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Effectiveness of Soil Amendments Application on Sandy Soil Properties and Peanut Productivity

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A FIELD experiment was carried out for two successive summer seasons at Ismailia Agric. Res. Station, Ismailia Governorate, Egypt (Latitude, 30° 35' 41.901" N and longitude, 32° 16' 45.834" E) to investigate the effectiveness of soil amendments on sandy soil properties, nutritional status and peanut productivity. Two forms of organic amendments (Compost and Farmyard manure, FYM) at two rates (5 and 10 m^3/fed.) and three forms of mineral amendments (Gypsum, Rock phosphate and Feldspar) were applied each alone at two rates (1 and 1.5 ton/fed.). Results indicate that values of field capacity (FC), wilting point (WP) and available water (AW) increased significantly by the application of both organic and mineral amendments as compared to control treatments at both studied seasons. Moreover, data indicate that values of soil moisture content (FC, WP and AW) increased significantly by increasing the rate of both organic and mineral amendments, however high rate was superior. Gypsum and farmyard manure treatments recorded the highest values of soil moisture content.

The available N, P and K in soil increased significantly in case of applying either10 m^3/fed Compost and FYMor1.0 ton/fed of Gypsum, rock phosphate and Feldspar. On the other hand, the pH and EC values, decreased by applying different soil amendments. Moreover, the application of gypsum (1.0 ton/fed.) and FYM (10 m^3/fed) gave the highest significant yield components as well as crude protein percentage as compared to either control or other tested treatments. The same trend was observed with (N, P and K) total content of grains, straw and apparent nutrients use efficiency for peanut.

Finally, application of FYM and Gypsum as soil amendments at a rate of (10 m^3/fed and 1 ton/fed),respectively, improved soil chemical and physical properties and increased apparent nutrients use efficiency and yield components of peanut as well as their total content of macronutrients.

Keywords: Organic amendments, Mineral amendments, Soil properties, Peanut yield

Soil amendment is defined as any material added to a soil to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration and structure. Soil amendment must be thoroughly mixed into the soil. At the same time, organic amendments increase soil organic matter content and improve soil aeration, water infiltration, and both water and nutrient holding capacity. Organic matter also is an important energy source for bacteria, fungi and earthworms that live in the soil. Thus, use of organic amendments (farmyard and compost) is an effective and eco-friendly approach for reducing the large volume of organic waste and the nutrients stored in them are returned to soil (Zahir *et al*., 2007). Mulching soil surface with different organic materials improves soil biological activities; retains soil moisture for longer time and helps to control weeds (Saima *et al*., 2013).

Composting is a biological process in which microorganisms like bacteria, fungi and other organisms convert organic materials, such as leaves, manure, sludge, paper, grass clippings and food wastes into a soil like material called compost or humus (Vasilica *et al*., 2009). During composting, microbes utilize carbon of organic material as a source of energy and for synthesis of new microbial cells. Carbon serves as both building block and an energy source for microbes. The use of composts offers several potential benefits including manure handling, enhances soil fertility and reduces environmental risk, enlarges the air spaces in soil, improves its permeability for air and water circulation, improves soil texture, helps retain soil moisture, facilitates the mechanical treatment of heavy clay soil, adds nutrients to the soil, stimulates biological activities, encourages vigorous plant rooting system, helps bind nutrients and prevents them from being leached out of the soil (Sarwar *et al*., 2008 and Chitravadivu *et al*., 2009).

Farmyard manure has played an important role in the continuous supply of well-balanced diets of nutrients to crops and represents an important component of the nutrients cycle in agricultural ecosystems. Ali *et al.* (2005) indicated that pH and EC values were slightly decreased with FYM application at rate of 2 or 3% to sandy soil after harvesting maize. Several studies have assured the roles of organic amendments as an improving agent. The improvement of soil physical and chemical properties as well as nutrients status depends to a great extent on the rational use of organic materials as amendments. Seddik *et al.* (2006) found that N, P and K contents in studied plant parts as well as yield components for both Tomato and Pea plants generally increased with application of organic manure (FYM and chicken manure) and natural minerals. Farm yard manure also improves the pH of the moderately acidic soils if applied repeatedly over several seasons. It's a good source of K and N. Therefore, it is hoped that the use of FYM alone or in combination with fertilizers will gradually improve and sustain soil productivity over the years (Mwangi, 2010).

Gypsum is almost a universal soil amendment (Wallace and Nelson, 1986) can reduce soil crusting, improve water infiltration, improve water transmission (conductivity, increased water absorption), and increase recovery of N from subsoil. It increases water use efficiency and improves water retention and infiltration in soil as compared with control (Farina *et al*., 2000). Gypsum stimulates tillering which

may be due to increased availability of nitrogen, with the improved aeration that follows gypsum application (Rixon, 1970).

Moreover, peanut production is governed by the application of different plant nutrients as well as gypsum as a soil amendment and a source of Ca and S is necessary for enhancing the vegetative growth. In addition, the released Ca and S from gypsum often present a yield limiting factor for pod growth and increasing peg strength. In this concern, 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 over the control treatment, which produced 2432 kg/ha pod yield. David *et al*. (2001) and Borham (2005) pointed out that application of Ca significantly increased pod yield of peanut, and in turn increased the yield of seeds.

Also, Assefa Adane *et al*. (2015**)** recorded that application of FYM or gypsum or their combination improved some soil chemical properties (soil pH, ECe). The minimum decrease in soil pH and ECe were recorded in case of the control soil.While the greater decreases in soil pH and ECe over the control were recorded in the soil treated by combined application of 20 t FYM ha^{-1} and 100% GR (gypsum requirement). Whereas, applying 2% FYM increases soil moisture content by about 25.6 % (Eldardiry and Abd El-Hady, 2015).

Rock phosphate is a raw material used in phosphate fertilizers production and during the last decade, has been recognized as an important alternative economical source of P for the crops (Reddy *et al.*, 2002). Furthermore, Hellal *et al*. (2009) found that application of natural alternative fertilizers (rock phosphate and feldspar) moderately increased sandy soil hydraulic conductivity under studied organic matter, while the highest value of available water existed under compost (rock phosphate). Recently, Ditta *et al.* (2015) showed that, growth and yield of lentil plant were significantly improved under different impregnation ratios of RP and compost and under different times of application. The maximum grain yield was recorded by the application of impregnation ratio of 50:50 RP and compost (4.08 g pot^{-1} grain yield).

The aim of the study is to evaluate the effect of applying organic (compost and FYM) and natural amendments (rock phosphate, feldspar and gypsum) on hydro-physical and chemical properties of sandy soil and its impact on the productivity of the peanut crop.

Materials and Methods

A field experiment was carried out for two successive summer seasons at Ismailia Agric. Res. Station, Ismailia Governorate, Egypt (Latitude, 30°35' 41.901" N and longitude, 32° 16' 45.834" E) during two successive summer seasons (2014–2015) with peanut (*Arachis hypogaea* c.v. Giaz 5) which was cultivated on sandy soil under drip irrigation system to evaluate the effectiveness of soil amendments on sandy soil properties, nutritional status and peanut productivity. Some physical and chemical characteristics of the studied soil before cultivation are shown in Table 1, while

farmyard manure and rice straw compost constituents are described in Table 2.The experiment was designed in a randomized complete block design with three replications. Two forms of organic amendments (Compost and FYM) were added at two rates (5 and 10 m^3/fed.) and three forms of mineral amendments (Gypsum, Rock phosphate and Feldspar) were applied each alone at two rates (1 and 1.5 ton/fed.).

All treatments including control received a recommended dose from ammonium sulphate (20.6 % N), super phosphate (15 % P_2O_5) and potassium sulphate (48%K_2O).

Soil amendments (organic and minerals) were added and thoroughly mixed with the surface soil layer only before peanut cultivation.

TABLE 1. Some physical and chemical properties of experimental soil

Particle size distribution%	**values**	**chemical properties**	**values**
Sand	89.00	pH (1:2.5 soil water suspension)	7.84
Silt	3.50	$CaCO_3$%	1.45
Clay	7.50	Organic matter (%)	0.30
Textural Class	Sandy	EC dS/m (saturated paste extract)	0.53
Bulk density (g/cm^3)	1.97		
Field capacity (%)	7.0		
Wilting point (%)	1.52		
Available water %	5.4		
Cations (saturated paste extract), meq/L		**Anions (saturated paste extract), meq/L**	
Ca^{++}	1.39	CO_3^{--}	0.00
Mg^{++}	1.53	HCO_3^-	1.85
Na^+	1.20	Cl^-	1.30
K^+	1.00	SO_4^{--}	1.97
Available macronutrients (mg/kg)			
N	45.0		
P	9.0		
K	56.1		

TABLE 2. Farmyardmanure and rice straw compost analysis

Characteristics	**Farmyard manure**	**Rice straw compost**
EC dS/m (1:10)	4.20	3.0
pH (1:10)	7.82	7.57
Organic matter (%)	41.0	30.0
C/N ratio	10.0	13.5
Total N (%)	2.50	2.33
Available N (mg/kg)	435	350
Available P (mg/kg)	170	503
Available K (mg/kg)	223	634

Soil and plant samples

Soil samples were taken (0-15 cm depth) after harvesting stage air-dried, grounded and passed through 2 mm sieve for analysis. Soil physical and chemical properties along with analyses for organic amendments (compost and farmyard manure) were evaluated according to Cottenie *et al*. (1982). Peanut plant samples were taken at harvesting stage to determine yield components (straw and grains yield) and nutrient status. Plant samples were oven dried at 70 C for 48 hr, up to constant dry weight, then ground and digested using H_2SO_4 and H_2O_2 mixture for N, P and K determinations, using Page *et al*. (1982). Crude protein (CP) % was estimated by multiplying N content in grains % by 6.25 (AOAC, 2000). Apparent nutrients recovery efficiency (ANRE) was calculated according to Quanabao *et al*. (2007).

ANRE = (Uptake in N fertilized plot, kg fed $^{-1}$– Uptake in control plot, kg fed^{-1}) X 100 /quantity of fertilizer nutrient applied (kg fed^{-1}).

Statistical analysis

Standard individual and combined analysis of variance over two seasons using LSD at 0.05 were performed to estimate the significant differences among treatments according to Snedecor and Cochran (1980).

Results and Discussion

Soil physical and chemical characteristics

Physical characteristics

Soil moisture contents at field capacity (FC), wilting point (WP) and available water (AW) are considered as a good indicator for the improvement of the main soil physical properties. Data in Table 3 show the changes of some soil physical properties as affected by the studied treatments of organic and natural amendments.

Statistical interactions analyses indicated that values of (FC, WP and AW) at the two studied seasons were positively affected by the application of both organic and natural soil amendments,where applying high rates are generally more effective.Also, results revealed that the values of FC, WP and AW increased significantly by increasing the applied rate of both organic and mineral amendments. Moreover, data indicated that the highest values of (FC, WP and AW) at the two studied seasons were recorded with farmyard manure followed by gypsum treatments. However, the least values were recorded in case of rock phosphate treatment.

The application of organic amendments (compost and Farmyard), resulted in a positive effect on (FC), (WP) and (AW) values possibly due to organic matter role as a cementing factor, necessary for forming stable aggregates (Tejada *et al*., 2007).

Regarding the applied organic amendments forms, results revealed that values of (FC, WP and AW) were significantly increased, where Farmyard manure being superior as compared to compost, high rates were more beneficial. This is due to the

increase of the decomposition rate of organic matter by time and the indirect effect of organic matter on soil biochemical and physical properties. These results are in good agreement with those obtained by Tayel and Abdel-Hady (2005) who stated that there is a positive correlation between organic matter application and available water in soil. Recently, Eldardiry and Abd El-Hady (2015) found that sandy soil treated by 2% FYM increased soil moisture content by about 25.6%.

As for the effect of natural amendments (gypsum, rock phosphate and feldspar) on soil water constants, data indicate that, for both seasons, the application of natural amendments significantly increased soil moisture content (FC, WP and AW) as compared to control. Gypsum, was superior as compared to rock phosphate and feldspar. This is due to gypsum improvement effect on water infiltration, water transmission (conductivity, increased water absorption), and increased water use efficiency (Farina *et al*., 2000).

In conclusion, the present data indicate that applying high rate of farmyard manure (10 m^3/fed.) followed by gypsum (1.5 ton/fed.) resulted in the highest values of soil moisture content (FC, WP and AW) as compared to control and/or the other applied treatments for both seasons.

TABLE 3. Effect of organic and natural amendment on soil moisture content (w/w) of sandy soil

Treatments	Rateof application	Soil moisture contents (%, w/w)					
		First season			Second season		
		FC	WP	AW	FC	WP	AW
Control		7.03	1.51	5.44	7.21	1.62	5.60
Compost	5 m^3/fed	9.17	2.52	7.76	9.40	2.91	8.17
	10 m^3/fed	10.2	2.96	8.83	10.5	3.70	9.13
	Average	9.69	2.74	8.29	9.95	3.31	8.65
Farmyard manure	5 m^3/fed	12.4	2.84	10.3	13.1	3.50	10.6
	10 m^3/fed	13.5	3.82	11.8	14.2	4.23	12.4
	Average	12.9	3.33	11.05	13.65	3.87	11.5
Gypsum	1.0 ton/fed	10.3	2.81	9.50	10.6	3.20	10.1
	1.5 ton/fed	11.5	3.05	10.4	12.9	4.10	11.1
	Average	10.9	2.93	9.95	11.75	3.65	10.6
Rock phosphate	1.0 ton/fed	8.03	2.14	7.03	8.40	2.51	7.60
	1.5 ton/fed	8.53	2.35	8.23	8.97	2.90	8.53
	Average	8.28	2.25	7.63	8.69	2.71	8.07
Feldspar	1.0 ton/fed	8.37	2.43	7.72	8.70	2.93	8.51
	1.5 ton/fed	9.30	2.83	8.73	9.57	3.47	9.53
	Average	8.84	2.63	8.28	9.14	3.20	9.02
LSD at 0.05 % A (conditioner) B (rate of application) A*B		 0.909 0.390 0.956	 0.307 0.113 0.276	 0.634 0.202 0.494	 0.999 0.488 1.195	 0.694 0.300 0.736	 1.356 0.349 0.550

Chemical characteristics

Soil reaction and electrical conductivity: Data in Table 4 revealed that pH values generally decreased by applying both organic and minerals amendments at both studied seasons where a gradual decrease exists; values decreased gradually by increasing the rates of organic and minerals amendments. This may be due to decomposition of organic manures thus producing organic acids that affecting soil pH. This finding agrees with those obtained by Seddik (2006). Also, Mairan *et al.* (2005) found that the noticeable reduction in soil pH is due to long term manuring and fertilization. The higher reduction in soil pH recorded with farmyard manure and gypsum treatments may be due to the presence of acidic compounds as outcome of sulphitation process nitrification and acidification processes stimulated by continuous application of fertilizers as well as by H+ released by roots. Similar results have been reported by Wang and Yang (2003) and Guo *et al.* (2010).

With respect to EC values, results revealed that EC values in soil at both studied seasons decreased due to application of bothorganic and minerals amendments. The decrease was more pronounced in case of gypsum and farmyard. These results are confirmed by Ali *et al.* (2005) who indicated that EC values were slightly decreased with application of FYM at a rate of 2 or 3% to sandy soil after harvesting maize.

Availability of macronutrients in soil after harvest: Data in Table 4 indicate that application of both organic and minerals amendments to the soil increased the available content of N, P and K in soil as compared to control treatments, especially in case of $10m^3$/fed. organic amendment (compost and FYM) compared with the low rate treatments possibly due to its high content of N, P, K and organic matter which resulted in reducing pH values and increasing the total soluble salts and soluble ions (Seddik, 2006).

As for the effect of organic manures (compost and farmyard), results indicate that N, P and K availability in soil generally increased due to application of organic manures (compost and farmyard) where the effect of farmyard manure treatment (FYM) is higher than compost treatment probably attributed to its relatively high organic matter content than compost. These results agree with Singh *et al*. (2015) who showed that the available nitrogen in soil after the harvest of maize and wheat were significantly increased with the application of FYM and press mud over control. It might be due to the direct addition of N from the decomposition of organic matter and mineralization of organically bound nitrogen. Also, the residual effect of FYM was higher in increasing available K than press mud. The increase in K availability as the residual effect of FYM was due to higher microbial activities in soil which influenced the release of non-exchangeable or fixed-K forms into available forms.

Concerning the effect of minerals amendment, data revealed that gypsum gave the highest values of available N, P and K in soil, especially with low rate (1 ton/fed.) Effect of natural minerals treatment could be arranged as follows: gypsum> rock phosphate >feldspar.

The above mentioned results revealed that, the application of high rate of organic manures (especially FYM) and low rate of minerals amendment (especially gypsum) increased macronutrient in soil for both growing seasons. In fact, available N, P and K in soil were positively affected by the application of organic amendment as compared to the natural minerals amendments.

TABLE 4. Effect of organic and natural soil amendments on chemical properties of the tested soil for both seasons after harvest

Treatments	Rate of application	First season					Second season				
		pH (1:2.5)	EC dSm^{-1}	N (mg/ kg)	P (mg/ kg)	K (mg/ kg)	pH (1:2.5)	EC dSm^{-1}	N (mg/ kg)	P (mg/ kg)	K (mg/ kg)
Control		7.57	0.4	116.6	26.9	58.5	7.12	0.26	127.7	28.6	61.7
Compost	5 m^3/fed	7.60	0.28	128.3	43.5	98.8	7.5.0	0.31	142.3	48.7	100
	10 m^3/fed	7.41	0.25	143.0	50.0	101	7.37	0.28	156	60.0	108.5
	Average	7.51	0.27	135.5	46.7	99.9	7.44	0.30	149.1	54.4	104.3
Farmyard manure	5 m^3/fed	7.33	0.30	141.2	45.0	92	7.40	0.24	159.7	50.7	89.8
	10 m^3/fed	7.27	0.28	167.7	73.6	111	7.33	0.21	176.8	80.9	114
	Average	7.30	0.29	154.4	59.3	101.5	7.37	0.23	168.2	65.8	106.4
Gypsum	1.0 ton/fed	7.52	0.23	154.0	60.8	104.4	7.55	0.24	168.7	63.3	106.8
	1.5 ton/fed	7.37	0.19	135.3	41.2	86.0	7.40	0.18	144.0	43.5	92.3
	Average	7.40	0.21	144.7	51.0	95.2	7.47	0.21	156.3	53.4	99.5
Rock phosphates	1.0 ton/fed	7.53	0.30	135.2	48.7	103	7.60	0.28	136.7	52.2	100.1
	1.5 ton/fed	7.35	0.25	127.7	32.0	84.0	7.48	0.21	130	35.5	87.3
	Average	7.44	0.28	131.4	40.3	93.9	7.54	0.25	133.3	43.8	93.7
Feldspar	1.0 ton/fed	7.50	0.27	130.0	40.0	94.6	7.55	0.20	134.4	50.1	100.3
	1.5 ton/fed	7.50	0.30	115.0	34.9	88.8	7.63	0.27	117.7	35.6	83.3
	Average	7.50	0.29	122.5	37.45	91.7	7.59	0.24	131.1	42.8	91.8
LSD at 0.05 %											
A (Conditioner)		0.235	0.051	17.7	11.3	27.6	0.35	0.080	30.9	14.3	17.1
B (Rate of application)		0.054	0.009	21.2	7.42	15.4	0.28	0.054	17.2	8.17	12.3
A*B		0.094	0.017	36.7	12.8	26.7	0.21	0.094	29.8	14.2	21.2

Peanut yield components and harvest index

Data presented in Table 5 revealed that the values of peanut yield components (grains and straw) and harvest index at both studied seasons were generally increased significantly for plants receiving organic (compost or farmyard) and mineral amendments (gypsum, rock phosphate and feldspar), the high rate of organic materials (compost or farmyard) is better than the low rate. These results agree with the findings of Farhad *et al.* (2009) who reported that grains yield of wheat plant significantly increased with increasing FYM from 1 to 1.5 tons ha^{-1} FYM. In addition, Amanullah *et al.* (2014) found that, plots treated with FYM had maximum harvest index (28.4 %) as compared with control (25.3 %).

TABLE 5. Effect of organic and natural amendment on yield components (ton/ fed) and harvest index of peanut

Treatments	Rate of application	Peanut yield (ton/fed)							
		First season				Second season			
		Pods	Straw	Biological yield	Harvest index	Pods	Straw	Biological yield	Harvest index
Control		2.62	1.67	4.29	0.61	2.90	1.67	4.57	0.64
Compost	5 m^3/fed	3.45	1.80	5.25	0.66	4.13	1.80	5.93	0.70
	10 m^3/fed	4.10	1.87	5.97	0.69	4.70	1.93	6.63	0.70
	Average	3.78	1.84	5.61	0.67	4.42	1.87	6.28	0.70
Farmyard manure	5 m^3/fed	4.40	1.90	6.30	0.70	4.87	2.03	6.9	0.72
	10 m^3/fed	5.00	2.07	7.07	0.71	5.50	2.13	7.63	0.69
	Average	4.70	1.99	6.69	0.70	5.19	2.08	7.27	0.71
Gypsum	1.0 ton/fed	3.93	1.89	5.82	0.67	4.23	1.92	6.15	0.68
	1.5 ton/fed	4.73	1.97	6.70	0.71	5.23	2.00	7.23	0.72
	Average	4.33	1.93	6.26	0.69	4.73	1.96	6.69	0.71
Rock phosphate	1.0 ton/fed	2.87	1.73	4.60	0.62	3.27	1.81	5.08	0.64
	1.5 ton/fed	3.40	1.78	5.18	0.66	3.83	1.80	5.63	0.68
	Average	3.14	1.76	4.89	0.64	3.55	1.81	5.36	0.66
Feldspar	1.0 ton/fed	3.50	1.87	5.37	0.65	4.17	1.87	6.04	0.69
	1.5 ton/fed	4.07	1.90	5.97	0.68	5.33	1.97	7.30	0.73
	Average	3.78	1.84	5.61	0.66	4.42	1.87	6.28	0.71
LSD at 0.05 %									
A (conditioner)		0.49	0.32	0.441	0.441	0.57	0.29	0.617	0.058
B (rate of application)		0.35	0.09	0.343	0.343	0.35	0.19	0.441	0.023
A*B		0.55	0.22	0.480	0.34	0.57	0.48	0.391	0.056

With regard to the effect of organic manures, data showed that grains, straw yield and harvest index were significantly increased due to application of organic manures particularly farmyard manures as compared to compost where the high rate was better. Farmyard manures improve the chemical properties, as well as overall diversity of microbes, provide macro-and micronutrients essential for

plant growth and suppress diseases which indirectly contribute to plant growth enhancement (Healther *et al*., 2006).

Regarding the applied mineral amendments, results indicate that yield components and harvest index increased significantly by adding the mineral amendments (gypsum, rock phosphate and feldspar) as compared to control. This behavior was more pronounced in case of gypsum treatment, probably due to its role, since it acts like soil amendment and attains some plant nutrients such as Ca and S that play an effective role for P and micronutrients availability. Consequently, it is necessary for enhancing the vegetative growth as well as the released Ca and S are often presenting a yield limiting factor for pod growth, increasing peg strength, improving the shelling percentage and peanut pod or seeds yield. In this concern, Borhamy (2005) found that application of gypsum (as a source of Ca and S) significantly increased pods and seeds yield of peanut. On the other hand, rock phosphate treatment recorded the inferior values of yield component and harvest index for both growing seasons. Moreover, yield components and harvest index increased significantly by increasing the rate of minerals amendments.

Total contents of macronutrients in peanut

With respect to total contents of macro nutrients in straw and grains, data illustrated in Table 6 showed that peanut values of nutrients N, P and K uptake increased significantly with the application of both organic and natural amendments as compared to control treatment. Data also, revealed that N, P and K uptake values increased gradually by increasing the rate of both amendments. Moreover, farmyard manure treatment was superior in increasing the uptake of macronutrients as compared to compost and control. The beneficial effects of the applied treatments are more attributed to the improvement status of air-water balance of the studied sandy soil, consequently increasing nutrients availability and mobility towards plant roots as well as the mechanism of their uptake by plant roots. These results agree with those reported by Adamu *et al*. (2015) who found that the use of organic (5 ton fed^{-1}FYM) fertilizer resulted in a significantly higher maize growth, dry matter yield and nutrient uptake compared to the control plot.

Regarding the application of natural minerals, results indicate that macronutrients uptake of straw and grains increased significantly with the application of natural amendments. This trend was more pronounced in case of gypsum treatment as compared to the other natural conditioners. Addition of gypsum exerts a more beneficial effect on the studied nutrient contents in peanut seed, probably due to the ability of gypsum to supply available Ca and S in soil, besides the positive effect of released S on either P on micronutrients availability and mobility from bulk soil to the rhizosphere and tended to increase their accumulation in plant tissues. Data also, mentioned that N, P and K uptake increased gradually by increasing the rate of natural conditioners. On the other

hand, rock phosphate treatment recorded the inferior values of total contents of macro nutrients for both growing seasons.

TABLE 6. Effect of organic and natural amendment on NPK total (kg fed^{-1}) content of peanut

Treatments	Rate of application	Macronutrients total contents (kg fed^{-1})											
		First season						Second season					
		Straw			Grain			Straw			Grain		
		N	P	K	N	P	K	N	P	K	N	P	K
Control		16.1	15.6	12.6	22.0	11.3	11.1	17.8	9.76	9.03	24.1	14.9	13.9
Compost	5 m3/fed	27.3	25.7	21.9	28.2	17.1	18.5	25.5	12.6	10.8	27.3	24.1	24.9
	10 m3/ fed	29.0	32.9	28.2	31.6	22.8	25.3	27.1	14.0	13.1	30.9	29.9	30.9
	Average	24.1	24.7	20.9	27.3	17.1	18.3	23.5	12.1	11.0	27.4	23.0	23.2
Farmyard manure	5 m3/fed	31.5	30.3	27.8	32.0	24.4	25.0	30.3	13.8	11.9	34.2	30.4	32.0
	10 m3/ fed	34.0	34.2	32.9	36.5	30.3	31.9	32.5	15.9	13.8	37.9	36.3	39.4
	Average	29.9	29.7	27.2	31.9	23.9	25.1	28.8	13.9	12.2	33.2	29.9	31.5
Gypsum	1.0 ton/ fed	25.4	32.0	28.9	29.0	29.4	27.1	24.1	16.7	13.6	30.0	35.7	34.2
	1.5 ton/ fed	27.1	44.3	40.8	31.0	39.7	40.5	28.8	18.7	16.7	33.0	46.4	47.6
	Average	27.5	35.3	32.3	30.6	31.0	30.9	27.2	16.4	14.2	32.1	37.3	37.8
Rock phosphate	1.0 ton/ fed	20.4	21.2	16.8	23.2	18.9	13.6	22.3	14.2	9.23	25.0	24.1	20.2
	1.5 ton/ fed	22.0	27.3	22.2	29.9	26.1	18.0	24.9	16.1	10.7	27.7	31.1	25.3
	Average	23.3	27.9	23.8	27.9	25.3	20.8	24.8	15.6	11.4	28.3	30.8	27.8
Feldspar	1.0 ton/fed	24.0	25.2	27.1	28.2	19.5	23.3	26.5	11.2	15.9	29.3	23.9	30.2
	1.5 ton/ fed	27.0	30.7	30.0	30.0	21.5	33.3	28.1	12.7	12.5	32.0	28.6	35.9
	Average	24.8	27.9	27.0	28.7	22.1	25.8	26.5	13.2	13.3	29.9	27.8	31.3
LSD at 0.05 %													
A (conditioner)		7.21	5.01	3.98	7.20	6.3	7.35	9.75	3.23	2.31	4.20	7.49	3.41
B (rate of application)		3.33	3.09	2.07	3.30	3.83	5.35	7.19	1.08	0.79	3.22	3.46	2.67
A*B		8.50	7.56	5.07	7.34	9.38	13.1	17.6	2.63	1.93	6.56	8.49	6.53

Crude protein (CP)

Results from Fig. 1 revealed that application of both organic and natural amendments increased crude protein in grains at both growing seasons compared to control treatment. Furthermore, results showed that the highest crude protein (CP) % was obtained with application of farmyard manures at a rate of (10 m^3/ fed.). This may be due to effect of organic component on enhancing the biosynthesis for peanut seed. It is noteworthy to mention that the positive effects of the applied treatments on the aforementioned parameters of peanut seed quality are more related tothe improvement of soil hydro physical properties, which increased soil ability to supply plants with their requirements of water, air and nutrients uptake along the growing season. Consequently, such favorable conditions were reflected positively on development of peanut seed yield and

crude protein. On the other hand, the lowest increase in (CP) % was obtained in case of applying feldspar.

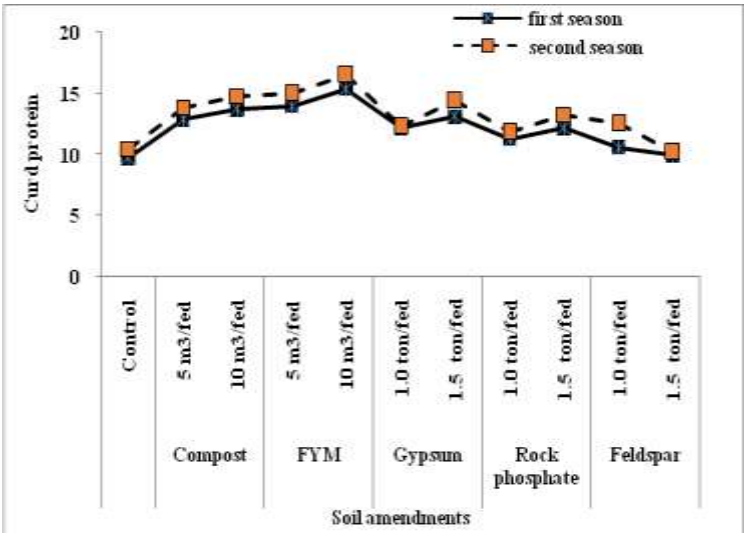


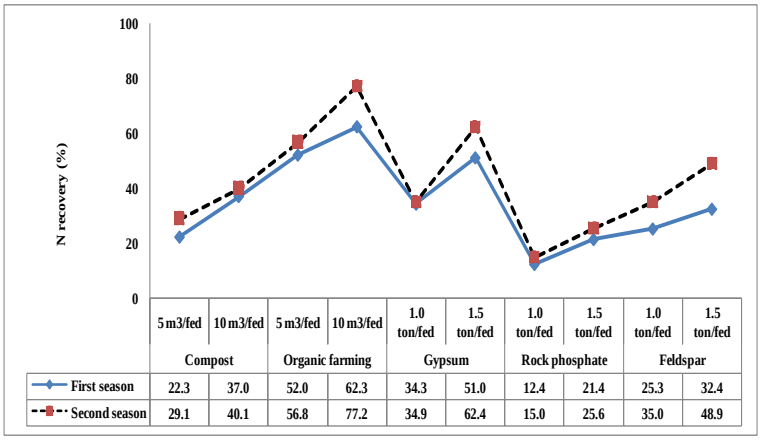
Fig. 1. Crude protein (%) of peanut plant as affected by organic and natural soil amendments

Apparent nutrients recovery efficiency (ANRE)

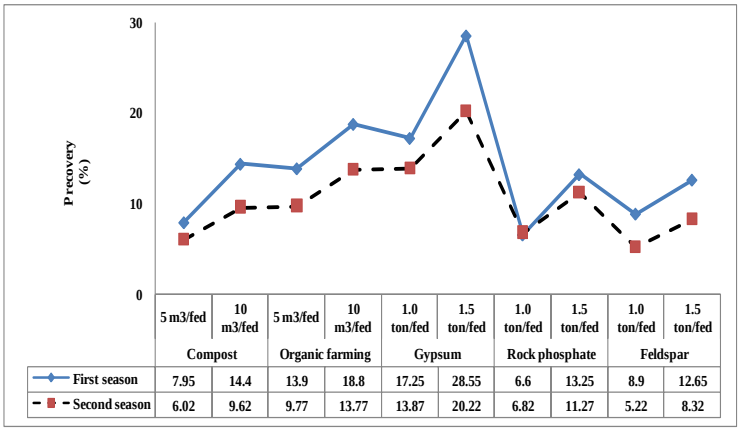
Apparent nutrients (N,P and K) recovery efficiency was defined as the ratio of total content of nutrients (N,P and K) in plants receiving different treatments minus total content of nutrients without treatments application (control), then divided by nutrients application as kg unit $^{-1}$, these parameters are presented in Fig. 2. Results indicate that application of both organic and minerals amenments to the soil increased apparent nutrients N, P and K recovery efficiency as compared to control treatments, and the applied high rate was superior compared to the low one.

With regard to organic soil conditioners forms, results indicated that the highest values of (ANRE) for peanut plants were recorded in case of applying farmyard as compared to compost, high rates were more beneficial.

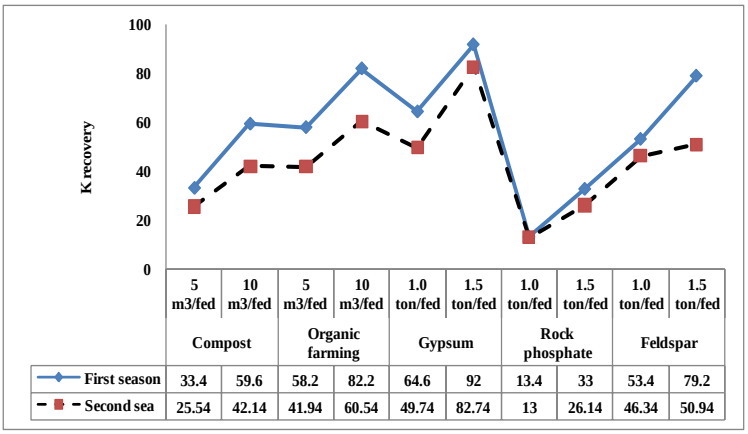
As for the effect of natural amendments (gypsum, rock phosphate and feldspar), data indicate that, for both studied seasons, the application of natural amendments significantly increased (ANRE) as compared to control. Gypsum was superior as compared to rock phosphate and feldspar. This is due to gypsum role in improving water infiltration, water transmission (conductivity, increased water absorption), and increased water use efficiency which affect the apparent nutrients N, P and K recovery efficiency (Farina *et al*., 2000). The treatments of soil amendments may be generally arranged as follows: Farmyard >compost >gypsum >feldspar >rock phosphate. The same trend was observed with both amendments application in two successive seasons.



	5 m3/fed	10 m3/fed	5 m3/fed	10 m3/fed	1.0 ton/fed	1.5 ton/fed	1.0 ton/fed	1.5 ton/fed	1.0 ton/fed	1.5 ton/fed
	Compost		Organic farming		Gypsum		Rock phosphate		Feldspar	
First season	22.3	37.0	52.0	62.3	34.3	51.0	12.4	21.4	25.3	32.4
Second season	29.1	40.1	56.8	77.2	34.9	62.4	15.0	25.6	35.0	48.9



	5 m3/fed	10 m3/fed	5 m3/fed	10 m3/fed	1.0 ton/fed	1.5 ton/fed	1.0 ton/fed	1.5 ton/fed	1.0 ton/fed	1.5 ton/fed
	Compost		Organic farming		Gypsum		Rock phosphate		Feldspar	
First season	7.95	14.4	13.9	18.8	17.25	28.55	6.6	13.25	8.9	12.65
Second season	6.02	9.62	9.77	13.77	13.87	20.22	6.82	11.27	5.22	8.32



	5 m3/fed	10 m3/fed	5 m3/fed	10 m3/fed	1.0 ton/fed	1.5 ton/fed	1.0 ton/fed	1.5 ton/fed	1.0 ton/fed	1.5 ton/fed
	Compost		Organic farming		Gypsum		Rock phosphate		Feldspar	
First season	33.4	59.6	58.2	82.2	64.6	92	13.4	33	53.4	79.2
Second sea	25.54	42.14	41.94	60.54	49.74	82.74	13	26.14	46.34	50.94

Fig. 2. Apparent nutrients recovery as affected by organic and natural amendments

Conclusion

From the abovementioned results, it could be concluded that, application of organic manures, especially (FYM) and natural minerals, especially (Gypsum) as soil amendments at a rate of (10 m^3/fed and 1 ton/fed), respectively improved soil chemical and physical properties and increased nutrients use efficiency and yield components of peanut as well as their total content of macronutrients.

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References

A.O.A.C. (1990) Association of Official Analytical Chemists, *Official Methods of Analysis,* 15th ed. (Horwitz, W, Ed.) Washington, D.C, USA.

Adamu, U. K., Mrema, J. P. and Msaky, J. J. (2015) Growth, nutrient uptake and dry matter yields of maize (*Zea mays* L. var) grown with different levels of organic and inorganic fertilizers in Morogoro, *Tanzania International Journal of Plant & Soil Science,* **7**(4), 246-255, Article no.IJPSS.2015.151 ISSN: 2320-7035.

Ali, Sayeda, M. Mervat, A. Hamza, G. Amin, M. Fayez, M. El-Tahan, Monib and Hegaz, N.A. (2005) *Archives of Agron. and Soil Sci.,* **5,** 589-604.

Amanullah, J., Ali, S., Ahmed, I. and Ahmed, I. (2014) Impact of soil amendments on yield and yield attributes of maiz (*Zea mays* L.) under different irrigation schedule. *J. Environ. And Earth Sci.* **4** (22), 132-139.

Assefa, A., Gebrekidan, H. and Kibret, K. (2015) Response of maize to FYM, gypsum and pore volume of leaching water in saline sodic soil of Bisidimo, Babile District, Eastern Lowlands of Ethiopia. *Agriculture, Forestry and Fisheries,* **4**(2), 29-35.

Borhamy, Sh. El. (2005) Effect of gypsum and m ineral fertilizers on yields and nutrient concentrations of peanut and wheat grown on sandy soil. *Egypt. J. Appl. Sci.,* **20**(2), 328-339.

Chitravadivu, C., Bal Krishnan, V., Manikandan, J., Elavazhagan, T. and Jayakumar, S. (2009) Application of food waste compost on soil microbial population in groundnut cultivated soil. *India. Middle-East J. Sci. Res.,* **4,** 90-93.

Cottenie, A., Verloo, M., Kiekens, L., Velghe, G. and Camerlynck, R. (1982) Chemical analysis of plant and soils. Laboratory of Analytical and Agrochemistry, State University of Gent, Belgium. 63 p.

David, I., Jordan, J.O., Bean, B., Dewayne, J. and Jan, F.S. (2001) Peanut response to prohexadione calcium in three seedling rate-row pattern planting system. *Argon. J.* **93,** 232-236.

Dittal, A., Arshadl, M., Zahir, Z. A. and Jamil, A. (2015) Comparative efficacy of rock phosphate enriched organic fertilizer *vs.* mineral phosphatic fertilizer for nodulation, growth and yield of lentil. *Int. J. Agric. Biol.,* **17(**3), 589-595.

Eldardiry, Ebtisam I. and Abd El-Hady, M. (2015) Effect of different soil conditioners application on some soil characteristics and plant growth. I-Soil moisture distribution, barley yield and water use efficiency. *J. Agric. Sci.* 361-367.

Farhad,W., Saleem, M.F., Cheema, M.A. and Hammad, H.M. (2009) Effect of poultry manure levels on the produ ctivity of spring maize (*Zea mays* L.) *Anim. Plant Sci. J.* **19** (3), 122–125.

Farina, M. P. W., Channon, P. and Thibaud, G. R. (2000) A comparison of strategies for ameliorating subsoil acidity: I. Long- term growth effects. *Soil Sci. Soc. Am. J.,* **64,** 646-651.

Guo, J.H., Liu, X.J., Zhang, Y., Shen., J.L., Han., W.X., Zhang., W.F., Christie, P., Goulding., K.W.T., Vitousek, P.M. and Zhang, F.S. (2010) Significant acidification in major Chinese croplands. *Sci.,* **327,** 1008–1010.

Healther, M. D., Alexandra, G. S. and Richard, P. D. (2006) Compost and manure mediated impacts on soil borne pathogens and soil quality. *Soil Sci. Soc. Amer. J.,* **70,** 347-358.

Hellal, F.A., Abd El-Hady, M. and Ragab, A. M. (2009) Influence of organic amendments on nutrient availability and uptake by faba bean plants fertilized by rock phosphate and feldspar. *Amr. Eurasian J. Agric. & Environ. Sci.* **6**(3), 271-279.

Mairan, N.R., Patil, S.G. and Kachhave, K.G. (2005) Physico-chemical properties under sorghum-sunflower cropping sequence in Vertisols. *J. Soils Crops,* **15**(2), 352-355.

Mwangi, T.J. (2010) Improving and sustaining soil fertility by use of farm yard manure and inorganic fertilizers for economical maize production in West Pokot, Kenya. *World J. Agric. Sci.* **6** (3), 313-321.

Page, A.L., Miller, R.H. and Keeney, D.R. (1982) *"Methods of Chemical Analysis"*. Part 2: *Chemical and Microbiological Properties* (second edition). American Society of Agronomy, Inc. and Sci. Soc. of America, Inc. Publishers, Madison, Wisconsin, USA.

Quanbao, Y., Hongcheng, Z., Haiyan, W., Ying, Z., Benfo, W., Ke, X., Zhongyang, H., Qigen, D. and Ke, X. (2007) Effects of nitrogen fertilizer on nitrogen use efficiency and yield of rice under different soil conditions. *Agric. China,* **1,** 30-36.

Reddy, M.S., Kumar, S., Babita, K. and Reddy, M.S. (2002) Biosolubilization of poorly soluble rock phosphates by *Aspergillus tubingensis*and *Aspergillus niger*. *Bioresour. Technol.,* **84,** 187–189.

Rixon, A. J. (1970) Effect of applied gypsum on the yield and herbage nitrogen of an irrigation pasture. *Proc. 11th Int. Grassland Congr.* 472-475.

Saima Hashim, Khan Bahadar Marwat, Muhammad Saeed, Muhammad Haroon, Muhammad Waqas and Shahfahad (2013) Developing a sustainable and eco-friendly weed management system using organic and inorganic mulching techniques. *Pak. J. Bot.* **45**(2), 483-486.

Sarwar, G., Schmeisky, H., Hussain, N., Muhammad, S., Ibrahim, M. and Safdar, E. (2008) Improvement of soil physical and chemical properties with compost application in rice-wheat cropping system. *Pakistan Journal of Botany*, **40**, 275-282.

Seddik, Wafaa M. A. (2006) Effect of organic manures and feldspar application on some sandy soil physical and chemical properties and their refection on peanut productivity. *J. Agric. Sci., Mansoura Univ., Egypt,* **33,** 6675 – 6687.

Sendecor, C. W. and Cochran, W. G. (1980) *Statistcal Method.* 7th ed. Iowa State Univ. Press, Ames, USA.

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

Singh, N. J., Athokpam, H. S., Devi, K. N., Chongtham, N., Singh, N. B., Sharma, P. T. and Dayananda, S. (2015) Effect of farm yard manure and press mud on fertility status of alkaline soil under maize-wheat cropping sequence. *Afr. J. Agric. Res.,* **10** (24), 2421-2431.

Tayel, M.Y. and Abdel Hady, M. (2005) Water movement under saturated and unsaturated flow in coarse textured soils under Baharia Oasis conditions. *Egypt. J. Appl. Sci.,* **20,** 358-370.

Tejada, M., Hernandez, M.T. and Garcia, C. (2009) Soil restoration using composted plant residues: Effects on soil properties. *Soil and Tillage Research,* **102,**109–117.

Vasilica, S., Virsta, A., MirelaDusa, E. and Glavan, A.M. (2009) Waste recycling and compost benefits. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, **37**, 9-13.

Wallace, A. and Nelson, S. D. (1986) Foreword (special issue on soil conditioners) *Soil Sci.* **141,** 311-312.

Wang, M.C. and Yang, C. H. (2003) Type of fertilizer applied to a paddy-upland rotation affects selected soil quality attributes. *Geoderma*, **114,** 93–108.

Zahir, Z.A., Naveed, M., Zabair, M., Khalid, A. and Arshad, M. (2007) Enrichment of composted organic wastes for improving rice production. *J. Chem. Soc. Pakistan*, **29,** 514-519.

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فاعلية استخدام محسنات التربة علي خواص الارض الرملية وإنتاجية الفول السوداني

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أجريت تجربة حقلية لمدة موسمين صيفيين متتاليين في محطة البحوث الزراعية بالاسماعيلية لدراسة تأثير اضافة بعض محسنات التربة العضوية والمعدنية على الخواص الطبيعية والكيميائية للاراضي الرملية وانعكاس ذلك علي الحالة الغذائية وإنتاجية الفول السوداني. تم اضافة المحسنات العضوية في صورة (Compost و FYM) بمعدلين (5 و 10م^3 / فدان) والمحسنات المعدنية الطبيعية في صورة (الجبس وصخرالفوسفات والفلسبار) بمعدلين (1 و 1.5 طن / فدان). اشارت النتائج إلى أن قيم السعة الحقلية(FC) ، نقطة الذبول (WP) والماء الميسر (AW) زادت معنويا باضافة كلا من المحسنات العضوية والمعدنية مقارنة بالكنترول خلال موسمي الزراعة. وعلاوة على ذلك، أظهرت النتائجزيادة محتوى رطوبة التربة (FC, WP and AW) معنويا بزيادة معدل الاضافة كما سجل الجبس والسماد البلدى أعلى قيم محتوى رطوبي بالتربة.

أما بالنسبة لمحتوي النيتروجين والفسفور والبوتاسيوم الصالح للاستفادة في التربة فقد زاد معنوياباضافة االمحسنات العضوية (الكمبوست و FYM) عند معدل (10م^{3}فدان) و المعدنية (الجبس صخر الفوسفات والفلسبار) عند معدل (1 طن / فدان) . اما بالنسبة لقيم ال pH, EC فقد انخفضت معنويا مع كل محسنات التربة المختلفة. وعلاوة على ذلك، قد سجلت اعلي قيمة عند اضافه الجبس بمعدل (1 طن / فدان) و FYM عند معدل (10 م^3 /فدان) . كما سجلت أعلى مكونات المحصول وكذلك نسبة البروتين في كل المعاملات مقارنة بالكنترول وكذلك بزيادة معدلات الاضافة. وقد لوحظ نفس الاتجاه مع المحتوى الكلي من النيتروجين والفوسفور والبوتاسيوم لكل من الحبوب والقش للفول السوداني وكذلك كفاءة استخدام النيتروجين والفوسفور والبوتاسيوم.

وأخيرا يمكن استخدام المحسنات العضوية وخاصة (FYM) والمحسنات الطبيعية وخاصة (الجبس) بمعدل (10م^{3}فدان و 1 طن / فدان) على التوالي في تحسين خواص التربة الرملية الطبيعية والكيميائية وزيادة محصول الفول السوداني ومحتواه الكلي من العناصر الغذائية.