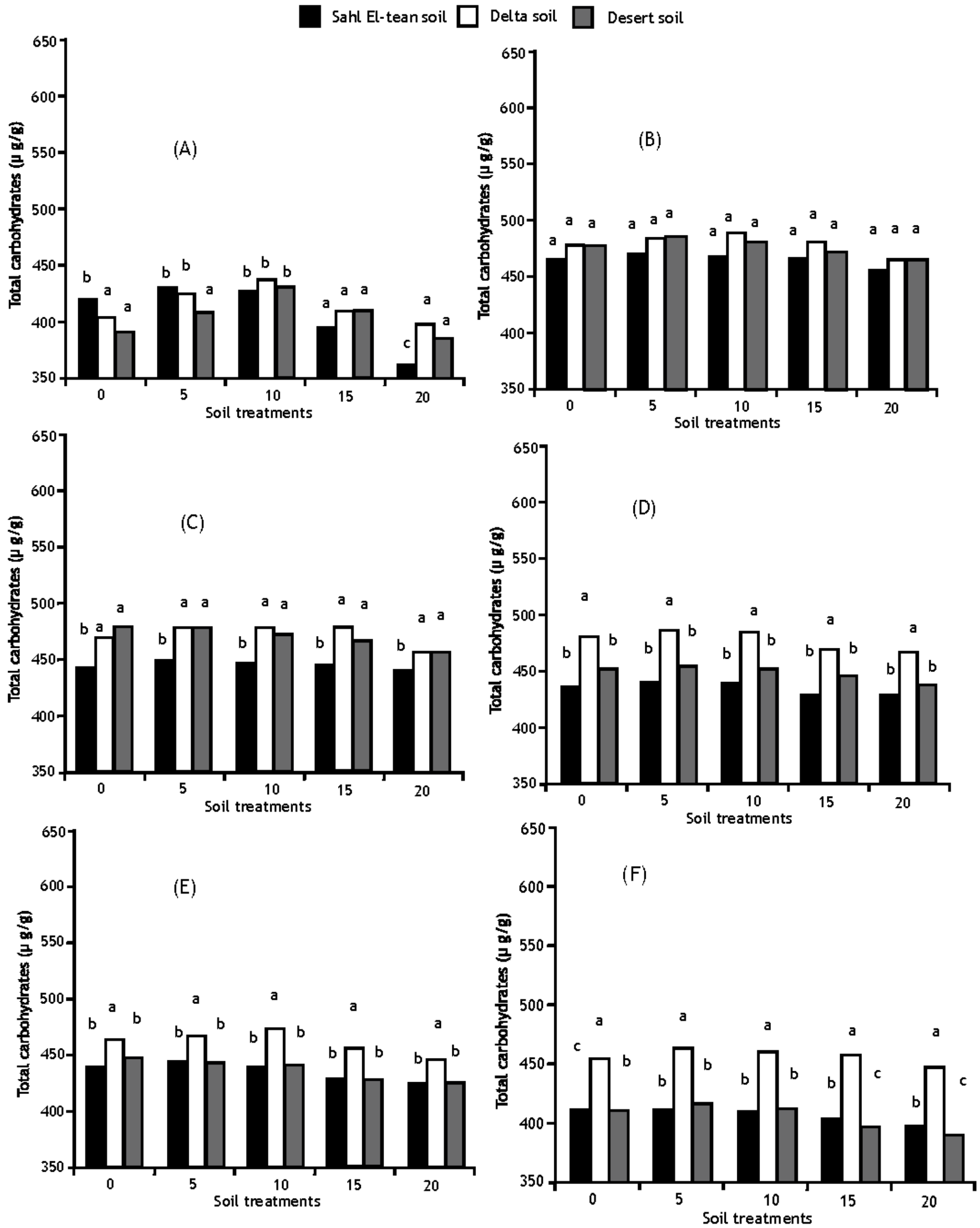

Fig. 9: Means of total carbohydrates content for soybean (m g/g) grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%)
(A) One plant soybean (B) One plant soybean + One plant rosemary
(C) Two plants soybean + One plant rosemary (D) Three plants soybean + One plant rosemary
(E) One plant soybean + Two plants rosemary (F) One plant soybean + Three plants rosemary
(Columns have the same letter are insignificant at $p < 0.05$)

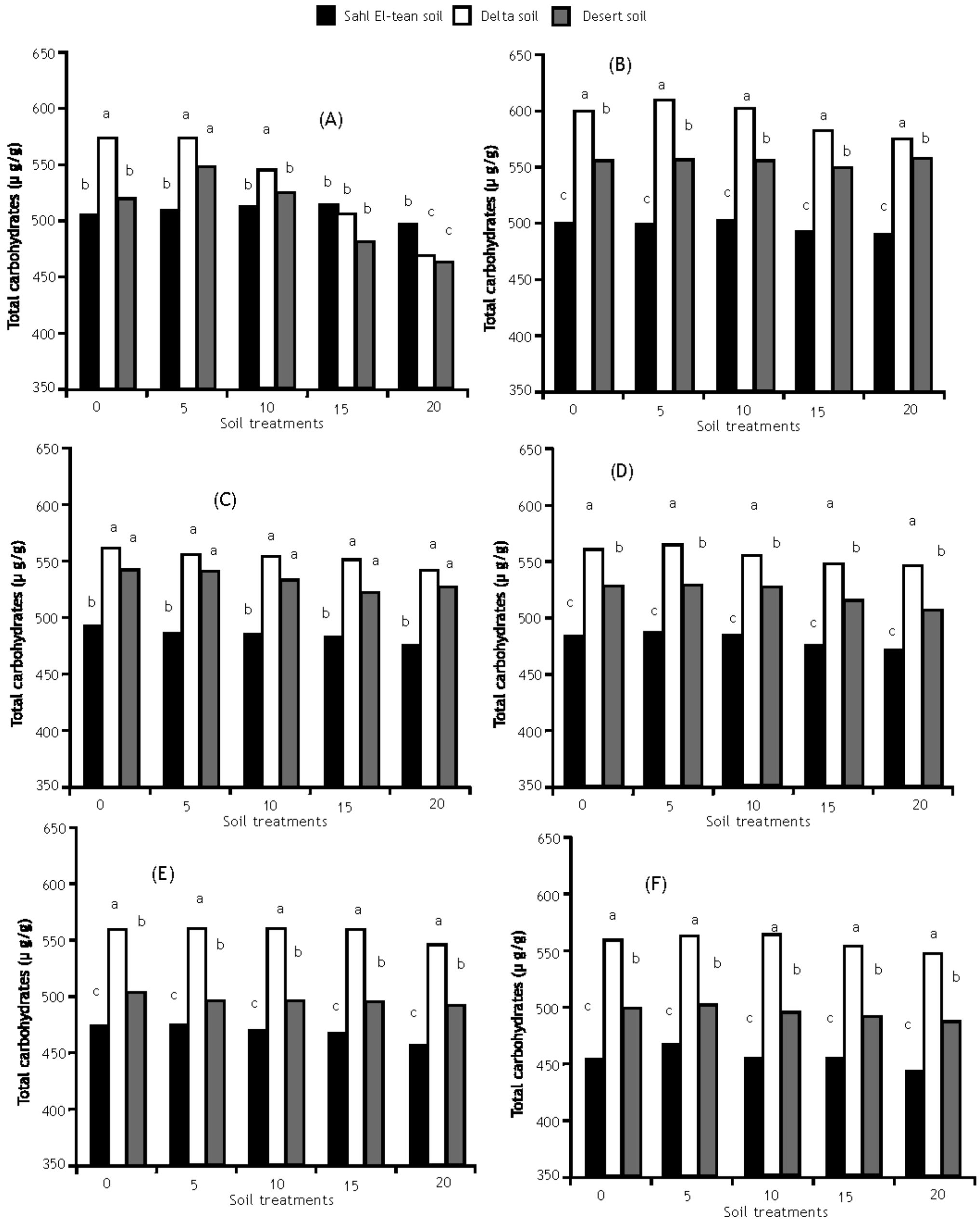

Fig. 10: Means of total carbohydrates content for rosemary (m g/g) grown in different kinds of soils treated with different concentrations of ceramic industrial residue (%)
(A) One plant rosemary (B) One plant rosemary + One plant soybean
(C) Two plants rosemary + One plant soybean
(D) Three plants rosemary + One plant soybean
(E) One plant rosemary + Two plants soybean
(F) One plant rosemary + Three plants soybean
(Columns have the same letter are insignificant at $p < 0.05$)

singly or with two rosemary plants exhibited the largest plant that was height response to ceramic dust stress with the rest of responses being comparable.

Plant production

Mean grain yields produced by soybean grown in three kinds of used soils under the ceramic dust treatments are shown in Fig. 5. The 10% soil application was significant differences for all competitions; however, only grain yield exhibited a significant increase for 5% treatment when soybean grown singly and in combination with one plant rosemary (Fig. 5A, B). Grain yields were reduced by an average of 125% by the ceramic dust stress treatments combined over growing seasons and competition showing significantly lower yields for 15 and 20% dust concentrations. Soybean yield showed no seed production in Desert and Sahl El-Teen soils under treatments for different kinds of competition (Fig. 5). Crown volume of rosemary for soil treated with 10, 15 and 20%, exhibited the largest responses to ceramic industrial residue stress of the Delta and Desert soils (Fig. 6). The Sahl El-Teen soils showed a lower vegetative size after rosemary grown singly and in combination with one plant soybean subjected to the treatment than after the rosemary grown with others. As will be shown later, Sahl El-Teen soils also exhibited slight similar plant growth rates from the all treatments except the 15 and 20% ceramic dust stress treatment. All treatments are affected similarly in competition of rosemary with two or three soybean than in the others (Fig. 6).

Leaf chlorophylls

The Sahl El-Teen, Desert and Delta soils initialed a good significant difference of chlorophyll content for all soil treatments and all plant competitions (Fig. 7). Non-significant difference of leaf chlorophyll content between Sahl El-Teen and Desert in four competitions was obtained (Fig. 7A,B,C,D). Only at the competition between one plant soybean and one plant rosemary for Delta soils, the 5, 10, 15 and 20% treatments were more significant than control, while other treatments were insignificant (Fig. 7). All plant competitions (Fig. 8A,B,C,D,E) generally produced more chlorophyll content for all soil kinds except the last competition (Fig. 8F). The clear significant increase produced in Delta soils in competition of one rosemary and one soybean ((Fig. 8B). Non-significant differences were found to all soils treatments in comparing to control. Plants cultivated in the Sahl El-Teen soils recorded the highest chlorophyll contents between all kinds of soils.

Leaf carbohydrates

The leaf carbohydrate content was generally higher in all plant competitions of Delta soils than the other two kinds of soils (Fig. 9). The carbohydrate content, however, had strikingly insignificant values with Desert soils in competition of two plants soybean and one plant (Fig. 9C). Also, there are non-significant differences in competition of three plants of soybean and one plant of rosemary for all kinds of soils (Fig. 9B). Clear significant greater in carbohydrate of Delta soils was in competition of one plant of soybean and three plants of rosemary (Fig. 9F). Total leaf carbohydrates were similar among all entries soil applications, but thereafter differed in between soils kinds and competitions (Fig. 10). Competition of plant of rosemary and one plant of soybean in general, had the greatest leaf carbohydrates for all soils kinds and soils treatments (Fig. 10B). The same manner was generally found in the last three competitions, which gives the best significant difference between all soils types (Fig. 10B, D, E, F).

Statistical analyses

Mean of ANOVA squares for the soybean and rosemary characteristics are listed in Table 1. Significant year effects were found for all examined characteristics that were likely caused by differing environmental conditions, planting dates and ceramic dust exposure treatments. The year $\times$ treatment interactions was not significant for any of the characteristics, which suggests that the treatment responses were consistent over the two studies. Year $\times$ plant competition interactions were significant for plant height and plant production. Significant ($p<0.05$) differences were observed among the plant competition for all of the characteristics examined except for leaf pigments. Ceramic industrial residue treatments caused significant ($p<0.05$) differences for plantation success, plant height, plant production and leaf carbohydrates, while leaf pigments being significant at ($P<0.10$). Ceramic dust treatments $\times$ plant competition interactions were significant ($p<0.05$) for plantation success, plant height, plant production, but insignificant for the rest. Plant height and plant production were the only characteristics found to be significant ($p<0.05$) for year $\times$ treatments $\times$ plant competition $\times$ soil kind interactions (Table 1).

Discussion

Ceramic dust applications to the soils of Delta (clayey), Desert (sandy) and Sahl El-Tean (loamy) cause negative effect on growth, yield, pigments contents and total carbohydrate contents at concentrations of 15 and 20% in comparing to control. These results are similar to those of Jarvan (2001), Misra ***et al.*** (2000), Subha and Dakshinamoorthy (2000), Mandre ***et al.*** (1999A), Mandre and Ots (1999), Mandre ***et al.*** (1999b), Saravanan and Appavu (1998) and Du ***et al.*** (1998) on cement dust treatments which is more or less similar to ceramic dust in native chemical constituents. The high level of alkaline dust emitted from the cement plant and the concomitant alkalinization of the soil retarded the height growth of trees and caused a decrease in total plant biomass. Carbohydrate contents, especially soluble sugars, tended to decrease. A misbalance in mineral nutrient composition was found as well as severe manganese deficiency in all species. The partitioning of carbohydrates and mineral nutrients between plant organs had changed significantly (Mandre ***et al.***, 1999a).

Comparison of biomass formation and the lengths of different organs of the trees showed that alkalinization of the growth substrate (pH 8.1) and the high level of annual dust pollution load (600-2400 g m^{-2}) were serious inhibitory factors to tree growth: height growth was inhibited by 61%, length of shoots and needles by 75 and 28%, respectively and the dry weights of roots, stems, shoots and needles by 88, 90, 91 and 55%, respectively. The ratio of root to shoot dry weights increased under stress in all the spruce species. ***P. mariana*** was the most sensitive to dust pollution impact and alkalinization of the environment (Mandre and Ots, 1999). The alkaline cement dust (pH 12.3-12.6) and the resulting alkalization of the environment inhibited the height growth of trees near the cement works and reduced the length of needles and shoots and the biomass of all organs. Based on the differences of morphological parameters from the control the following order of tolerance of conifers to dust was established: ***Pseudotsuga menziesii>Picea abies>Pinus sylvestris>Picea glauca>Picea mariana***. An important reason for the reduced biomass of conifers was an unbalanced content of nutrients in tissues and changes in their partitioning. Deficiencies of N, Mn and P developed in seedlings near the works, especially in roots, stem and shoots. Regression analysis revealed a dependence of the biomass of organs on N and K content in trees and, in the case of those growing in a polluted area, also on the content of Ca, Mg and P (Mandre ***et al.***, 1999b).

The germination of green gram and sorghum was increased by the addition of 20 and 40% cement kiln dust, respectively, but cement kiln dust addition above these proportions decreased germination in both crops. The root length, shoot length and seedling vigor index of both the crops were significantly decreased when the cement kiln dust was incorporated to the soil even at the lowest level of 20% (Saravanan and Appavu, 1998). The effects of airborne cement dust on the growth of China fir (***Cunninghamia lanceolata***), black pine (***Pinus thunbergii***), masson pine (***Pinus massoniana***) and their wood chemistry was investigated at Wanzhi (control site), Leizhan and Jianshan [in Anhui] China. Observations were made for several years before and after 1983 (when the cement factory started production); in the case of growth the observation period was 1978-1994 and it the case of wood chemistry it was 6 yr before and after 1983. Cement dust adversely affected the height, diameter and volume increment of the trees. It also increased the wood contents of Si, Ca, K and P, while decreasing Mg, Fe and Al contents. The effects varied between tree species (Du ***et al.***, 1998).

Vegetation was investigated in the area around Chunar Cement Factory in the Sonbhadra district of Uttar Pradesh. Dust deposition, pH of different plant tissues and epidermal and cuticular traits were determined for ***Azadirachta indica***, ***Cajanus cajan***, ***Delonix regia***, ***Eucalyptus citriodora***, ***Eugenia jambolana [Syzygium cumini]***, ***Mangifera indica***, ***Morus alba***, ***Phyllanthus emblica***, ***Psidium guajava***, ***Thevetia nerifolia*** and ***Ziziphus mauritiana***. Plants growing near the factory were severely affected, showing foliar injury symptoms and very poor growth. 38 plant species were classified as sensitive, intermediate or tolerant to pollution and several species which are good collectors of cement dust and are resistant to pollution are recommended for growing in polluted sites (Misra ***et al.***, 2000).

Two pot culture experiments were conducted at the Agricultural College and Research Institute in Killikulam with sorghum (K-8) and blackgram (ADT-3) as test crops on a sandy clay soil during October 1997-January 1998. Cement kiln dust collected from a cement factory was artificially mixed with the soil at 10 different rates varying from 10 to 100 g dust per kg of soil. The seeds of the 2 crops were sown on this soil. There was a significant reduction in the N and P contents of both sorghum and blackgram in dusted soils. The uptake of Ca, Mg, Na and K, however, were increased in both crops. Cement dust addition reduced the leaf area index; dry matter production and grain yield of both crops (Subha and Dakshinamoorthy, 2000).

Increasing of growth, yield, pigments contents and total carbohydrate contents at concentrations 5 and 10% in comparing to control were recorded. The mechanism for such results is unknown and merits further investigation. Only one study supports these results. Ali (2002) improved the damaged soils at Nabq protected area, Sinai, Egypt by using 6% ceramic dust application for three years. These treatments altered the soil quality from 30-40% to be 7o-80%. All the processes altering the mineral nutrition of any ecosystems will also be active in agricultural systems. Increased plant residues resulting from stimulated crop growth would be useful in soil conservation and improvement. Stimulated symbiotic nitrogen fixation by legumes (soybean) could make legumes an even more important factor in crop management. Increased residual nitrogen from legume crops may allow farm managers to decrease their reliance on nitrogen fertilizer. Of course, in drier climates the use of legumes and the maintenance of soil organic matter could be important concerns for crop husbandry under a changed climate.

With the potential for increased plant growth rates, the overall management of fertilizers is likely to become more complex. Since potential crop growth is likely to be increased with atmospheric CO_2 concentration, increasing the total amount of available minerals by increasing amounts of fertilizer would likely be profitable. This is especially so because the marginal return from the addition of minerals seems to be high. However, important issues will need to be addressed on fertilizer management practices. When and how are the fertilizers (like ceramic dust) to be applied to maximize the benefit to the crops, yet minimize the deleterious effects on the environment.

The ceramic industrial residue “dust” had a positive indirect effect in soybean and rosemary growth. It causes increase in plant viability and activity during growth. Ceramic dust plays a fundamental role in the improvement of soil structure. This improvement for chemophysical structure causes an effect on soybean and rosemary growth, which showed as improve in plant phytochemical analysis for chlorophyll and carbohydrates analysis. So we can say ceramic dust can be used in agriculture especially with delta soil. Using of ceramic dust with desert soil not only for improving the plant yields and chemophysical properties of soil but also for reducing the amount of water used in cultivation. This study illustrated that ceramic dust has better effect in cultivation than cement dust. Further research is needed; it would appear many cases of ceramic dust effects partially and totally on plant-soil ecosystems.

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