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IMPACT OF APPLIED NATURAL AND ORGANIC AMENDMENTS ON IMPROVEMENT SOME PROPERTIES AND PRODUCTIVITY OF SANDY SOIL

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ABSTRACT

A field experiment was carried out on a newly reclaimed sandy soil under sprinkler irrigation at Ismailia Agricultural Research Station, with peanut plants (*Arachis hypogaea*) Giza 5 cultivar, during 2009, to assess the effect of (compost, FYM) and (gypsum and bentonite shale) with zinc and boron as micronutrients on some hydrophysical and fertility status of sandy soil (bulk density, total porosity, hydraulic conductivity, moisture constants and nutrients retained) at maximum vegetative growth stage (90 days after sowing) as well as vegetative growth, yield and its attributes of the studied crop, *i.e.*, seed& foliage yields, weight of 100 seeds, seed oil, protein and N, P, K, Zn, and B content. The applied rate of organic soil amendment individual or in combined treatments was 12.5 tons fad^{-1}., and inorganic one at a rate of 10 ton fad^{-1}., which were thoroughly mixed with the 5 cm soil surface layer. The applied rates of zinc and boron as micronutrients individual or incombined treatments were at a rate of 500 g fad^{-1} as foliar application at two times. The results obtained indicated that the applied inorganic soil amendments (compost or FYM either individual or in combined treatments zinc+boron) showed significant and positive improvements in both soil characteristics and the grown peanut yield parameters under investigation, with a significant superior for the combined treatments. It is evident that the applied organic and inorganic amendments, either as individual or in combined treatments with zinc+boron, caused many of the beneficial effects on soil hydro physical and fertility status as well as plant parameters, since organic and inorganic conditioning partially capable to retain water and nutrients for growing plants due to containing organic acid and structures, which would act as complexing agent, thus minimizing the loss of nutrients by leaching. These chelating agents, through phenolic and carboxylic active groups for micronutrients and water molecules (organic one), are considered as a storehouse with easily or available to be taken by plant roots, and this reflected positively on development of yield and its attributes for studied peanut crop cultivated under sprinkler irrigation system.

Key words: Organic, Inorganic soil amendments, Soil properties, Sandy soil and Peanut plants.

INTRODUCTION

The main mechanical constituent of sandy soil is the sand fraction, which is not partially capable to retain neither water nor nutrients for growing plants. Accordingly, these soils are poor not only in the nutrient-bearing minerals, but also in the organic contents which are a storehouse for the essential plant nutrients. In addition, the occurrence of inadequate water retention under severe conditions, causes the productivity crops to decrease markedly (Metwally and Khamis, 1998).The beneficial effect of organic material is more related to a direct effect on the retention function because of its hydrophilic nature, coupled with the processes of infiltration, runoff, erosion, chemical movement and crop growth. El-Sedfy

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(2002) and Qi *et al.* (2004) found that application of bentonite at the rate of 24 Mg/ha followed by organic compost at a rate of 24 Mg/ha gave the greatest beneficial effect of sandy soil characteristics. Moreover, application of organic matter had an indirect effect on modification of soil structure that influences the water movement into and out of as well as within the soil, and thus affects the quantity of water retaining in the soil.

Application of organic materials, as a soil management, is of direct relevance since it has drastic effects on some soil properties which reflect positively on growing crops, in particular, their growth, yield and yield quality (Celik *et al.,* 2004 and Ertli *et al.,* 2004). Peanut is one of the most important summer oil crops in Egypt due to its application to grow on newly reclaimed desert sandy soils besides being an important seed crop of high nutritive value for human consumption and industrial purposes (Dorenbos *et al.,* 1979). In relatively coarse textured soils, however, peanut needs, fertilization with different plant nutrients as well as gypsum as a soil amendments and source of Ca and S for enhancing the vegetative growth. In addition, the released Ca and S from gypsum are often considered a yield limiting factor for pod growth and increasing peg strength.In this concern, Beech *et al.* (1987) reported that as increase in peanut seed yield was achieved as a result of applying 112 kg gypsum/ha due to improving the shelling percentage by 2.2%. Also, Sharma *et al.* (1992) found that application of gypsum at a rate of 270 kg/ha increased the pod yield significantly by 537 kg/ha (22%). David *et al.* (2001) and Borhamy (2005) pointed out that application of Ca significantly increased pod yield of peanut, and in turn increased the yield of seeds. To increase the production, it is essential to grow the recently released large seeded peanut, using latest fertilizer recommendations (Singh *et al.,* 2009).

Dallas (1994) stated that boron is a highly mobile element that rapidly leaches from the soil. Boron deficiency often results in internal nut damage known as "hollow-heart," which greatly reduces the quality and value of the crop. In hollow-heart, the insides of the kernels are discolored and abnormal. Peanuts with hollow-heart do not fare well in the market because of their off-flavor and short shelf-life. Boron is necessary for normal fruiting of the peanut plant. When boron levels become very low and no supplemental boron is applied, fruiting does not take place. In severe cases of boron deficiency, yield can be almost wiped out. A strong indication of severe boron deficiency is split limbs. Zinc application to peanuts has not been shown to increase yields or grades. Zinc deficiency is associated with high soil pH and high available phosphorus. Zinc toxicity will more likely be diagnosed on peanuts grown on sandy soils rather than on clayey soils.

This study was conducted to assess the effect of applying some natural organic and inorganic materials as soil amendments with micronutrients (zinc and boron) for improving soil characteristics of sandy soils, and in turn for maximizing the peanut seed yield and its quality.

MATERIALS AND METHODS

A field experiment was carried out on peanut (*Arachis hypogaea*) Giza 5 cultivar grown on a newly reclaimed sandy soil at El-Ismailia Agricultural Research Station. Disturbed and undisturbed soil samples were collected from the initial state of the experimental soil at a depth of 0-30 cm for determining the main physical (*i.e.,* particle size distribution, particle density, dry bulk density, total porosity, hydraulic conductivity and soil moisture content at available water range) and chemical properties (*i.e.,* pH in 1: 2.5 soil water suspension, soluble ions in soil paste extract, ESP, $CaCO_3$ and organic matter contents) according to the standard methods outlined by Black *et al.* (1965) and Page *et al.* (1982). In addition, the nutrients status in soil, however, available N, P and K were extracted and determined according to Jackson (1973) and Soltanpour and Schwab (1977). Also, available micronutrients (Fe, Mn, Zn, and Cu) were extracted using ammonium bicarbonate DTPA extract according to Lindsay and Norvell (1978), and measured by using Atomic Absorption Spectrophotometer. The obtained data of the studied soil properties and nutrients status are presented in Table 1.

Table 1. Some physical, chemical and fertility characteristics of the studied soil

Soil characteristic	Value	Soil characteristic	Value
Particle size distribution%:		**Soluble cations (soil paste, m mole$_c$/l):**	
Sand	89.4	Ca^{2+}	0.49
Silt	7.60	Mg^{2+}	0.80
Clay	3.00	Na^{+}	0.78
Textural class	Sand	K^{+}	0.25
Soil chemical properties:		**Soluble anions (soil paste, m mole$_c$/l):**	
pH (1:25 soil water suspension)	7.71	CO_3^{2-}	0.00
$CaCO_3$ g/kg	1.80	HCO_3^-	1.85
Organic matter g/kg	0.25	Cl^-	0.20
		SO_4^{2-}	0.27
Soil physical properties:		**Available macro & micronutrients mg/kg:**	
Bulk density Mg/ cm^3	1.47	N	50.0
ESP	4.92	P	2.85
Total porosity %	69.75	K	55.1
Hydraulic conductivity cmh^{-1}	11.39	Fe	3.89
Soil moisture at field capacity %	17.18	Mn	0.89
Soil moisture at wilting point %	10.46	Zn	0.48
Available Water %	7.21	Cu	0.05

The field experiment started, after winter wheat, at summer season of 2009. The applied localy soil amendments were represented by organic compost (composted plant residues), farm yard manure (FYM), enrich bentonite and gypsum shales. The main physical, chemical and nutrient status of the soil amendments were determined according to the above mentioned methods, besides semi-quantitative of clay minerals for bentonite shale, which was carried out on the basis of visual estimates of X-ray diffraction intensity from test samples and standard mixtures of clay fractions according to Jackson, (1973) data are illustrated in Table 2. The applied treatments were performed as solely or combined treatments with foliar sprayed zinc and boron in fixed plots, with an area of 10.5 m^2 for each plot, arranged in a split-split design, with three replicates, as follows:

1. Untreated soil.
2. Organic compost, *i.e.,* composted plant residues and FYM
3. Inorganic treatments, *i.e.,* gypsum and bentonite shale.
4. Micronutrients (zinc and boron) at a rate of 500 g fad^{-1}.

* Organic compost at a rate of 12.5 Mg fad^{-1}.

* Bentonite and gypsum shale at a rate of 10 Mg fad^{-1}.

The tested soil amendments were added to the experimental soil plots during their preparation for planting, where the plots were ploughed twice in two ways and received 13 kg p fad^{-1}., as calcium superphosphate 6% P. Peanut seeds (Giza 5) were sown under sprinkler irrigation system at last of May 2009. Nitrogen as ammonium sulphate (20.6%N) and potassium as potassium sulphate 40% K were added at the rates of 50 kg N/fad., as basal dose and 30 kg K fad^{-1}., respectively, in two equal doses, *i.e.,* after 1 and 2 months of planting. The other agronomic practices, except irrigation and organic fertilization, have been followed according the usual methods being adapted for peanut crop.

Soil samples were collected from a depth of 0-30 cm of each plot at 75 days of sowing (figure maximum vegetative growth stage of peanut) for identifying impact of the applied treatments on some soil physical properties (*i.e.,* bulk density, hydraulic conductivity and available water range) and the nutrients status (*i.e.,* available contents of N, P, K, Zn and B) in the treated soil plots. Available macro nutrients of N, P and K were extracted by 1% potassium sulphate, 0.5 M sodium bicarbonate and 1.0 M ammonium acetate, respectively according to Jackson, 1973, Chapman and Pratt , 1961 and

Table 2. Characteristics of the studied organic and inorganic soil amendments

a. Organic amendments

Organic Compost		Farmyard Manure	
Characteristic	**Value**	**Characteristic**	**Value**
pH (1:10 water suspension)	7.15	pH (1:10 water suspension)	8.04
Bulk density Mg/ cm^3	497	Bulk density Mg/ cm^3	358
Moisture content%	35.07	Cellulose g kg^{-1}	38.3
EC (dS m^{-1}, 1:10 water extract)	2.34	Lignin g kg^{-1}	13.8
CEC c mol$_c$ kg^{-1}	28.81	Moisture content%	35.07
Organic matter g kg^{-1}	49.44	EC (dS/m, 1:10 water extract)	1.91
Organic carbon g kg^{-1}	28.8	CEC (m mol$_c$ L^{-1})	20.11
Total N g kg^{-1}	1.63	Organic matter g kg^{-1}	49.44
C/N ratio	17.7	Total carbon g kg^{-1}	25.9
Total P g kg^{-1}	0.42	Total N g kg^{-1}	1.73
Total K g kg^{-1}	3.07	C/N ratio	20.4
Available nutrients (mg kg^{-1})		**Available nutrients (mg kg^{-1})**	
N	674	N	580
P	756	P	675
K	704	K	304
Fe	41.93	Fe	970
Mn	23.8	Mn	5.31
Zn	19.84	Zn	16.04
Cu	1.41	Cu	4.90
B	0.25	B	0.11

b. Inorganic amendments

Bentonite shale		Gypsum shale	
Characteristic	**Value**	**Characteristic**	**Value**
pH (1:2.5 water suspension)	7.39	pH (1:2.5 water suspension)	7.7
CEC (meq/100 g shale)	64.1	**Total components of shale %**	
EC (dS m^{-1}, paste extract)	7.12	$CaSO_4 .2H_2 O$ %	97.00
$CaCO_3$ %	0.35	Soluble salts %	4.63
Gypsum %	0.14	$CaCO_3$ %	5.46
Particle size distribution %		Organic matter %	0.11
Sand	2.74	Ca^{2+}	23.3
Silt	9.81	Cl^-	1.2
Clay	87.45	NaCl	0.2
Semi-quantitative analysis of clays %		**Physical properties%**	
Smectites	71.3	Sand	4.85
Kaolinite	9.56	Less than 2mm	90
Illite	6.7	Less than 1mm	50
Vermiculite	5.93	Purity	97

Black *et al.* (1965). Available micronutrients (*i.e.* Fe, Mn Cu and Zn) were extracted by DTPA according to Lindsay and Norvell (1978) and measured by using the Atomic Absorption Spectrophotometer. Boron was extracted from plant by wet digestion and from soil by hot water and was measured colorimetrically by Azomethine-H method using the Spectrophotometer according to Chapman and Pratt (1961).

Water salinity and sodicity classes were according to Ayers and Westcot (1985). Data in Table 3 indicated that irrigation water lies in the first category of non-salinity problem, and no sodicity problem "C1S1".

Water use efficiency (WUE), which calculated using the equation of Vites (1965) for grain yield, as follows:

WUE= (Seed yield in kg) ÷ (fad./actual consumptive use in m^3/fad.)

At harvest (end of September 2009), pod and straw yields of peanut were determined from each plot. Peanut pods were dried to separate seeds, and samples were dried and weighted to determine seed yield as well as seed quality (*i.e.*, weight of 100 seeds, crude protein, oil and nutrient contents). Seed samples were dried, ground and digested according to Thomas *et al.* (1967), then subjected to the determination of N, P, K, Zn and B by using the standard methods described by Chapman and Pratt (1961). Crude protein of peanut seed was calculated by multiplying total N-content by 6.25 (Deyoe and Shellenberger, 1965). Oil content of peanut seed was determined by using solvent extraction method in Soxhlets apparatus with N-hexane as solvent according to AOCS (1964). Micronutrients were determined according to AOAC (2005) and measured spectrophotometrically using the Atomic Absorption Spectrophotometer.

The obtained data of soil and plant characteristics were statistically analyzed according to the methods suggested by Gomez and Gomez (1984) using the LSD. at a 0.05 level of significance.

RESULTS AND DISCUSSIONS

The current work may be helpful for identifying the mot efficient soil agro-management practices of some newly reclaimed soils for maximizing their productivity, especially for soils which are partially capable to retain neither water nor nutrients for growing plants. In addition, these soils are poor not only in the nutrient-bearing minerals, but also in organic matter, which are the storehouse plant nutrients, thus in turn to these soils as low productivity. (Moustafa *et al.*, 2005).

Hydrophysical Status

The identified changes in the studied hydrophysical properties of sandy soil under consideration as related to the application of organic soil amendments during the summer season is presented in Table 4.

In general, the studied soil characteristics responded markedly to all the tested treatments added either individually or together under peanut cultivation during the summer season. Data also indicated that the individual and combined treatments showed a positive effect for improving the soil characteristics, *i.e.*, the values of bulk density and hydraulic conductivity were decreased, whereas total porosity and retained moisture at field capacity, wilting point and available range as well as available nutrient contents (N, P, K, Zn and B) increased with increasing the applied organic soil amendments.

Soil bulk density and total porosity

The results obtained in Table 4 show that the applied organic soil amendments as individual or combined treatments play a positive role, *i.e.*, reducing soil bulk density vs increasing total soil porosity. This increase involves an increase of storage pores in the sandy soil. Organic material partially covered the walls interconnected pores (Amjad *et al.*, 2010), which are usually most common in such soils.

Hydraulic conductivity and soil moisture constants

The pronounced decrease in hydraulic conductivity in soil may be attributed to a creation of micro pores, and a dominance of meso and micro pores. These results are in agreement with those of El-Fayoumy and Ramadan (2002). Concerning changes in available water range, field capacity and wilting point, the soils treated with inorganic soil amendments (FYM and compost) showed

Table 3. Water characteristics of the used irrigation source

Characteristic	Value	Characteristic	Value
pH	7.23	**Sodium absorbtion ratio (SAR)**	2.40
EC dS m^{-1}	0.57	**Residual sodium carbonate (RSC)**	0.00
Total dissolved salt mg L^{-1}	364.8	**Irrigation water suitability degree**	C1S1

Sioluble ions mmol$_c$ L^{-1}

Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO$_3^{2-}$	HCO$_3^-$	Cl$^-$	SO$_4^{2-}$
1.90	0.83	3.80	0.25	0.00	1.95	2.60	1.23

Table 4. Changes in soil hydrophysical at the maximum vegetative growth stage of peanut plants as related to the influence of the applied organic soil amendements

Treatments	**Soil Characteristics**					
	Hydrophysical					
	BD	**TP**	**HC**	**FC**	**WP**	**AW**
Control	1.78	40.27	16.94	12.65	4.71	7.94
	Natural soil amendments (N)					
Gypsum	1.71	42.51	15.19	13.15	5.21	8.75
Bentomite	1.58	45.16	13.92	15.41	6.14	9.26
	Organic soil amendments					
FYM	1.59	46.34	12.98	16.15	6.24	9.91
Compost	1.50	50.05	10.99	19.15	7.27	11.88

BD= soil bulk density (Mg cm^{-3}), TP= Total porosity%, HC=Hydraulic conductivity (cm h^{-1}).
FC= soil moisture at field capacity%, WP= soil moisture at wilting point%.
AW=soil moisture at available range%

relatively high values as compared to those amended with gypsum and bentonite. This may be due to the fact that organic substances attain a pronounced high content of active organic compounds enhancing water retention. Active -OH and -COOH are reported to effect only the biological activity, but also soil structure (El-Fakharani, 1999 and Moustafa *et al.*, 2005). Colloidal particles not only improve the soil structure parameters but also the properties of solid-liquid system interface due to the change in the contact angle of the soil particle with water (Sadek et *al.*, 1992).

According to Tayel *et al.* (2001) and (Anas *et al.*, 2009), the increase in water retention in sandy soils treated with organic materials may be due to one or more of the following reasons, a) decrease in soil bulk density and the increase in porosity, b) a modification of soil structure and pore size distribution, c) an increases in the capacity of the released active organic acids for water retention, and a rise in soil hydraulic resistively and a decrease in soil hydraulic conductivity accompanying soil structure modification (Anas *et al.*, 2009).

Soil Fertility Status

Data illustrated in Tables 5a and b reveal that the micronutrients of boron and zinc when added as individual treatment or combined with other organic or inorganic soil amendments surpassed the other treatment in enhancing the availability of essential plant nutrients (N, P, K, Zn, and B). Organic acids are capable to retain nutrients for growing plants, acting as complexing agents (Mackowiak *et al.,* 2001). Enhanced plant growth following addition of organic substances has sometimes been related to increased micronutrient availability especially iron and zinc. Metal concentration could be reduced to non- toxic levels following addition of organic substances, and affecting significantly the solubility of Zn (Prasad and Sinha, 1982). Organic materials can incorporate iron into chelate, maintaining its availability to plants (Ramasamy *et al.,* 2006). Therefore, these chelating agents, through active groups for micronutrients, are considered a storehouse of nutrients for plant roots, and in turn reflected positively on development of yield and its attributes for the studied crops.

The positive effect of organic soil amendments lead to enhance crop growth and nutrient uptake by plants through improvement of hydrophysical properties and thus increase soil ability to supply plants with their requirements of water and air along the growing season. On the other hand, organic acids act as a soil-conditioning agent, forming polymers of greatly increased molecular weight. These cross linked improve the water-holding characteristics of the soil (Lattner *et al.,* 2003) which, consequently, stimulates root growth and the activities of beneficial microorganisms (Chen *et al.,* 2003).

Inorganic amendments are stable, non-toxic products which contain plant nutrients Chunming and Suarez, (2004) stated that boron desorption has received less attention than B adsorption, yet it is as important to B availability in soils.

Effect of the Applied Treatments o Crop Yield and its Components

Seed and foliage yield

Results in Table 6 indicate the effect of applied treatments on peanut seed and foliage yields. Data showed marked increases in each of seed and foliage yields reached 33.4 and 47.83% for seed *vs* 72.69 and 55.42% for foliage due to natural and organic amendments, respectively.

It is evident that the combined treatments showed superior increases as well as zinc + boron as a combined treatment, followed by boron and zinc. Application of zinc+boron in combination with organic or inorganic amendments , enhanced the role of both organic materials for increasing seed and foliage of peanut plants, where the treatment of zinc + boron combined with compost showed the highest yields, followed by zinc + boron combined with FYM, bintonite and gypsum added. This is mainly due to its natural origin from soil processes, contains chemical structures which can oxidize or reduce elements, photosensitize chemical reactions and enhance or retard the uptake of toxic compounds or micronutrients to plants and microorganisms thereby greatly benefiting plant growth (Bacilio *et al.,* 2003; Nardi *et al.,* 2002 and Reza *et al.,* 2009).

Weight of 100 seeds

Data presented in Table 6 indicated that the weight of 100 seeds for the grown peanut was positively affected by the different applied treatments of zinc, boron and zinc+boron as individual or combined ones (zinc+boron with inorganic amendments and zinc+boron with organic amendments). The relative increase in 100 seed weight of peanut reached 46.11 and 52.48% over the control treatment, respectively. These results were true for peanut as summer crop, and confirmed as effect of the organic materials obtained by Rathore *et al.* (2009) who reported that the applications of organic materials could be a promising option for yield enhancement. These benefits are more related to the improvement of soil hydrophysical properties that is increased soil ability to supply plants with their requirements of water and air along the growing season (Poganiac, 1972). These results could be explained according to the finding of Cheng *et al.* (1998) who reported that the beneficial effect of the released active organic acids on plant growth is more related to their role, since they act like plant growth hormones, decreased the loss of soil moisture, enhanced the water retention, increased the ability rate of leaves for photosynthetic process, increased the seed filling intensity, enhanced the drought resistance of seed and increased its hundred weight.

Table 5a. Effect of applied natural and organic soil amendments on available soil macronutrient

Treatment (T)	Soil amendments							LSD at 0.05
	Control	Natural (N)			Organic (O)			
		Gypsum	Bentonite	Mean	FYM	Compost	Mean	
			Nitrogen (mg kg^{-1})					
Control	16.69	23.97	24.64	21.77	38.36	47.08	34.04	T =0.14
Zinc	16.91	25.71	27.11	23.24	40.09	50.89	35.96	N = 1.50
Boron	15.00	26.91	30.65	24.19	45.65	55.87	38.84	O = 2.51
Zinc + Boron	17.01	33.23	34.54	28.26	57.87	60.11	44.99	T×N =2.12
Means	16.40	27.46	29.24	24.37	45.49	53.49	38.46	T×O =2.63
			Phosphorus (mg kg^{-1})					
Control	5.00	5.55	6.21	5.59	5.66	6.11	5.59	T = 0.65
Zinc	5.77	6.11	6.87	6.25	6.14	6.77	6.22	N = 0.45
Boron	6.31	7.00	7.23	6.84	6.87	7.12	6.77	O = 1.54
Zinc + Boron	7.13	7.57	7.72	7.47	7.01	7.86	7.33	T×N =1.11
Means	6.05	6.56	7.00	6.54	6.42	6.97	6.78	T×O =2.24
			Potassium (mg kg^{-1})					
Control	64.12	65.14	66.54	65.27	67.51	69.45	66.56	T = 2.16
Zinc	77.92	89.54	90.54	86.00	78.35	98.45	84.91	N =3.12
Boron	85.01	99.23	100.01	94.75	94.25	99.89	93.05	O = 6.21
Zinc + Boron	95.08	103.12	103.45	100.55	100.21	105.31	100.2	T×N =4.86
Means	81.28	89.26	90.13	86.89	85.08	93.27	89.18	T×O =4.25

Table 5b. Effect of applied natural and organic soil amendments on available soil micronutrient

Treatments (T)	Soil amendments							LSD at 0.05
	Control	Natural (N)			Organic (O)			
		Gypsum	Bentonite	Mean	FYM	Compost	Mean	
			Zinc (mg kg^{-1})					
Control	0.50	0.62	0.67	0.59	0.70	0.79	0.66	T = 0.03
Zinc	0.61	0.80	0.98	0.79	0.89	0.99	0.83	N = 0.43
Boron	0.77	0.98	1.00	0.92	0.99	1.19	0.98	O = 0.57
Zinc + Boron	1.05	1.17	1.29	1.17	1.15	1.37	1.19	T×N =0.03
Means	0.73	0.89	0.99	0.87	0.93	1.09	0.91	T×O =0.05
			Boron (mg kg^{-1})					
Control	0.03	0.02	0.04	0.03	0.05	0.07	0.05	T = 0.03
Zinc	0.04	0.03	0.05	0.04	0.06	0.08	0.06	N = 0.04
Boron	0.09	0.10	0.09	0.07	0.10	012	0.10	O = 0.02
Zinc + Boron	0.10	0.13	0.14	0.12	0.14	0.15	0.13	T×N =0.02
Means	0.07	0.07	0.08	0.07	0.09	0.11	0.09	T×O =0.06

Table 6. Effect of applied natural and organic soil amendments on peanut seed, foliage yields and weight of 100 seeds

Treatments (T)	Soil amendments							LSD at 0.05
	Control	Natural (N)			Organic (O)			
		Gypsum	Bentonite	Mean	FYM	Compost	Mean	
			Seed yield (ton fad^{-1}.)					
Control	910.2	1023.2	1133.7	1022.4	1134.9	1156.7	1067.3	T = 62.1
Zinc	976.8	1123.9	1439.0	1279.9	1567.9	1675.7	1406.8	N = 35.3
Boron	997.0	1275.1	1533.8	1269.6	1612.3	1698.4	1435.9	O = 20.4
Zinc + Boron	987.8	1309.0	1561.6	1256.1	1665.1	1765.0	1472.6	T×N =44.6
Means	967.95	1257.8	1417.0	1214.3	1495.1	1573.8	1345.6	T×O =26.4
			Foliage yield (ton fad^{-1}.)					
Control	1527.7	2243.0	2454.9	2075.2	2504.6	2558.4	2196.9	T = 37.9
Zinc	1456.9	2539.9	2627.6	2208.1	2775.5	2899.5	2377.3	N =59.6
Boron	1516.8	2446.5	2705.3	2222.8	2789.7	2956.8	2421.1	O = 46.4
Zinc + Boron	1654.1	2527.6	2764.8	2315.5	2886.5	2966.9	2502.5	T×N =49.4
Means	1538.9	2439.2	2638.2	2205.4	2739.1	2845.4	2374.4	T×O =38.4
			Weight of 100 seeds (g)					
Control	45.10	60.21	65.56	56.95	65.22	66.10	58.80	T =1.82
Zinc	63.17	63.25	70.66	65.69	70.99	71.45	68.53	N = 2.91
Boron	65.19	66.22	74.97	68.79	75.00	76.47	72.22	O = 1.65
Zinc + Boron	69.63	70.10	76.78	72.17	77.01	79.98	75.54	T×N =1.11
Means	60.77	64.94	71.99	65.90	72.05	73.50	68.77	T×O =1.65

Seed protein and oil contents of peanut

Peanut seed protein content as affected by the applied solely organic materials as well as their combination are illustrated in Table 7. Data showed a positive and significant increase. In general, it is obvious that the beneficial effect of zinc+boron and organic and inorganic amendments as combined treatments followed by zinc and boron as individual treatment surpassed the other tested ones (gypsum, bentonite, FYM and compost as individual treatments). The corresponding relative increases were 41.44 and 48.93% for peanut seed over the control treatment. These results were true due to indirect and direct effects on the physiological processes of plant growth. They provide minerals, increase the micro-organism population, provide biochemical substances, and carry trace elements and growth regulators (Young *et al.,* 2004 and 2006).

Regarding oil content, data in Table 7 revealed that the magnitude of the increases for the applied treatments acts like their direct effect on peanut seed protein content. The relative increase percentages were 26.27 and 29.02% for the combined treatments of organic and inorganic amendments with micronutrients (zinc and boron). The progressively increased in peanut seed oil content as percentage may be due to the effect of applied treatments especially organic component on enhancing the biosynthesis for peanut seed oil. Said-Al Ahl and Hussein (2010) reported that the oil production increased significantly with organic materials application.

Nutritional status of peanut seed as affected by the applied treatments

The N, P and K content by seed of peanut as affected by different applied organic and inorganic soil amendments are shown in Table 8a. It is noticed that N, P and K content showed significant and positive response to applied treatments; the highest increases were strictly associated with the applied compost in combination with zinc+boron, since N content as kg/fad., raised over the control treatment in peanut seed with 1.4-1.5 times. The corresponding values of P and K were 1.4 - 1.5

Table 7. Effect of applied natural and organic soil amendments on peanut seed crude protein content and seed oil content

Treatments (T)	Soil amendments							LSD at 0.05
	Control	Natural (N)			Organic (O)			
		Gypsum	Bentonite	Mean	FYM	Compost	Mean	
	Seed crude protein content (%)							
Control	11.75	12.56	15.25	13.18	15.50	17.81	16.50	T = 1.40
Zinc	13.18	15.87	16.75	15.25	18.68	19.75	17.18	N = 2.00
Boron	16.50	17.81	18.68	17.68	19.50	20.31	18.75	O = 1.97
Zinc + Boron	19.62	18.75	22.67	20.31	20.43	22.31	20.75	T×N =2.01
Means	15.25	16.25	17.75	16.62	17.25	20.06	17.50	T×O =1.32
	Seed oil content (%)							
Control	21.12	22.23	22.58	21.97	23.90	24.00	23.00	T = 0.96
Zinc	26.77	27.32	27.98	27.36	28.03	29.11	27.97	N = 1.20
Boron	27.81	28.11	29.01	28.31	28.88	29.87	28.86	O = 1.11
Zinc + Boron	28.02	28.97	29.85	28.94	29.21	30.12	29.12	T×N =1.04
Means	25.96	26.65	27.36	26.67	27.50	28.28	27.25	T×O =1.67

and 2.0-2.3 times, respectively. Also, data revealed that the N, P and K uptake by peanut exhibited pronounced increases as a result of the direct effects of the applied treatments as compared to their control. These beneficial effects are more attributed to the improvements status of soil-water regime of studied sandy soil, consequently increasing nutrients availability for plants (Wanas, 1996). Moreover, Kachinsky and Mosolova (1976) reported that the applied organic polymers contain nitrogen and potassium in their molecules, were found to be available for plant utilization.

As for Zn and B content in peanut seed, data in Table 8b showed the applied organic and FYM towards increasing micronutrients content, since progressive increases in Zn and B raised over the control treatment in peanut seed with 1.9-2.0 and 1.2-1.7 times, respectively.

The aforementioned results indicated that the applied organic amendments affect directly or indirectly nutrients content. This means that the applied organic soil amendments are considered as a storehouse with easily mobile or available to taken by plant roots. Consequently, these benefits are reflected positively on development of yield.

Also, these findings indicated an important role for organic materials in improving the efficiency of nutrients content, and in turn increasing the quantity and quality of both peanut seed and foliage. These results are confirmed by Mackowiak *et al.* (2001) and Madlain *et al.* (2002) who reported that the beneficial effect of organic materials on dry matter yields may be attributed to improving the bio-availablity of micronutrients by complexion, which prevent early micronutrients deficiency. Application of organic materials induced higher yields and a better nutrient use efficiency (Rathore *et al.*, 2009 and Viqar *et al.*, 2011).

Water Use Efficiency

The water use efficiency (Table 9) is expressed as kg seeds/m^3 water consumed by the peanut plants. This criterion has been used to evaluate the crop production under different applied treatments per unit of consumed water by the crop plants. The obtained results showed that irrigating peanut plants at combined treatments especially for compost one achieved a significantly increase for the water use efficiency value, particularly for the combined treatment under the applied gypsum shale it tended to reduce.

Table 8a. Effect of applied natural and organic soil amendments on macronutrient content of peanut seeds

Treatments (T)	Soil amendments							LSD at 0.05
	Control	Natural (N)			Organic (O)			
		Gypsum	Bentonite	Mean	FYM	Compost	Mean	
				Nitrogen content (%)				
Control	1.88	2.01	2.44	1.44	2.64	2.85	2.46	T = 0.87
Zinc	2.11	2.54	2.68	2.44	2.99	3.16	2.75	N = 0.23
Boron	2.64	2.85	2.99	2.83	3.12	3.25	3.00	O = 0.54
Zinc + Boron	3.14	3.00	3.62	3.25	3.27	3.57	3.31	T×N =0.33
Means	2.43	2.60	2.91	2.64	3.01	3.21	2.88	T×O =0.11
				Phosphorus content (%)				
Control	0.232	0.235	0.242	0.236	0.257	0.264	0.251	T = 0.043
Zinc	0.323	0.325	0.333	0.327	0.359	0.372	0.351	N = 0.023
Boron	0.334	0.350	0.367	0.350	0.400	0.419	0.384	O = 0.054
Zinc + Boron	0.375	0.401	0.428	0.401	0.441	0.458	0.419	T×N =0.043
Means	0.316	0.322	0.343	0.327	0.364	0.378	0.351	T×O =0.065
				Potassium content (%)				
Control	0.278	0.399	0.455	0.377	0.548	0.600	0.475	T = 0.65
Zinc	0.590	0.596	0.645	0.610	0.691	0.699	0.660	N = 0.023
Boron	0.611	0.670	0.658	0.644	0.687	0.715	0.671	O = 0.032
Zinc + Boron	0.628	0.698	0.711	0.679	0.729	0.789	0.715	T×N =0.043
Means	0.526	0.576	0.617	0.573	0.661	0.701	0.629	T×O =0.076

Table 8b. Effect of applied natural and organic soil amendments on micronutrient content of peanut seeds

Treatments (T)	Soil amendments							LSD at 0.05
	Control	Natural (N)			Organic (O)			
		Gypsum	Bentonite	Mean	FYM	Compost	Mean	
				Zinc content (mg kg^{-1})				
Control	0.228	0.288	0.277	0.281	0.289	0.297	0.288	T = 0.054
Zinc	0.590	0.618	0.625	0.611	0.635	0.657	0.627	N = 0.047
Boron	0.291	0.296	0.278	0.288	0.299	0.306	0.299	O = 0.062
Zinc + Boron	0.628	0.634	0.655	0.639	0.676	0.689	0.664	T×N =0.069
Means	0.447	0.459	0.459	0.455	0.475	0.487	0.470	T×O =0.038
				Boron content (mg kg^{-1})				
Control	0.021	0.022	0.021	0.021	0.023	0.024	0.023	T = 0.008
Zinc	0.011	0.010	0.012	0.011	0.016	0.026	0.018	N = 0.004
Boron	0.030	0.033	0.035	0.031	0.035	0.037	0.034	O = 0.003
Zinc + Boron	0.032	0.036	0.038	0.035	0.040	0.044	0.036	T×N =0.008
Means	0.024	0.025	0.027	0.025	0.029	0.033	0.037	T×O =0.006

Table 9. Effect of applied natural and organic soil amendments on water use efficiency

Treatments	Control	Natural		Organic	
		Gypsum	Bentonite	FYM	Compost
	Water use efficiency kg seed/m^3				
Control	0.489	0.551	0.610	0.610	0.622
Zinc	0.526	0.604	0.774	0.843	0.901
Boron	0.537	0.686	0.825	0.867	0.914
Zinc + Boron	0.532	0.700	0.840	0.896	0.949

Water consumptive used (sprinkler irrigation 85% use efficiency) = 1858 m^3 fad^{-1}

Conclusions

From the abovementioned results, it evidence that the beneficial effect of organic compost and bentonite with micronutrient zinc+boron was more attributed to water use efficiency with enhancing the biological active in the soil which have ability to encourage the released nutrients, particularly the micronutrients that are considered as a storehouse in more mobile or available forms to uptake by peanut plant roots.

REFERENCES

AOAC (2005). Official Methods of Analysis of the Association of Official Analytical Chemists. 17th Ed., AOAC International, Maryland, USA.

AOCS (1964). Official and Tentative Methods of American Oil Chemists Society. 2nd Published by American Oil Chemists Society, 35 East Wacker Drive. Chicago. Illionis, USA.

Amjad, A.S.A., Y.M.A. Khanif, H.A. Aminuddin, O.A. Radziah and H.A. Osumanu (2010). Impact of potassium humate on selected chemical properties of an Acidic soil. 19th world congress of soil science, soil solutions for a changing world, 1-6, Brisbane, Australia.

Anas A.A.W., A.M. Ibrahim and M.A.A. Bakry (2009). Integrated input soil and water managements in maximizing peanut crop under the eastern drought-front desert outskirt of El-Fayoum Governorate, Egypt. Res. J. Agric. and Biological Sci., 5 (1): 1-15.

Ayers, R.S. and D.W. Westcot (1985). Water quality for agriculture, irrigation and drainage. Paper No. 29, FAO, Rome, Italy.

Bacilio, M., P. Vazquez and Y. Bashan (2003). Alleviation of noxious effects of cattle ranch composts on wheat seed germination by inoculation with *Azospirillum* spp. Biol Fertil Soils, 38: 261-266.

Beech, D.F., E.S. Wallis and D.E. Blyth (1987). Production of peanut in Burma. 2: research of nutrition. Food Legum Improvement for Asian Farming System, 231.

Black, C.A., D.D. Evans, L.E. Ensminger, J.L. White and F.E. Clark (1965). Methods of Soil Analysis. Amer. Soc. Agron. Inc., Pub., Madison, Wisconsin, USA.

Borhamy, Sh. El. (2005). Effect of gypsum and mineral fertilizers on yield and nutrient concentrations of peanut and wheat grown on sandy soil. Egypt. J. App. Sci., 20 (2): 328-339.

Celik, I. A.; I.M. Ortaz and S.S. Kilic, (2004). Effects of compost, mycorrhiza, manure and fertilizer on some physical properties of a Chromoxeret soil. Soil and Till. Res., 78:59-67.

Chapman, H.D. and P.F. Pratt (1961). Methods of Analysis for Soils, Plants and Waters. Univ. of California, Riverside, USA.

Chen, S.K., C.A. Edwards and S. Subler (2003). The influence of two agricultural bio-stimulants on nitrogen transformations, microbial activity, and plant growth in soil microcosms. Soil Biol. and Bioch., 35 : 9- 19.

Cheng, F.J., D.Q. Yang and Q.S. Wu (1998). Physiological effects of humic acid on drought resistance of wheat. Chinese J. of App. Ecology, 363-367.

Chunming, S. and D.L. Suarez, (2004). Boron Release from Weathering of Illites, Serpentine, Shales, and Illitic/Palygorskitic Soils. Soil Sci. Soc. Am. J. 68:96–105.

Dallas, L.H. (1994). Boron and other minor elements for peanuts. The Alabama Cooperative Extension System, 2.

David, I., J.O. Jordan, B. Bean, J. dewayen and F.S. Jan (2001). Peanut response to prophexadine calcium in three seedling rate-row patteren planting system. Agron. J., 93 : 232-236.

Deyoe, C.W. and J.A. Shellenberger, (1965). Amino acids and proteins in sorghum grain. J. Agric. and food Chem., 13: 446.

Dorenbos, T., A.H. Kassam, I.M. Bentveleson and V. Branscheio (1979). Yield respons to water. FAO Irrigation and Drainage, paper No. 33, Roma Italy.

El-Fakharani, Y.M. (1999). Combined effect of P fertilization and organic manuring on barley production in sandy soil. Fayoum J. Agric. Res. and Dev., 13: 81-94.

El-Fayoumy, M.E. and H.M. Ramadan (2002). Effect of bio-organic manure on sandy soils amelioration and peanut productivity under sprinkler irrigation system. Egypt. J. Soil Sci., 42(3): 838.

El-Sedfy, O.F. (2002). Effect of bentonite, compost and biofertilizer additions on some physical properties of sandy soil, wheat and peanut yields. J. Agric. Sci., Mansoura Univ., 27 (10):7117-7126.

Ertli, T.T., A.U. Marton and R.A. Foldenyi (2004). Effect of Ph and the role of organic matter in the adsorption of isoproton on soils. Chemosphere, 57: 771-779.

Gomez, K.A. and A.A. Gomez (1984). Statistical procedures for agricultural research. John Wiley and Sons, Inc., New York, USA.

Jackson, M.L. (1973). Soil chemical Analysis.. Prentice-Hall of Indian private, Limited, New Delhi.

Kachinsky, N.A. and A.I. Mosolova (1976). The application of polymers for artificial improvement of soil structure and amelioration. Med. Fac. Landbouw Rijks, Univ., Gent, 41: 437-441.

Lattner, D., H. Flemming and C. Mayer (2003). 13C-NMR study of the interaction of bacterial alginate with bivalent cations. International J. Biological Macromolecules, 33: 81-88.

Lindsay, W.L. and W.A. Norvell (1978). Development of DTPA soil test for Zn, Mn and Cu. Soil Sci. Soc. Am. J., 24: 421-424.

Mackowiak, C.L., P.R. Grossl and B.G. Bugbee (2001). Beneficial effects of humic acid on micronutrient availability to wheat. Soil Sci. Soc. Am. J., 65: 1744-1750.

Madlain, M. and M. Salib, (2002). The integrated effect of humic acid and micronutrients in combination with effective micro-organisms on wheat and peanut grown on sandy soils. Zagazig J. Agric. Res., 29(6): 2033- 2050.

Metwally, Sh.M. and M.A. Khamis (1998). comparative effects of organic and inorganic nitrogen sources applied to a sandy soil on availability of N and wheat yield. Egypt. J. Soil Sci., 38 (1-4): 35-54.

Moustafa, M.A.A., N.R. Habashy and A.A.W. Anas (2005). Utilization of some organic polymers and humic acids for improving a sandy soil productivity of peanut and their residual effects on the next crop of faba bean. Fayoum J. Agric. Res. And Dev., 9 (2): 42-55.

Nardi, S., P.D. Muscol and A. Vianello (2002). Physiological effects of humic substances in higher plants. Soil Biol. Bioch., 34: 1527-1537.

Page, A.I., R.H. Miller and D.R. Keeney, Eds., (1982). Methods of soil analysis. Part 2: chemical and microbiological properties. 2nd Ed., Amer. Soc. of Agron., Madison, Wisconsin, U.S.A.

Poganiac, K.P. (1972). Artificial structure: Functional soil properties and soil productivity for cotton. FAN, Tashken. USSR.

Prasad, B. and P. Sinha (1982). Change in the status of micronutrients in soil with long term application of chemical fertilizers, lime and manure. Plant and Soil, 64 (3): 437-441.

Qi, C.K., C.C. Hoffmann and K.W. Jaggard (2004). The Broom's Barn sugar productivity for cotton. FAN, Taskhent, USSR.

Ramasamy, N., S. Kandasamy, S. Thiyageshwari and B.P. Murugesa (2006). Influence of lignite humic acid on the micronutrient availability and yield of blackgram in an alfisol. 18th world congress of soil science. Philadelphia, USA.

Rathore, S.S., D.R. Chaudhary, G.N. Boricha, A. Ghosh, B.P. Bhatt, S.T. Zodape and J.S. Patolia, (2009). Effect of seaweed extract on the growth, yield and nutrient uptake of soybean (*Glycine max*) under rainfed conditions South African J. of Botany, 75 (2): 351-355.

Reza, S., G. Aladdin, G. Elshad and V. Mustafa (2009). Applications of potassium humate to wheat for organic agriculture in Iran. As. J. Food Ag-Ind. Special Issue, 164-168.

Sadek, M.I., A.M. Amal and T.A. Abou Defan, (1992). Effect of some physical properties of sandy soil. Annals of Agric Sci. Moshtohor, 30(4): 2081-2091.

Said-Al Ahl, H.A.H. and M.S. Hussein (2010). Effect of water stress and potassium humate on the productivity of organo plant using saline and fresh water irrigation. Ozean J. of Applied Sci., 3(1): 125-141.

Sharma. P.K., O.P. Gill and B.L. Sharma (1992). Effect of source and mode of sulphur application on yield groundnut (*Arachis hypogaea*). Indian J. Agron., 37:489-492.

Singh, A.L., R.S. Jat and J.B. Misra (2009). Boron fertilization is a must to enhance peanut production in India.The Proceedings of the International Plant Nutrition Colloquium XVI, Department of Plant Sci., UC Davis, UC Davis.

Soltanpour, P.N. and A.B. Schwab (1977). A new soil test for simultaneous extraction of macronutrients in alkaline soils. Comm. Soil Sc. and Plant Annual., 8: 195-198.

Tayel, M.Y., A. Ghazy, R.S. Abdel Aal and Sh.A. Wanas (2001). Improving sand soils using cellulose derivatives. 2: pore size distribution, soil water retention, soil hydraulic conductivity and soil hydraulic resistivity. Egypt. J. Soil Sci., 41:231-234.

Thomas, R.L., R.W. Shearel and Z.R. Mayer (1967). Comparison of conventional and automated procedure for nitrogen, phosphorus and potassium analysis of plant material using single digestion. Agron. J., 5: 240-252.

Viqar, S., G.N. Baloch, J.A. Ambreen, M.R. Tariq and D.S. Ehteshamul-Haque (2011). Comparative efficacy of a red alga *Solieria robusta*, Chemical fertilizers and pesticides in managing the root diseases and growth of soybean. Pak. J. Bot., 43(1): 1-6.

Vites, F.Jr. (1965). Increasing water use efficiency by soil management in plant environment and efficient water use. J. Amer. Soc. of Agron., 26: 537-546.

Wanas, Sh.A. (1996). Improvement of sandy soil by the use of hydrogels derived from agricultural and industrial wastes. Ph.D. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

Young, C.C., C.H. Su, G.H. Li, M.H. Wang and A.B. Arun, (2004). Prospects for nitrogen incorporation into humic acid as evidenced by alkaline extraction method. Curr. Sci., 87: 1704-1709.

Young, C.C., P.D. Rekha, Wei-An Lai and A.B. Arun (2006). Encapsulation of Plant Growth-Promoting Bacteria in Alginate Beads Enriched With Humic Acid. Biotechnology and Bioengineering, 37: 76-83.

تأثير إضافة المحسنات الطبيعية و العضوية علي تحسين بعض خواص وإنتاجية الأراضي الرملية

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أجريت تجربة حقلية علي محصول الفول السوداني (*Arachis hypogaea*) صنف جيزة-٥ كمحصول صيفي منزرع في أرض رملية تحت نظام الري بالرش في محطة البحوث الزراعية بالإسماعيلية، وذلك خلال الموسم الزراعي ٢٠٠٩. وتهدف هذه الدراسة إلي تحديد مدي الاستفادة المباشرة وذلك من خلال إضافة محسنات التربة العضوية (كومبوست ومخلفات المزرعة) وكذلك الغير عضوية (جبس زراعي وبنتونيت) على خواص التربة الرملية (الكثافة الظاهرية، المسامية، التوصيل الهيدروليكي، الثوابت المائية للتربة) مع إضافة كل من الزنك والبورون كمغذيات عناصر صغري، وكذلك قياسات المحصول ومكونات المحصول تحت الدراسة، ممثلة في محصولي الحبوب والعرش، وزن ١٠٠ حبة، محتوي الحبوب من الزيت، البروتين، النيتروجين، الفوسفور، البوتاسيوم، الزنك والبورون. وكان معدل الإضافة لمحسنات التربة العضوية ١٢,٥ طن/فدان وبمعدل ١٠ طن/ فدان من محسنات التربة غير العضوية حيث تم الخلط جيدا مع الطبقة السطحية للتربة حتي عمق ٥ سم من السطح بينما كانت العناصر الصغري من البورون و الزنك بمعدل ٢٥٠ جرام / فدان علي دفعتين من خلال الرش الورقي. وتشير النتائج المتحصل عليها إلي أن استخدام تلك المحسنات العضوية سواء كمعاملات منفردة أو مشتركة مع العناصر الصغري (من بورون والزنك) قد حقق كثير من التأثيرات المفيدة، و التي ربما ترجع إلى أن محسنات التربة العضوية بما تحويه من أحماض عضوية يعمل كهرمون منشط لنمو النبات، أو الغير عضوية لرفع قدرة التربة علي الاحتفاظ بالرطوبة الأرضية والمغذيات للنباتات النامية كنتيجة أنهما يعملان كمواد خالبة محتوية علي أحماض عضوية و تكون معقدات تحد من الفقد بالغسيل، ومثل هذه المواد الخالبة للماء و المغذيات من خلال مجموعات الكربوكسيل والفينول النشطة المعتبرة كمخزون عنصري أكثر حركة و صلاحية وتيسرا للامتصاص بواسطة جذور النبات مما ينعكس إيجابيا علي زيادة إنتاجية محصول الفول السوداني وجودة مكوناته في تلك التربة ذات الطبيعة الرملية وتحت نظام الري بالرش.

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