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Enhancing the soil quality of coastal salt marshes vegetation Die-off in Sinai protected areas, Egypt

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Abstract

Salt marches vegetation along coastlines of Red Sea is frequently and severely damaged by different resources. The objective of this research was to develop a routine test method using ceramic and cement dust pollutants singly and combination for the soil supporting dried and/or died hypersaline marshes vegetation at Nabq and Ras Mohamed protected areas in Egypt. A large number of soil samples representing a wide range of properties and parameters were analyzed. The approach used to test the soil quality (SQ) indicators was based on subjective, a-priori judgment of expected SQ and does not include all the parameters of SQ. However, the procedure is adaptable to integrate most SQ properties and applicable to diverse soil-vegetation management systems. Results showed that the soil test based on carbon fractions is the most useful in monitoring SQ and identifying fields in which organic matter management is a limiting factor for agricultural production systems. Of the orthogonal SQ properties, C_{AMB} (active microbial biomass C), qR (metabolic quotient), BR (basal respiration), TSS (total soluble salts) and cations accounted for 97.2, 85.2, 81.6, 92.3 and 88.5 as the single most sensitive indicator of the variation in SQ, respectively. The SQ properties were consistently enhanced where management practices was used in concentration ceramic and cement (2:1) and these values of most SQ properties were higher in intertidal sites and in El-Ghargana locality vs. the rest of sites and localities at Nabq protectorate. The mean SQ values were more respond in 0-10cm soil depth, loamy clay sand soil texture and soil supporting *Avicennia marina* than others. There were significant interactions among sites, management applications and localities on SQ. This study proved that ceramic and/or cement dust industrial pollutants could be used in near future as known wastes to improve the soil fertility.
Keywords: Protected areas; Dried and/or died salt marches; Industrial practices; Protection.

Introduction

The South Sinai is one of the most spectacularly beautiful landscapes on Egypt, some of which have in recent years been set aside as national parkland. The most famous of these parks (and in fact Egypt's first national park) is found at the far southern tip of the Sinai. In this area, there are four protected areas: Nabq, Ras Mohamed, Saint Katherine and Abu Galum (Al-Mufti, 2000). One of the importances of this area is mostly with its extensive mangrove (one of salt marshes vegetation) stands at Nabq and Ras Mohamed protected area. Huge areas of salt marches especially mangrove forests have been lost from Northeast Africa (Red Sea coast) and Southeast Asia due to population expansion and human activities such as wood extraction, conversion to aquaculture and agriculture, salt production, mining, and pollution from coastal industrialization and urbanization (Hussain, 1996; Lewis, 1998; Reynolds *et al.,* 2003; Vanhala and Pietola, 2003). The mangrove forest in Malaysia decreased 12% between 1980 and 1990 (Spalding, 1997), 60% in Philippines, 55% in Thailand and 37% in Vietnam (Lewis, 1998) and 75% in Sulawesi, Indonesia (Nurkin, 1994). In Egypt, mangrove forests at Nabq protectorate decreased year after year without solution to this biggest problem till now. Little studies were carried out on the mangal vegetation of this area by Hemming (1961); Kassas and Zahran (1967); Zahran (1982).

Increased interest to soil fertility management is of course predicated on a significant maturing of the discipline that has taken place over the last two decades and that has been summarized in a range of reviews (Woomer and Swift, 1994; Tod *et al.*, 2002; Amezketa *et al.,* 2003; Reynolds *et al.,* 2003). So, maintenance and improvement of the soil resource are prime requirements for sustainable management of agro- and natural-ecosystem to protect the environment (Weil *et al.,* 1993). Soil quality (SQ) expresses both the inherent properties of a soil and the soil's functional capacity to interact with applied inputs (Larson & Pierce, 1991; Doran and Parkin, 1994). Growing awareness in protecting SQ suggests that key SQ indicators need to be identified and made the basis for monitoring and predicting changes in SQ (Acton & Gregorich, 1995). A large body of literature has documented the beneficial effects of certain type practices on soil properties associated with soil quality (Karlen *et al.,* 1992; Alabouvette *et al*., 1996; Jouquet *et al.*, 2004).

Ceramic dust is a raw material. It is formed from natural components such as clay minerals (Ali et al. 2003a). The clay minerals are hydrated alumina silicates. There are a variety of clay mineral including: kaolinite, pyrophyllite, and monomorillonite. All of them are formed by weathering processes for igneous rocks under the influence of water, dissolved CO_2 and organic acids (Ali et al. 2003a). On the other hand, the cement dust resulted from Portland cement. It is resemble the color and quality of Portland stone. The Portland cement is manufactured by mixing calcareous (like limestone) and an argillaceous such as clay materials. It can be done either in water or in dry condition (El-Daly, 1984). Mixture of grinding raw materials is burned at temperature up to 1450°C in rotary kiln. The product of the rotary kiln is called cement clinker, which is mixed with a few percent of gypsum and ground to a very fine powder. The main constituents exist in the cement clinker are: Trical silicate, Alite, β dicalcium silicate, Belite, and Tricalcium Aluminate (El-Daly, 1984).

Studies on positive effects of ceramic and/or cement dust are still little. Only few studies were done on ceramic applications in soil. Ali *et al.* (2003a, 2003b) studied that 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. They mixed dust with loamy, clayey and sand soils at five rates varying from 0-g to 200-g dust per kg of soil. Results showed ceramic dust at 5% and 10% caused significant increase in plantation success, plant height, yield, pigments and carbohydrates contents of soybean and rosemary as compared to control of loamy soil. On the other hand, this study concluded that ceramic dust may be mediate both the synthesis and decomposition of soil organic matter (SOM) and therefore influence cation exchange capacity; the soil N, S, and P reserve; soil acidity and toxicity; and soil water-holding capacity, then improve its characteristics.

On the other hand, changes in plants/soil in response to cement dust are varied. Few results ensure that cement dust can improve plants/soil properties (Dinel *et al*., 2000; Mandre, 2000; Udoeyo & Abubakar, 2001; Bayhan *et al*., 2002). The use of cement dust at low levels might be increasing organic C content of soil, particularly when applied in conjunction with manure (Kulikov & Chelpanov, 1999), while largest applications of cement dust increased the pH of a suspension of soil in water to 8.0-8.1. Contents of mobile major elements in soil also increased, as did yields of rye and the ratio of root to shoot dry weights increased under stress in all the spruce species. Mandre and Ots (1999) concluded that *Picea mariana* was the most sensitive to dust pollution impact and alkalinization of the environment. Saravanan and Appavu (1998) found that the germination of green gram and sorghum was increased by the addition of 20 and 40% cement kiln dust. Tuber yields increased with increasing rates of cement kiln dust and plant uptake of K and Mg increased with cement kiln dust and K rates (Lafond & Simard, 1999). Pooled data from the 3 seasons study showed that soybean has the ability to produce the highest yields under both low and high levels of cement dust pollution (Potkile *et al*., 1999).

The objectives of the study were: 1) To assess the status of soil supporting dried and/or died salt marches vegetation using data from replicated field experiments as a primary investigation, 2) To determine the best of several measurable key soil properties of SQ indicators, and 3) To assess the effects of ceramic and/or cement dust management practices on soil properties.

Materials and Methods

Study area description

The Gulf of Aqaba is a small, semi-enclosed branch of the Red Sea, 180 km long and 5 to 26 km wide, forming part of the Afro-Syrian Rift system. The Egyptian coast occupies most of the western Sinai coast stretching along the Gulf for about 250 km Northward from Ras-Mohamed to Taba. The coastal plain is narrow with Granite Mountains descending almost directly into the sea. Nabq Protected Area lies 35 km north of Sharm El-Sheikh, along the Aqaba Gulf, South Sinai and is an outstanding natural area with many unique systems of linked ecosystems (Al-Mufti, 2000). Monospecific stands of salt marches are growing naturally in different habitat types. It is divided into wet and dry. Wet types become submerged and occasionally populated by adapted, terrestrial mangroves (*Avicennia marina*). Dry ones don't get flooded during high tide; nevertheless show a high salt content that varies from location to location. Vegetation here includes *Avicennia marina* (terresterial) and salt tolerant species like *Zygophyllum album, Nitraria retusa* and *Limonium axilare*. These hypersaline marches are found in one or more of four sites (sand mounds; salt flats; shorelines; intertidals) in Nabq protectorate. The coast of the study area is classified into segmental beaches (El-Monqatea; El-Rwaisia; Marsa Abu Zabad; El-Ghargana). The north is mainly swampy, the central is sandy and the south is rocky. The region is arid with average monthly temperature of 14^{o}C in January at Taba and 45^{o}C in August at Sharm El Sheikh. Water temperature in the Gulf is 21.5^{o}C at depth 200 meters and varying from 20^{o}C in January to 27^{o}C in August at the surface. Salinity is almost 4000 ppm (Al-Mufti, 2000). The study areas on the coastlines of Gulf of Aqaba are illustrated in Fig. 1.

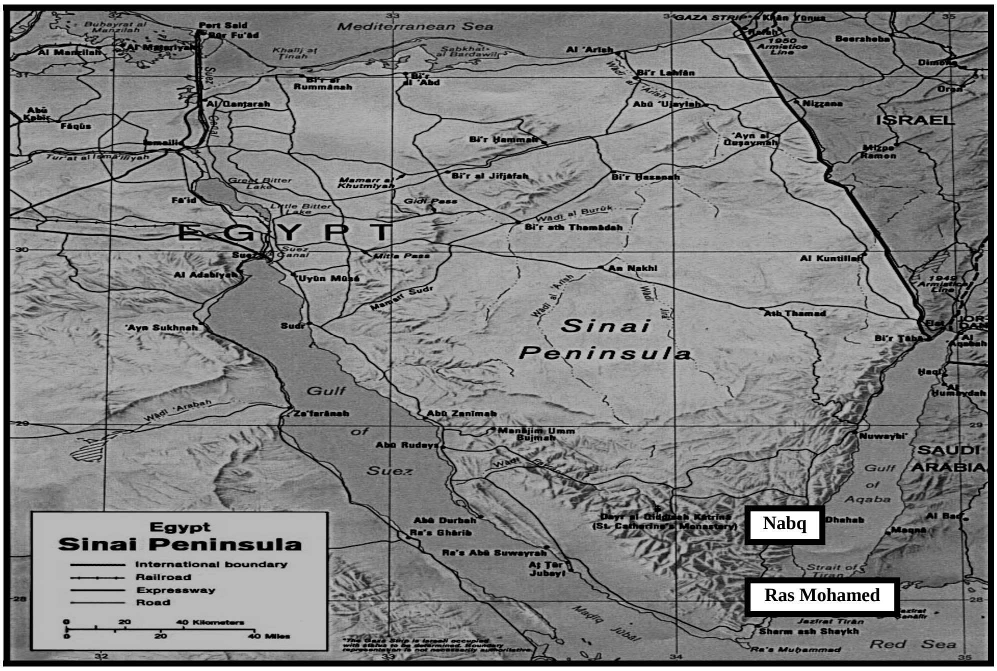

Fig. 1: Map showing the study area (Nabq and Ras Mohamed).

Field experiments and treatments

This study is conducted in soil of dry and/or died coastlines salt marches vegetation of the western Gulf of Aqaba of Red Sea. Four localities namely; El-Monqatea, El-Rwaisia, Marsa Abu Zabad and El-Ghargana at Nabq protected area and one locality at Ras Mohamed protected area were selected. Each one of these localities is divided into four sites: sand mounds; salt flats; shorelines; intertidals and arranged in vertical lines to the sea shore. Each site is also divided into large number of plots with area 5-m length x 5-m wide. . Since the appearance of salt marshes vegetation at Nabq is dried and/or died, so this protectorate is only subjected to industrial dust treatments. On the other hand, the vegetation at Ras Mohamed protected area is designated as control (looks healthy without dried or died plants). Plots were arranged in split plot design. Soil supporting *Avicennia marina, Zygophyllum album, Nitraria retusa* and *Limonium axilare* with different textures (loamy clay sand; sandy loam; loamy sand) and in different depths (0-10; 11-50; 51-100cm) for all plots were chemically analyzed before ceramic and/or cement dust application.

In general, the chemical properties of ceramic dust are: SiO_2 = 62.6%, Al_2O_3 = 17.55%, Fe_2O_3 = 1.42%, CaO = 4.28%, MgO = 0.21%, SO_3 = 0.41%, K_2O = 1.74%, Na_2O = 0.45%, TiO_2 = 0.88%, MnO_2 = 0.03%, P_2O_3 = 0.57%, Cl^- = 0.06%, pH = 8.00, T.S.S = 1.20%, $CaCO_3$ = 7.45%, SO_4^{-2} = 0.16%, organic carbon (OC) = 0.05%, CO_3^{-2} = 0.02%, HCO_3^- = 0.78%, and physical properties are: moisture content (MC) = 14.60%, hygroscopic water (HW) = 1.80% and water holding capacity (WHC) = 47.64% (Ali et al. 2003a), while the cement dust included: $CaCO_3$ (65%), KCl (20%), Na_2SO_4 (traces), K_2SO_4 (traces), $Ca(OH)_2$ (traces) and clay (El-Daly, 1984).

Only 150-g from ceramic and/or cement dust is used to improve the quality of damaged soil in this study, for each plot of three groups replicated field experiments at Nabq and Ras Mohamed protectorates. The field experiments treatments composted at ratios were: 1) ceramic dust crude (150-g); 2) cement dust crude (150-g); 3) ceramic and cement dust crude, 1:1 (75-g : 75-g); 4) ceramic and cement dust crude, 1:2 (50-g : 100-g), and 5) ceramic and cement dust crude, 2:1 (100-g : 50-g). Soil management factors that vary among localities and sites included: vegetation soil, soil depth and soil texture.

Soil Collection and Processing

Soil samples were collected to a depth of 0-10, 11-50, 51-100 cm using a 1.9-cm soil probe. Fourteen cores were randomly collected within a 5 m x 5 m quadrates at each site, each locality and each replicated plot to obtain a composite sample. Soils were transported from the field site in plastic bags kept on ice in a dark cooler. The unsieved soil cores were gently sieved to pass through a 4-mm mesh to remove stones, roots, and large organic residues. Soil texture was made by the sieve method. After sieving, the composite soil was divided into two equal parts and each sub-sample was placed in a separate plastic bag. Field moist soil from one sub-sample bag was passed through a 2-mm sieve and immediately homogenized to measure antecedent moisture content by microwave drying at 2000 joules (j) g of soil. Field moist soil was stored in polyethylene bags and kept under short-term refrigeration at 4°C before analysis. Soil from the second bag was spread on a polyethylene sheet and air-dried for 48 hours with a fan at room temperature. Part of the air-dried soil was ground and sieved (< 2-mm) and kept refrigerated (4°C) until analysis.

Measurements of soil quality properties

Total organic carbon (C_T) content was determined using Walkely and Black's rapid titration method (Piper, 1947). The total nitrogen content (N_T) was determined after Kjeldahl digestion. Mineralizable carbon (C_{MIN}) was determined by dividing the total amount of CO_2-C evolved soil respiration by the total organic C. Particulate organic carbon (C_P) and particulate organic nitrogen (N_P) were separated from soil by a floating method (Islam, 1997). The C_{TMB} (M CO_2-C m^{-3}) was determined by the chloroform fumigation incubation method (Jenkinson & Powlson, 1976). The C_{AMB} (M CO_2-C m^{-3}) was determined by the stimulated basal respiration method (Van de Werf & Verstate, 1987). The BR (M CO_2-C d^{-1} m^{-3}) was measured by absorbing evolved CO_2 by 0.5 M sodium hydroxide from untreated field moist soil adjusted at 60% water-filled porosity (WFP). Several metabolic quotients (*q*R), such as C_{TMB} C_T^{-1}, C_{AMB} C_T^{-1} and C_{AMB} C_{TMB} were calculated (Insam & Domsch, 1988). The specific maintenance respiration rates (qCO_2) were calculated as mean daily BR/C_{TMB} (M CO_2-C d^{-1} C_{TMB}^{-1}) by the method of Anderson and Gray (1991).

Soil organic matter was determined colorimetrically using the method described by Walinga *et al*. (1992). Total soluble salts (TSS), calcium, magnesium, sodium, potassium, chloride, sulphate, carbonate and bicarbonate ions in 1:5 soil-water extracts, pH in 1:2.5 soil-water suspension and cation exchange capacity (CEC) were determined as described by Richards (1954). Calcium carbonate ($CaCO_3$) content was determined using rapid titration method (Piper, 1947).

Statistical Analysis

All the calculations and statistical analyses were done using the SPSS (VER. 11). For the field experiments, treatment effects on various measures of C were tested by ANOVA using split plot design of the experiments. Means were separated by F-protected LSD at $p < 0.05$ and $p < 0.01$ level. Mean separation between management practices of the grouped soil in each locality was calculated by using the means of individual sites as replications.

Results

Status of damaged soil before treatments

In general, data in Table (1 and 2) illustrated that soil supporting dried and/or died coastal salt marshes vegetation at selected four localities at Nabq protected area is highly damaged reaching to 80% as compared with soil of vegetation at Ras Mohamed protected area. The highest significant of soil variables under the effect of single parameter was: C_{AMB} > qR > BR > C_{TMB} > C_{MIN} > cations > anions. Of the soil measurements of C-fractions used, the C_{AMB} and qR gave the best indicators (60-65%) of the soil quality (SQ) status (Table 1). The C_T, C_P and C_{MIN} indicated only 33.8 %, 35.2% and 34.7% of the variability in SQ, respectively but also, the N_T and N_P expressed only 24.6 and 23.2% of the variability in SQ, respectively (Table 1). The rest of soil quality properties recorded the lowest values of indicators ranged between 20% -15% (Table 1 and 2). Anions were of little value in indication of SQ than cations (Table 2). Soil supporting *Avicennia marina* showed more damaging than *Zygophyllum album, Nitraria retusa* and *Limonium axilare* with average 10%. Loamy sand soil and soil depth 51-100cm have more reduction of quality than others. Sand mounds and salt flats represented the highest damaged sites. Damaging of soil of El- Monqatea and El-Ghargana localities is reached to 19-20%, while reaching to 24-25% for El-Rwaisia and Marsa Abu Zabad localities at Nabq protected area (Table 1 and 2).

Effects of industrial dust on damaged soil

All five of ceramic and/or cement dust applications have ability to improve the damaged soil of all localities at Nabq area with different degrees (Tables 3 and 4). The mixtures of ceramic + cement dust (1:2) and ceramic + cement dust (2:1) recorded the highest recover (82% and 91%, respectively) of soil supporting dried/died vegetation at the studied area than did the others. Significantly the highest quality in soil under application with ceramic + cement dust (2:1) and the lowest in soil under cement dust singly. The C_T, C_{MIN}, N_P, C_{AMB}, qR, BR and qCO_2 (Table 3) and OM_T, TSS, $CaCO_3$, cations and anions (Table 4) did not distinguish between management practices of ceramic dust and cement dust alone, while C_T, N_T, N_P, qR, BR and qCO_2 (Table 3) and OM_T, TSS, $CaCO_3$, Ca^{++}, K^+, SO_4^{--} and HCO_3^- (Table 4) did not distinguish between soil treated with ceramic + cement dust (1:1) and ceramic + cement dust (1:2). The C_{AMB} and qR ($C_{TMB}C_T^{-1}$) did not differentiate between the mixtures of ceramic + cement dust (1:2) and ceramic + cement dust (2:1) treatments (Table 3). The C_{AMB} and BR are the best reflectant in the compost treated soils of ceramic + cement dust (2:1) on soil compared to other soil variables. The highest respond to industrial dust treatments in C_T, N_T, C_{TMB}, C_{AMB}, BR and cations of vegetation soil at El-Ghargana locality, the intermediate respond in soil variables: C_T, C_{MIN},

N_T, N_P, C_{TMB}, BR, OM_T, TSS, Cl^- and SO_4^{--} of vegetation at Marsa Abu Zabad locality, and the lowest respond in all soil characters except C_P, N_P, C_{AMB}, qCO_2, OM_T, TSS, $CaCO_3$, Mg^{++}, K^+, Na^+, $SO_4^{--}$and HCO_3^- at El-Monqatea locality under ceramic/cement treatments (Table 3 and 4). Quality of soil supporting vegetation at El-Ghargana reached to 95%, while in other localities reached to 61.5%, 70.8% and 83.4% at El-Ghargana, El-Rwaisia and Marsa Abu Zabad localities, respectively.

In effects of vegetation soil, only the soil of *Avicennia marina* is highly responding to treatments (65.5%) and it is differed significantly among the soils of other plants (Tables 3 and 4). The C_{MIN}, qR ($C_{AMB}C_T^{-1}$), $CaCO_3$ and Ca^{++} was significant at ($P < 0.01$), while significant ($P < 0.05$) differences are recorded for the rest of characters except N_P. The C_{TMB}, $C_{AMB}C_T^{-1}$, OM_T, $CaCO_3$, Ca^{++}, Mg^{++}, Cl^-, SO_4^{--} and HCO_3^- are only differ among the soils of *Nitraria retusa* and *Limonium axilare*. Intermediate amounts of the major variables of soil supporting *Zygophyllum album*. High amounts of all soil variables were detected from loamy clay sand soil, while small amounts were recorded from sandy loam and loamy sand soil texture (Tables 3 and 4). On the other hand, sandy loam soils are significantly differed from loamy sand soil in all variables except N_T, N_P, C_{AMB}, BR, qCO_2 and HCO_3^- . The soil texture effects are significant ($P < 0.01$) in C_T, C_{TMB}, qR, TSS, $CaCO_3$, Ca^{++} and K^+.

Averaged across all the soil characters, the soil depth (0-10cm) has about 52.3% more quality than in other soil depths (Tables 3 & 4). The C_T, C_P, C_{MIN}, qR, OM_T, TSS, $CaCO_3$, K^+, $SO_4^{--}$and HCO_3^- differ significantly among the soil depth (11-50cm) and soil depth (51-100cm). In the effect of study sites, the soil properties are differed significantly between the intertidal sites and the others. The shorelines have more quality (about 34.9%) than salt flat and sand mound sites. Values of soil properties of shorelines are close to the values of intertidal sites. Majors of soil quality characters C_T, C_{MIN}, N_T, N_P, C_{TMB}, C_{AMB}, BR, OM_T, TSS, $CaCO_3$, cations and anions were consistently higher in the intertidals than shorelines. On the other hand, the sand mounds recorded the lowest response to ceramic/cement dust applications.

Interactions between parameters effects

Summary of significant ANOVA mean squares of interactions between different parameters affect on quality of 1st set of selected properties of soil supporting dried and/or died coastal salt march vegetation after treatments with ceramic and/or cement industrial dust of four localities at Nabq and Ras Mohamed protectorates, South Sinai, Egypt is listed in Table 5. Based on two parameters effect, less significant was recorded. Significant ($p < 0.01$) differences for the interactions between vegetation soil, soil texture, soil depth, sites soil, treatments soil and localities soil were observed among all soil characteristics examined and significant ($p < 0.05$) differences for C_{MIN}, qR and qCO_2 of soil properties were recorded. Significant ($p < 0.05$ and $p < 0.01$) effects were found for the interactions between soil texture, soil depth, sites soil, treatments soil and localities soil for all of the characteristics examined except for C_{AMB}. The soil treatments interaction with soil depth and sites soil was significant ($p < 0.05$ and $p < 0.01$) for all of the characteristics except C_{AMB} and qR. Interaction between vegetation soil, soil texture and sites soil was significant at ($p < 0.05$) for all characteristics but it was significant at ($p < 0.01$) for C_{MIN} and BR and nonsignificant for C_P, qR and qCO_2. Significant at ($P < 0.01$ and $P < 0.05$) were obtained for all interactions for C_T, C_{MIN}, C_{TMB} and BR of soil quality properties.

Also, summary of significant ANOVA mean squares of interactions between different parameters affect on quality of 2nd set of selected properties of soil supporting dried and/or died coastal salt march vegetation after treatments with ceramic and/or cement industrial dust of four localities at Nabq and Ras Mohamed protectorates, South Sinai, Egypt is shown in Table 6. Interactions between two parameters were recorded little significant on soil variables. Ceramic and/or cement treatments interactions with one or more of studied parameters caused significant ($p < 0.01$) differences for all soil quality indicators over two years except in few cases. Significant at ($P < 0.01$ and $P < 0.05$) were obtained for all interactions for pH, TSS, all cations, $SO_4^{--}$and HCO_3^-. Interactions between all parameters effects based on all soil characters being significant at ($P < 0.01$) except for SO_4^{--}. Soil treated with industrial dusts x soil texture x soil depth x sites soil and localities soil interactions was significant ($P < 0.01$) for soil quality index based on all studied properties except for SO_4^{--} ($P < 0.05$), while it was significant ($P < 0.01$) for quality based on all studied properties except for OM_T, $CaCO_3$, Ca^{++}, Na^{++}, K^+ and Cl^- when interacted with vegetation soil, locations soil and sites soil. Soil quality index based on pH, OM_T, $CaCO_3$, Mg^{++} and Cl^- was significant at ($P < 0.05$) but significant at ($P < 0.01$) for the others of soil quality characters in combination effect of treatments soil, locations soil and sites soil. Based on all soil properties except pH, Mg^{++}, Na^{++} and HCO_3^-, the interaction between treatments soil, soil depth and sites soil is significant at ($P < 0.05$). Interaction between soil texture, locations soil and sites soil was significant at ($p < 0.05$) for soil characteristics pH, OM_T, $CaCO_3$, Mg^{++}, Cl^- and SO_4^{--} but it was significant at ($p < 0.01$) for others.

Discussion

The soil quality indicators (SQI) may be useful as a "report card" to evaluate whether a soil is improving, sustaining or degrading in quality under a particular management regime. This study supported that field practices could affect the quality of soils. This success trial is designated for soil supporting dried and/or died some of vegetation at Nabq protected area. This soil is highly damaged reaching to 80% as compared with soil of vegetation at Ras Mohamed protected area. Damaging of soil of El- Monqatea and El-Ghargana localities is reached to 19-20%, while reaching to 24-25% for El-Rwaisia and Marsa Abu Zabad localities at Nabq protected area. As the causes of endangered ecosystem at Nabq more than at Ras Mohamed protectorates were not obvious, nor knowingly approved, it was necessary to assess a wide range of possibilities in this preliminary investigation. Two main possible causes were considered, including: many of ships were destructed in this area because lands of seawater are filled with rocks, and lacks in the movement of seawater stream were observed. Then, the soil in this area is subjected to high receptions of possible detrimental factors like toxic pollutants. Conversion of tidal areas to upland developed lands, nutrients in sewage, chemical leachates and human damage are also effected. These factors caused a continuous loss of CO_2 from soil may indicate ecosystem inefficiency, that is, energy loss from the soil system (Campbell *et al*., 1999). High ecosystem respiration, qCO_2 in soil may often result from stress and disturbance factors.

The mixtures of ceramic + cement dust (1:2) and ceramic + cement dust (2:1) recorded the highest recover (82% and 91%, respectively) of soil supporting dried/died vegetation at the studied area than did the others. Quality of soil supporting vegetation at El-Ghargana reached to 95%, while in other localities reached to 61.5%, 70.8% and 83.4% at El-Ghargana, El-Rwaisia and Marsa Abu Zabad localities, respectively. Majors of soil quality characters were consistently higher in the intertidals than other sites. The soil of *Avicennia marina* is highly responding to treatments (65.5%) and it is differed significantly among the soils of other plants. High amounts of all soil variables were detected from loamy clay sand soil, while small amounts were recorded from sandy loam and loamy sand soil texture. The superficial soil has about 52.3% more quality than in other soil depths. These results agree with studies of Ali *et al.* 2003a, b; Dinel *et al*., 2000; Mandre, 2000; Udoeyo & Abubakar, 2001.

In general, the use of management practices ceramic and cement dust improved the quality of damaged soil (Tables 3 and 4) because they could increase inputs of organic residues, plant and animal manures, and increase biological activity (Dick 1992; Wang *et al.* 2003). The organic amendment is not only responsible for a large portion of the biological and chemical properties of soil but also a disproportionate effect on its physical properties (Boyle and Paul 1989). Addition of fertilizer usually increases microbial biomass (Boyle and Paul 1989) and soil enzyme activities (Dick *et al.* 1988) over soils that have not received any organic or inorganic amendments. Each organic addition to soil can improve its water-holding capacity, decrease bulk density, stabilize soil structure, and indirectly increase water filtrate rate (Khaleel *et al.* 1981; Al-Omran *et al.* 2004). The application of these wastes to soils might be increase the number and size of water-stable aggregates. Other indices that increase the N mineralization potential and soil respiration (Verstraete and Voets, 1977)

Of the soil measurements of C-fractions used, the C_{AMB} and qR gave the best indicators (60-65%) of the SQ status (Table 1). Criteria for the possible choice of active C for routine measures of SQ include: (i) the degree to which the qualitative measures of C-pools functionally, predicted SQ, (ii) the performance of the C-pool in predicting SQ under routine handling; (iii) the relationship between C-pool measured on both field moist and air-dried soils; iv) a combination of expediency, rapidity, simplicity, and cost effectiveness of the method; and v) the applicability to wide range of soils (Wander and Triana 1996). Ceramic/cement dust in soil could have increased the C-fractions by i) enhancing the bond cleavage of C_{org} (Bartlett and James 1980) and (ii) desiccating soil microbial biomass cells and leakage of intracellular C compounds (Marumoto et al. 1982). With only one drying and-rewetting cycle, microbial biomass C turnover contributes more soluble C than does the C_{org} bond breakdown (Soulides and Allison 1961). On the other hand, total organic carbon (C_{org}) did not correlate significantly with SQ (Table 1), suggesting that only a small variable part of the C_{org} may be responsible for regulating SQ. Total C_{org} is inadequate as predictor of SQ may be due to lack of sensitivity not only over a short period (1 to 3 years) but also against a higher background proportion of stable C fraction in relation to changes in SQ properties (Saffigna et al. 1989).

Differences in C-fractions (Tables 1 and 3) was more likely related to differences in quality rather than quantity of organic inputs (Boyer and Groffinan 1996) and efficient C assimilation through increase in microbial biomass (Yakovchenko et al. 1996). My results are consistent with other findings that suggest more organic recycling, more nutrients, reduce stresses, and increase the labile C content in soil (Yakovchenko et al. 1996). The C-fractions measured on treated of air-dried soil may be an active pool of C that: i) is mineralizable in quality (Aoyama 1991), ii) is soluble in nature (Lineweber et al. 1995), iii) continuously originates from turnover cycling of soil biomass and their metabolites (Coleman et al. 1983), iv) release from decomposition of organic residues, plant root exudates and lysates (Lineweber et al. 1995), v) loosely bound in humic molecules (Lineweber et al. 1995), and vi) is present in soil macroaggregates (Hartman and De Boodt 1974).

Finally, the use of ceramic/cement dust inputs of different quantities to improve the efficiency of nutrient transfer to the crop will not be a practice of any significance if the total amount of nutrient available is insufficient to satisfy the needs for production. So, more studies needed to ensure the exact inputs where they are effective only at low levels.

Conclusions

The results of this research at Nabq and Ras Mohamed protected areas elucidate the following:

1. The coastal areas are subjected to greater developmental pressures and exploitation.
2. The economic value of the industrial wastes is usually not taken into account while assessing their value.
3. There are many ecological benefits, that ceramic and cement dust provide, that need to be economically evaluated.
4. It is necessary to maintain the population of various communities of protected areas in order to sustain natural genetic diversity.
5. Two factors could affect the soil activity: the nature and the amount of nutrient (ceramic and cement dust) added to the soil as a fertilizer.

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تَحسين نوعيةِ تربةَ نباتاتِ المستنقعات الملحيةِ الساحليةِ الميتةِ في محَميات سيناء الطبيعية – مصر

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نظرا لتَضرّر نباتات المستنقعات الملحُية على طول الأشرطة الساحلية مِنْ البحر الأحمرِ كثيراً بالمصادرِ المختلفةِ لهذا يهدف هذا البحثِ إلي إختبارِ التربةِ التي ماتتْ لنباتاتَ المستنقعاتِ الملحُية في محميتي نبق وراس محمد في سيناء، مصر. تم إختيارأربع مواقع في محمية نبق: ألمونتاكيا ، ألروايسيا، مرسي أبو زبد وألغرقانة في محمية نبق وموقع واحد في محمية راس محمد. تم إضافة تراكيز مختلفة من مخلفات صناعة السيراميك والأسمنت إلي التربة الميتة بشكل منفرد أو شكل خليط. أظهرت النَتائِجَ بأنّ التربةَ تَحُسّنتْ بثبات حيث بإستعمال تركيز2:1 من السيراميك والأسمنتِ في موقعِ ألغرقانة في محميةِ نبق. هذه الدراسةِ أثبتتْ بأنّ السيراميك و/ أَو غبار الأسمنتِ يُمْكِنُ أَنْ يُستَعملَ في المستقبلِ القريبِ كنفاياتِ معروفة لتَحسين خصوبةِ الأرض.