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AMELIORATING CALCAREOUS SOIL PROPERTIES AND AGRICULTURE METHODS FOR ACHIEVING THE SUSTAINABLE AGRICULTURE ASPECT

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ABSTRACT

The main objective of this investigation was to ameliorate calcareous soil properties, *i.e.*, some hydrophysical and chemical properties of the sandy loam soil by using organic manure, *i.e.,* composted rice straw at rate of 7.87 Mg f^{-1} +50%NPK and chicken manure at rate of 4.08 Mg f^{-1} +50%NPK as well as applying some agriculture methods, *i.e.,* lines and prose for achieving the sustainable agriculture aspect. The field experiments were conducted in private farm of El Nubaria area, El-Behera Governorate, Egypt. Yield of wheat crop as well as the concentrations of micronutrient in straw and grains was determined.

Application of either composted rice straw or chicken manure significantly improved the hydrophysical properties of the tested soil, *i.e.*, bulk density, total porosity, pore size distribution, soil water retention and hydraulic conductivity. Composted rice straw has a preference to improve the hydrophysical properties compared to chicken manure. In addition, methods of agriculture treatments had no significant effect on soil hydrophysical properties. Concerning the effect of organic fertilizers application along with applying lines agriculture on pH, EC_e, OM and $CaCO_3$ content and chemically available Fe, Mn, Zn and Cu in the cultivated soil, chicken manure was better than composted rice straw.

Grain and straw yields of wheat plants as well as concentrations of Fe, Mn, Zn and Cu in straw or in grains of wheat were significantly increased due to organic fertilizers application and use of lines agriculture methods. Lines agricultural method gave 5.70 % greater grain yield and 3.54 % straw yield over the prose agricultural method. Lines methods emphasized the role of applied organic manure on improving soil properties and consequently, increasing the availability of Fe, Mn, Zn and Cu in the calcareous soil. Where, lines agriculture method was the best treatments compared to prose method, which reduces the growth of roots and plant.

In general, the study recommends using the chicken manure (4.08 Mg f^{-1}+50% NPK "recommended rate") or composted rice straw (7.87 Mg f^{-1}+ 50% NPK "recommended rate") with lines agriculture methods, which will give better results in increasing the productivity of calcareous soils. Thus, these treatments can replace entirely or partially N, P and K mineral fertilizers, which reduce production costs and conserve the environment from chemical pollution hazards on human and animal health.

Keywords: Agricultural sustainable, calcareous soil, chicken manure, method of agriculture, micronutrients, rice straw compost, soil physical and chemical properties, wheat.

INTRODUCTION

The importance of sustainable agriculture is no longer in any doubt; it is at heart of a new social contract between society as a whole and its farmers. But, implementing sustainability remains a difficult issue. The concept of sustainability has yet to be made operational in many agricultural situations (Gafsi *et al*., 2006). Sustainable agriculture is defined as the way of practicing agriculture, which seeks to optimize skills and technology to achieve long-term stability of the agricultural enterprise. It is achieved through strategies for soil improving and soil fertility sources (Gold, 1999). Calcareous soils are typical ones in Egypt. The main problems of these soils are related to one or more of the following; high pH, lack of adequate texture and structure, very poor in either organic matter, distractive effect of some micronutrients availability, low moisture content, low hydraulic conductivity as reported by Noufal *et al*. (2005). Egypt faces a noticed reduction in fertile cultivated soils in the old Nile Valley and Delta, which represent about 3 - 4% of the total area of Egypt. So, an attention was directed towards the desert soils, either those characterized calcareous in nature, reclamation and cultivation. Organic fertilizers as chicken manure at 3 Mg f^{-1} with compost at 10 Mg f^{-1} gave almost the same crop production of using the recommended dose of mineral fertilizers as reported by Taalab (1999).

Recently, on the way of sustainable agriculture with minimum pollution effects, the use of natural materials such as plant residues, *i.e.,* rice straw compost or chicken manure is recommended to substitute the chemical fertilizers. Organic manures increase soil organic matter, particularly for the calcareous soils in Egypt. Yield of wheat was increased with added of rice straw compost under the conditions of calcareous sandy soil as showed by Ali (2001). Medina *et al*. (2004) indicated that, the use of organic amendments to improve symbiotic development is of great importance for plant growth in poor and desertified soils. Illmer *et al*. (2007) showed that, organic matter content, the biomass and height of test plants pointed distinctly to better within the samples treated with compost compared to the untreated samples. Naguib (2002) noticed that organic fertilization by using FYM or other organic wastes helps in improving the physical characters of the soil and that sustain the increase in soil fertility. Cox *et al.* (2001) summarized that organic materials and compost decreased soil bulk density and increased total porosity and improved structure. Soil water content at field capacity, welting point as well as available water contents was increased due to addition of organic materials to a calcareous soil.

Compared between sawdust compost (4 and 8 10 Mg f^{-1}) and farmyard manure (FYM) there were real increases in soil-water relationships with manuring such as total porosity, water holding capacity, field capacity and available water instead of decreasing in bulk densities. The rate of 8 Mg f^{-1} of compost was as the same effect as FYM on total porosity, water holding capacity and bulk densities (Negm *et al*., 2004 and Kushwaha *et al*., 2001). Paramasivam *et al*. (2005) reported that concentrations of Fe, Mn Zn and Cu increased with increasing the applied of organic amendment up to 98.8 Mg ha^{-1} irrespective of plant parts. El-Naggar (1996) reported that available Fe, Mn, Zn and Cu were positively and significantly correlated with organic residues and composts content. Application of composted materials to the saline calcareous soil decreased both EC and pH values (Abd El-Moez *et al*., 2002).

This study was aimed at ameliorating calcareous soil properties by using organic manure, *i.e.,* composted rice straw and chicken manure as well as applying some agriculture methods, *i.e.,* lines and prose for achieving the sustainable agriculture aspect.

MATERIALS AND METHODS

Field experiments were conducted at a private farm located at a El Nubaria area, El-Behera Governorate, Egypt during two successive seasons started in 2007/2008 and lasted 2008/2009. Wheat "*Triticum aestivum*, var. Giza 168" was used as a test plants. Wheat grains were sowed on November 15^{th}, and the crop was harvested on April 15^{th}. This investigation was conducted to improve soil chemical and physical properties as well as the yield of wheat plants irrigated by flood system. The experiment included the following treatments:

A **Method of agriculture (M)**:
1. Lines.
2. Prose.

B Organic fertilizers (O):
1. Control (100 kg N f^{-1} "485 kg f^{-1} as ammonium sulphate 20.6%N", 150 kg f^{-1} as ordinary superphosphate 6.6%P and 50 kg f^{-1} as potassium sulphate 40.2%K). These rates were applied based on recommended rate by Ministry of Agriculture.
2. Rice straw compost "1.27%N" + 50% NPK.
3. Chicken manure "2.45%N" +50% NPK.

The ratios of organic fertilizers were calculated based on the recommended rate of wheat from nitrogen (100 kg N f^{-1} "7.87 Mg f^{-1}as rice straw and 4.08 Mg f^{-1}as chicken manure ") which was calculated according to its total nitrogen content.

Two main plots representing method of agriculture treatments were separated by 2m. Each main plot contains 9 subplots (3 replicates × 3 organic fertilizers treatments). The sub-subplot area was 10.5 m^2. Plots replicated three times in Randomized Block Design. The organic manures were mixed with the soil surface (0-15cm layer) 15 days before cultivation. Phosphorus was added during seedbed preparation, while potassium fertilization was applied after 25 days from sowing. Nitrogen was split into three equal doses 20, 40 and 75 days after sowing.

Soil samples:

Soil samples were collected from the surface layer (0-15 cm) for all plots after harvest. These soil samples and those of initial soil were taken from experimental field and analyzed for physical and chemical characteristics as follows: 1) Soil pH, salinity, organic matter and total calcium carbonate according to Page *et al*. (1982).2) Soil particle size distribution was carried out by the pipette method described by Gee and Bauder (1986) using sodium tri poly-phosphate as a dispersing agent. 3) Soil bulk density and total porosity were determined according to Dewis and Freitas (1970); hydraulic conductivity was determined by the constant head method (Klute and Dirksen, 1986). 4) Moisture content at field capacity and wilting point were determined after Klute (1986).5) Chemically available micronutrients were extracted by DTPA according to Lindsay and Norvell (1978) and measured using the Atomic Absorption Spectrophotometric. Some physical and chemical properties of the used soil and organic fertilizer are given in Table (1 and 2).

Table (1): Some characteristics of the studied soils

Characteristics	Value	Characteristics	Value
pH (1:2.5 soil : water suspension)	8.50	Calcium carbonate %	26.4
EC_e (soil paste extract) dSm^{-1}	3.06	Sand %	68.91
Available micronutrients (mg kg^{-1})		Silt %	16.57
Iron	2.45	Clay %	14.52
Manganese	0.77	Textural class	Sandy Loam
Zinc	0.62	Organic matter %	0.58
Copper	0.28	Bulk density Mg m^{-3}	1.41
Moisture content w/w % at 0.33 atm w/w at 15.0 atm	17.18 10.40	Total porosity %	46.79
Sat. Hyd. Conductivity (cm h^{-1})	0.31		

Table (2): Some characteristics of the used organic fertilizer

Characteristics	Rice straw compost	Chicken manure
EC (1:5 soil : water extract)"dS m^{-1}"	5.03	1.83
pH (1:5 soil: water suspension)	7.49	6.19
Bulk density (Mg m^{-3})	0.36	0.56
Moisture content %	29.1	9.92
Total nitrogen (TN) %	1.27	2.45
Organic carbon (O.C) %	15.9	28.5
C/N ratio	12.5	11.6
Organic matter %	27.4	49.1
	Total micronutrients (mg kg^{-1})	
Iron	2118	2482
Manganese	170	248
Zinc	142	288
Copper	25	29

Plant measurements:

The crop was harvested at physiological maturity and yields recorded. The dried straw and grains of plant samples were digested in concentrated H_2SO_4 and H_2O_2 at $400C^0$; Fe, Mn, Zn and Cu were determined in the digested materials. The data from this study were statistically analyzed through analysis of variance (ANOVA) and least significant difference (LSD) at 0.05 probability level to make comparison among treatment means according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Wheat grains and straw yields

Data presented in Table 3 indicate that the amounts of grain and straw yields of wheat crop significantly increased due to the application of chicken manure (C) and rice straw compost (R) as compared with control. Increases due to R and C averaged 63.3 and 127.9 %, respectively for grains yield. Increases due to R and C averaged 41.8 and 138.5 %, respectively for straw yield. The superiority of the C over the R was most pronounced under two methods of agriculture. Such increases could be due to the positive effect of organic fertilizer on improving nutritional status and nutrients release and hence their availability to the growing plants as well as on improving soil physical properties. These findings are in agreement with results reported earlier by Anan *et al*. (2008) using some of these organic fertilizers in the field studies. Lines agricultural method gave 5.70 % greater grain yield and 3.54 % straw yield over the prose agricultural method. Most probably, such positive effect of lines method of agriculture may be due to the distribution and loosening of the compacted subsurface layers which may cause appreciable improvement of the physical factors affecting root growth namely; soil mechanical impedance, soil aeration, soil water and soil temperature, there by crop productivity increases. These findings are quite in agreement with Carter (1990) and Said (2002). The lines method of agriculture is thus an efficient method of many crops which are most suited to lines-methods. This may be referred to the favorable effect of some practices on enhancing soil physical and chemical properties which increase the decomposition of organic manure (El-Maghraby, 2001). Under the chicken manure fertilizer the superiority is of the prose method over the lines method.

Table (3): Wheat grain and straw yields (Mg f^{-1}) as affected by method of agriculture and organic fertilizer treatments and their interaction (average two seasons)

Organic fertilizer (O)	Grains			Straw		
	Method of agriculture (M)					
	Lines	Prose	Mean	Lines	Prose	Mean
Control[1]	0.941	0.777	0.859	1.643	1.479	1.561
Rice straw compost (R)[2]	1.403	1.403	1.403	2.226	2.200	2.213
Chicken manure (C)[3]	1.994	1.923	1.958	3.759	3.688	3.723
Mean	1.446	1.368	1.407	2.543	2.456	2.499
LSD at 0.05	M=0.011 O=0.014 M*O=ns			M=0.010 O=0.012 M*O=ns		

[1]Mineral N, P and K (the recommended rates); [2]Rate 7.87 Mg f^{-1}+ 50% NPK "recommended rate"; [3]Rate 4.08 Mg f^{-1}+50% NPK "recommended rate"

Micronutrients concentrations of wheat grains and straw

Table 4 showed iron, manganese, zinc and copper concentrations in wheat grain and straw as influenced by organic fertilizer and method of agriculture. Applying organic fertilizer significantly resulted in increasing Fe, Mn, Zn and Cu concentrations compared to control in both grain and straw. Lines method of agriculture gave significantly higher values of Fe, Mn, Zn and Cu concentrations in grain and straw of wheat compared with the prose method of agriculture. The increase of nutrients concentrations may be due to one or more of the following reasons: (1) the more efficiency of these nutrients in the soils treated with organic fertilizer compared with the untreated one, (2) increasing CEC of the treated soil through organic fertilizer, (3) improving soil chemical, biological and fertility properties and (4) the improvement of the soil physical properties which is reflected on water behavior and decreasing nutrient losses by leaching and deep percolation. On the other hand, it can be noticed that, micronutrients concentrations in wheat plants due to chicken manure application are higher than those of rice straw compost. This could be due to the relatively high contents of Fe, Mn, Zn and Cu in chicken manure and low value of pH (Table 2). Our findings agree with those obtained by Sun Kegang (2005). Generally, the release of organic acids during the decomposition of organic fertilizers increases the micronutrients availability to the growing plants via their abilities to chelate Fe, Mn, Zn and Cu (Allam, 1999).

Table (4): Micronutrients concentrations in grain and straw of wheat plants (mg kg^{-1}) as affected by method of agriculture and organic fertilizer treatments and their interactions (average two seasons)

A-Iron concentrations

Organic fertilizer (O)	Fe in grains			Fe in straw		
	Method of agriculture (M)					
	Lines	Prose	Mean	Lines	Prose	Mean
Control	270	201	236	285	190	237
Rice straw compost	341	222	281	330	211	270
Chicken manure	351	321	336	366	310	338
Mean	321	248	284	327	237	282
LSD at 0.05	M=1.10 O=1.35 M*O=ns			M= 1.49 O= 1.82 M*O=ns		

B-Manganese concentrations

Organic fertilizer (O)	Mn in grains			Mn in straw		
	Method of agriculture (M)					
	Lines	Prose	Mean	Lines	Prose	Mean
Control	35.67	28.33	32.00	25.00	25.00	25.00
Rice straw compost	36.33	36.33	36.33	38.67	32.00	35.33
Chicken manure	65.00	57.67	61.33	54.00	39.00	46.50
Mean	45.67	40.78	43.22	39.22	32.00	35.61
LSD at 0.05	M= 0.71 O=0.87 M*O=1.23			M= 0.26 O=0.32 M*O=0.45		

C-Zinc concentrations

Organic fertilizer (O)	Zn in grains			Zn in straw		
	Method of agriculture (M)					
	Lines	Prose	Mean	Lines	Prose	Mean
Control	78.00	43.33	60.67	60.67	61.33	61.00
Rice straw compost	90.00	60.00	75.00	64.67	68.67	66.67
Chicken manure	93.67	87.00	90.33	78.67	71.33	75.00
Mean	87.22	63.44	75.33	68.00	67.11	67.56
LSD at 0.05	M= 0.33 O= 0.41 M*O=ns			M=0.59 O= 0.73 M*O=1.03		

D-Copper concentrations

Organic fertilizer (O)	Cu in grains			Cu in straw		
	Method of agriculture (M)					
	Lines	Prose	Mean	Lines	Prose	Mean
Control	22.00	20.00	21.00	22.00	20.00	21.00
Rice straw compost	39.00	36.67	37.83	37.00	33.00	35.00
Chicken manure	46.00	42.00	44.00	43.00	40.00	41.50
Mean	35.67	32.89	34.28	34.00	31.00	32.50
LSD at 0.05	M= 0.74 O= 0.90 M*O=ns			M= 0.75 O=0.92 M*O=ns		

Soil chemical properties after crop harvest

EC_e, pH, organic matter and $CaCO_3$ content of studied soil

The experimental soil sites are shown in Table 1 which indicate that, calcareous soil is characterized by textural grade (sandy loam), with a relatively high $CaCO_3$ (26.4%). Soil pH value is alkaline for the studied soil (8.50). EC_e value is 3.06 dS m^{-1} and tends to be non-saline soil. Data in Table 5 show that after harvesting of wheat, the estimated EC_e values are reduced by about 10.9 and 44.4 % due to rice straw compost and chicken manure application, respectively, as compared with the control (mineral fertilization) under lines method of agriculture. However, the EC_e values are reduced by about 3.31 and 32.55 % due to rice straw compost and chicken manure application, respectively, as compared with the control (mineral fertilization) under prose method of agriculture. The EC_e values of soil after the application of rice straw compost are higher than those treated with chicken manure due to the high EC_e value in rice straw compost (5.03 dSm^{-1}) as compared to chicken manure one (1.83 dSm^{-1}). On the other hand, the decrease of EC_e values of soil in the organic fertilizer treatments could be attributed to the beneficial effect of organic fertilizer in improving the physical properties of soils, *i.e.*, total porosity and infiltration rate. These results agree with those obtained by El-Kouny *et al*. (2004).

The obtained results show a slight decrease of soil pH values after wheat harvesting in the treatment of both organic fertilizers compared to control treatment. This may be due to the soil buffering capacity. On the other hand, the favorable effects of organic fertilizers on decreasing soil pH due to organic and inorganic acids formed during organic fertilizer decomposition as well as improving the structure of the studied calcareous soils was also reported by Beheiry and Soliman (2005).

Concerning soil organic matter content, it increases after wheat harvesting due to organic fertilizer application, such increases record 18.3 and 30.0 % by application of rice straw compost and chicken manure, respectively as compared with control treatment under lines method of agriculture. However, the organic matter content increases record 23.7 and 28.8 % by application of rice straw compost and chicken manure, respectively as compared with control treatment under prose method of agriculture. The positive effect of increasing application of chicken manure on soil organic matter content may be due to the high initial content of organic matter in the applied manure (Table 2).

The obtained results show a slight decrease of $CaCO_3$ percentage after wheat harvesting in the treatment of both organic fertilizers compared to control treatment. This could be explained sources organic fertilizer application enhances the increase of soluble $CaCO_3$ (Tan, 1993 and Beheiry and Soliman (2005).

Table (5): Some chemical properties of the studied soil as affected by method of agriculture and organic fertilizer treatments (Average of two seasons)

Method of agriculture (M)		Organic fertilizer (O)	EC, dS m^{-1}	pH*	OM** %	$CaCO_3$ %
Lines		Control	2.34	8.14	0.60	22.70
		Rice straw compost	2.11	8.12	0.71	21.20
		Chicken manure	1.62	8.02	0.78	18.90
		Mean	2.02	8.09	0.70	20.93
Prose		Control	2.81	8.19	0.59	24.50
		Rice straw compost	2.72	8.11	0.73	22.90
		Chicken manure	2.12	8.08	0.76	20.80
		Mean	2.55	8.13	0.69	22.73
Mean	Organic fertilizer (O)	Control	2.58	8.17	0.60	23.60
		Rice straw compost	2.42	8.12	0.72	22.05
		Chicken manure	1.87	8.05	0.77	19.85
LSD at 0.05			M=0.04 O=0.05 M*O=0.07	M=0.01 O=0.01 M*O=0.01	M=ns O=0.02 M*O=ns	M=0.22 O=0.26 M*O=ns

***pH (1:2.5) Soil: water suspension ** OM = Organic matter**

Chemically available Fe, Mn, Zn and Cu in soil after harvesting of wheat plants

Analysis of variance revealed significant effects of organic fertilizer and method of agriculture. Table 6 showed significant increases in the amounts of Fe, Mn, Zn and Cu in soil as compared with control. The obtained data indicated that application of chicken manure or rice straw compost significantly increased the amounts of Fe, Mn, Zn and Cu in soil compared with mineral fertilizer treatment (control). The organic material can influence the solubility of such elements in soils in different ways causing an increase in the solubility of micronutrient cations by forming relatively stable organic complexes. However, the ability of organic material to immobilize those nutrients has also been reported. The mobilization or immobilization effects of organic materials are dependent on the soil reaction which influences the behavior of organic form of these nutrients (Abou-Seeda *et al.*, 1992) and Ali (2001). They showed that DTPA-extractable Fe, Mn and Zn were significantly increased due the application of such composts after wheat harvestings. The obtained results show that the amounts of DTPA-extractable Fe, Mn, Zn and Cu resulted from treating soil with chicken manure under lines method of agriculture are significantly higher than those treated with rice straw compost. This could be related to the relatively high contents of micronutrients and organic matter also, lower pH values in the chicken manure than rice straw compost, as previously reported in Table 2. Application of lines agricultural methods increased significantly soil micronutrients availability compared to prose method and control. This means that lines method emphasized the role of applied organic manure on improving physical and chemical soil properties and consequently, increases the availability of Fe, Mn, Zn and Cu in the calcareous soil.

Table (6): Available of micronutrients in soil (mg kg^{-1}) after harvesting of wheat plants as affected by method of agriculture and organic fertilizer treatments and their interactions (average of two seasons).

A. Available iron and manganese

Organic fertilizer (O)	Fe			Mn		
	Method of agriculture (M)					
	Lines	Prose	Mean	Lines	Prose	Mean
Control	4.09	3.92	4.01	0.97	0.85	0.91
Rice straw compost	6.51	6.07	6.29	2.29	2.02	2.16
Chicken manure	10.13	8.19	9.16	4.78	4.51	4.65
Mean	6.91	6.06	6.49	2.68	2.46	2.57
LSD at 0.05	M=0.07 O=0.08 M*O=ns			M=0.05 O=0.06 M*O=ns		

B. Available zinc and copper

Organic fertilizer (O)	Zn			Cu		
	Method of agriculture (M)					
	Lines	Prose	Mean	Lines	Prose	Mean
Control	0.76	0.66	0.71	0.43	0.37	0.40
Rice straw compost	1.31	1.10	1.21	0.65	0.61	0.63
Chicken manure	2.58	2.42	2.50	1.31	1.22	1.27
Mean	1.55	1.39	1.47	0.80	0.73	0.77
LSD at 0.05	M=0.07 O=0.08 M*O=ns			M=0.02 O= 0.02 M*O=ns		

Moisture retention in the soil

Effects of agriculture methods were insignificant on soil physical properties. Retained moisture in soil under different suctions as influenced by rice straw compost and chicken manure are shown in Table 7.

Table (7): Effect of agriculture method and organic fertilizer on moisture retention and available moisture in calcareous soil

Method of agriculture (M)		Organic fertilizer (O)	WHC* %	F.C* %	W.P* %	A.W* %
Lines		Control	33.69	17.17	10.39	6.78
		Rice straw compost	30.86	15.73	7.79	7.94
		Chicken manure	30.53	15.56	7.09	8.47
		Mean	31.69	16.15	8.42	7.73
Prose		Control	33.72	17.19	10.40	6.79
		Rice straw compost	30.94	15.77	7.99	7.78
		Chicken manure	30.60	15.60	7.11	8.49
		Mean	31.75	16.19	8.50	7.69
Mean	Organic fertilizer (O)	Control	33.70	17.18	10.39	6.79
		Rice straw compost	30.90	15.75	7.89	7.86
		Chicken manure	30.57	15.58	7.10	8.48
LSD at 0.05		M	ns	ns	ns	ns
		O	0.10	0.05	0.21	0.20
		M * O	ns	Ns	ns	ns

WHC= water holding capacity, F.C= field capacity, W.P= wilting point, A.W= available water.

***on dry weight basis**

Data reveal that rice straw compost and chicken manure decreased the retained moisture by 8.31 and 9.29 % for the water holding capacity (WHC), 8.32 and 9.31% for the field capacity (FC) and 24.10 and 31.70% for wilting percentage (WP) of untreated soil, respectively.

Because the increase in water retained at FC is far beyond that at wilting percentage (WP), *i.e.*, water retained at pF= 4.2, the available water (FC-WP) increased. Incorporating rice straw compost and chicken manure into the soil raised its available moisture to 15.84 and 24.98% of that untreated soil, respectively. These results are in accordance with those obtained by Ahmed (2000), Clark *et al*. (2000), Negm *et al*. (2004) and Ali (2011).

Bulk density, total porosity, pore size distribution and hydraulic conductivity

The hydraulic conductivity is one of the most important hydrophysical properties in these soils. These values are highly affected by different soil physical properties, especially pore size distribution (P.S.D), total porosity (T.P), and bulk density (B.D). Data in Table 8 reveal that rice straw compost and chicken manure decrease the bulk density of the soil by 4.30 and 2.15% of that of untreated, respectively. However, the increase relative to these untreated soils reached 4.77 and 2.39% for total porosity, 4.78 and 2.41% in drainable pores (D.P.), that having the diameter of > 28.8 μ) and 32.29 and 40.99% in water holding pores (WHP), that having the diameter of 28.8-0.19 μ), were obtained when soil treated with rice straw compost and chicken manure, respectively.

Table(8): Effect of agricultural method and organic fertilizer on soil porosity and hydraulic conductivity in calcareous soil.

Method of agriculture (M)		Organic fertilizer (O)	B.D, Mgm^{-3}	T.P, %	Pore size distribution (P.S.D) Macropores (D.P) >28.8 µ	Micropores (WHP) 28.8-0.19 µ	Micropores (N.U.P) < 0.19 µ	H.C, $cm\ h^{-1}$
Lines		Control	1.40	47.17	23.13	9.49	14.55	0.31
		Rice straw compost	1.34	49.43	24.23	12.72	12.48	0.74
		Chicken manure	1.37	48.30	23.68	13.40	11.22	0.63
		Mean	1.37	48.30	23.68	11.87	12.75	0.56
Prose		Control	1.39	47.55	23.31	9.57	14.67	0.31
		Rice straw compost	1.33	49.81	24.42	12.52	12.86	0.73
		Chicken manure	1.36	48.68	23.86	13.51	11.31	0.61
		Mean	1.36	48.68	23.86	11.87	12.95	0.55
Mean	Organic fertilizer (O)	Control	1.39	47.36	23.22	9.54	14.61	0.31
		Rice straw compost	1.33	49.62	24.33	12.62	12.67	0.73
		Chicken manure	1.36	48.49	23.78	13.45	11.26	0.62
LSD at 0.05		M	ns	ns	ns	ns	ns	ns
		O	0.02	0.42	0.25	0.25	0.40	0.05
		M * O	ns	ns	ns	ns	ns	ns

B.D= bulk densities, T.P= total porosity, P.S.D= pore size distribution, D.P= drainable pores, WHP= water holding pores, N.U.P= non useful pores, H.C= hydraulic conductivity.

On other hand, non useful pores (NUP) were lower than that of non conditioned ones by 13.28 and 22.93 %. Therefore, hydraulic conductivity (H.C) of the soil under constant head significantly was increased by 137 and 100% of that untreated, in sequence. This means that the improving effect of studied soil due to carbonate-organic matter associations result in the formation of highly stable micro aggregates in calcareous soils (Oyonarte *et al*., 1994). The previous results are in agreement with the findings of other workers (Felton, 1995; Kushwaha *et al.*, 2001, El-Maghraby, 2002 and El-Hady and Abo-Sedera, 2006).

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تحسين خواص الاراضي الجيرية وطرق الزراعة لتحقيق مفهوم الزراعة المستدامة

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اجريت دراسة حقلية في مزرعة خاصة بالنوبارية – محافظه البحيره وكان الهدف من هذه الدراسة تحسين خواص التربة الجيريه ،أي بعض الخصائص الفيزيائية والكيميائية وكذلك انتاجية محصول القمح ومحتواه من العناصر الغذائية الصغري في القش والحبوب بأستخدام الاسمدة العضوية (كمبوست قش الارز بمعدل 7.87 ميجا جرام للفدان +50% NPKومخلفات الدواجن بمعدل 4.08 ميجا جرام للفدان+50%NPK) وكذلك تطبيق بعض طرق الزراعة (الزراعة علي خطوط والزراعة بالنثر) وذلك لتحقيق مفهوم الزراعة المستدامة.

1- أظهرت الدراسة تحسن في الخواص الهيدروفيزيائيه بقيم معنوية للأرض الرملية الطميية الجيرية تحت الدراسة بإضافة الاسمده العضوية (كمبوست قش الارز أو سماد مخلفات الدواجن) مقارنة بالأرض الغير معاملة، ويشمل هذا التحسن: الكثافة الظاهرية - المساميه-التوزيع الحجمى للمسام- قدرة التربه على الاحتفاظ بالماء- حركة الماء لأسفل من خلال دراسة قيم التوصيل الهيدروليكى (سم/ ساعة) للتربة المشبعة.
2- إضافة كمبوست قش الأرز له أفضلية لقيم تحسن الخواص الهيدروفيزيائيه مقارنة بسماد الدواجن.
3- أوضحت الدراسة عدم وجود تأثير معنوي لطرق الزراعة علي الخواص الهيدروفيزيائيه للتربه تحت الدراسة.
4- بتتبع تأثير الاسمدة العضوية علي الخواص الكيميائية وجد أن تأثير سماد الدواجن مع اتباع نظام الزراعه علي هيئة خطوط علي بعض الخواص الكيميائية والصورة الكيميائية الميسرة من الحديد والمنجنيز والزنك والنحاس أفضل من كمبوست قش الارز. كما أدات النتائج الي حدوث زيادة معنوية في قيم الحديد والمنجنيز والزنك والنحاس المستخلصة بمركب ال DTPA بعد الحصاد لكل من مخلفات الدواجن وقش الارز.
5- أوضحت النتائج أيضا حدوث زيادة معنوية في وزن محصول القش والحبوب مقارنة بمعاملة الكنترول. كما حدث زيادة معنوية في تركيزات الحديد والمنجنيزوالزنك والنحاس في القش والحبوب نتيجة لاضافة الاسمدة العضوية و طريقة زراعة القمح علي خطوط.
6- أدي تطبيق نظام الزراعة علي الخطوط زيادة في محصول الحبوب 5.70 % ومحصول القش 3.54% بالمقارنة بنظام الزراعة بالنثر.
7- تطبيق نظام الزراعة علي الخطوط ادي الي زيادة كفاءة السماد العضوي وزيادة دوره في تحسين خواص الاراضي الجيرية وبالتالي زيادة محتواها من الحديد والمنجنيز والزنك والنحاس حيث كانت أفضل المعاملات هي تطبيق الزراعة علي خطوط مقارنة الزراعة بالنثر الذي يقلل من نمو الجذور والنبات.

وبناء علي هذه النتائج نوصى باستخدام كمبوست قش الارز بمعدل 7.87 ميجا جرام للفدان +50% NPK أومخلفات الدواجن بمعدل 4.08 ميجا جرام للفدان+50% NPK مع طريقة زراعة القمح علي خطوط حيث انه يعطي نتائج أفضل في زيادة انتاجية الاراضي الجيرية .ومن ثم فأنه يمكن الاستغناء عن التسميد الكيماوي جزئيا والاقلال من إستخدامة حمايه للبيئة من التلوث الكيماوي وأثره الضار علي صحه الانسان والحيوان، بالاضافة الي خفض تكاليف الانتاج وبالتالي يمكننا الوصول الي تحقيق مفهوم الزراعة المستدامة.

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