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EFFECT OF TILLAGE PRACTICES AND APPLICATION OF ORGANIC MATERIALS ON SOME PROPERTIES AND PRODUCTIVITY OF CALCAREOUS SOIL

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ABSTRACT: *A field experiment was conducted at Nubaria Agricultural Experimental Station through the winter season (2004-2005) and Summer Season (2005) to study the impact of tillage practices, especially plough depth and adding of organic materials on some properties of calcareous soil and its productivity. The experiment was laid out in a split design with three replicates. Chisel plough was used for the depth of 20 cm. While, the subsoiler plough was utilized for the depths of 40 and 60 cm. The plough depths were placed in the main plots. The used organic materials were Farmyard manure by the rate of (10 and 20m³/f) and Bio-fertilizer as well as the mixture of Farmyard manure by the rate of (10m³/f) and Bio-fertilizer which, placed in the subplots.*

The obtained results indicated that, plough practices and application of organic amendments resulted in a substantial improvement of the soil properties as well as yield of Wheat and Sorghum. Water stable aggregates (WSA), total aggregates (T. Agg.), mean weight diameter (MWD) and hydraulic conductivity (Ks) were intensified by either plough practices or organic amendments application under Wheat crop than Sorghum crop. The highest values of large aggregates having a diameter (8-2mm), (MWD) and (Ks) are (39.61%) and (2.82mm) and (1.38m\day) respectively, which attained for soils tilled by chisel plough for (20 cm) depth and received (20m³/f) farmyard manure under Wheat. The increase in total aggregates was realized by using chisel Plough. Using the subsoiler plough for the depth of 60 cm intensified the (Ec) values of the deeper soil layers (40-60 cm) for all organic materials treatments. The organic matter content of the top soil layers (0-20 cm) increased as the rate of farmyard manure application increased.

The highest content of available NP for soil was achieved by applying 20m³/fed farmyard manure under the use of chisel plough, while the highest available P content is attained for top soil layers after harvesting of Sorghum than after harvesting of Wheat. The highest grain and straw yield of Wheat crop were achieved by using the subsoiler plough for the depth of 60 cm and application farmyard manure (20m³/ f). However, the increase of Sorghum grain yield was realized by subsoiling plough for the depth of 60 cm and the application of (10m³/f) farmyard manure mixed with Bio-fertilizer.

Key words: *Plough depth, Chisel, Subsoiler, Organic amendments, Physical, Properties, NPK, Wheat, Sorghum, Calcareous soil.*

INTRODUCTION

The main land utilization problems of Calcareous soils are crusting of the surface soil layers, cemented condition of the subsoil layers and nutrient availability. In addition, most of these soils are low in organic matter. It is will established that the tillage practices and the proper application of appropriate organic materials as soil amendments are the main fundamental agro technical practices. They tend to improve soil quality from the standpoint of physical and hydrological condition as well as nutrient sufficiency. Following observations by (Voorhees and Lindstorm, 1984; Culley *et al.,* 1987; Hill, 1990; Miclke and Wihelem, 1998) indicated that, tillage practices strongly affect soil physical and chemical properties, especially when similar tillage systems have been practiced for long period. Changes in frequency and intensity of tillage practices alter the soil properties, distribution of nutrients and soil organic matter in the soil profile. Hence, tillage changes in one of soil property might cause associated changes in other soil properties.

Soil structure is an important property that mediates many soil physical and biological processes and controls soil organic matter decomposition. In this connection, El–Kholy, (1992) and Six *et al.,* (2000 a) reported that, Water stable aggregates (WSA) respond to tillage practices. For example, reduced tillage seems to be the most effective tillage way to increase the presence of aggregates, especially those of (> 5 mm) and (5 – 2 mm) in diameter. Jackson (1973) and Bruce *et al.,* (1992) stated that, the subsoiling ploughing led to break up the impervious soil layers. While, Millard *et al.*, (1995) found that, ploughing the soil once and minimum tillage by using chisel plough increases soil total aggregates (T.Agg.) of the top soil layers. Mean weight diameter (MWD) that considered as an index that characterizes the soil structure of the whole soil by integrating the aggregate size classes' distribution into one number (Angers *et al.*, 1993). El –Kholy, (1992) stated that, the forming aggregates in the tilled clay soil plots resulted in increasing the mean weight diameter (MWD) of aggregates, especially at planting period where is a reverse behavior is noticed in the untilled plots.

Soil structure and soil crusting may be influenced by manure application. Oades, (1984), Haynes and Swift (1990) reported that, Water stable aggregates in soil are shown to depend on organic materials. Much of the soil organic matter consists of discrete particles such as plant fragments, free humus particles and coal-like substances, which vary greatly in terms of size and degree of humification. It is unlikely that any of these components will have a direct influence on the formation and stabilization of soil aggregates. One year after manure application, Sun et al., (1995) found a significant higher proportion of water stable macroaggregates (1-2 mm) in eroded soils treated with manure compared with untreated soils. Aoyama et al., (1999) found that, Macroaggregates depend largely on roots and hypha, and thus on growing root system. Numbers of stable macroaggregates decline with organic matter content as the root and hypha were decomposed and were not replaced.

Tillage operations affect saturated hydraulic conductivity (Ks) in contrasting ways. Burwell et al., (1968) and Metwally et al., (1972) reported that tillage destroys soil crusts and generally increases water intake rate. Bouma, (1991) stated that tillage especially, plowing creates macropores that cause saturated hydraulic conductivity to increase considerably, but also disrupts pore continuities that reduce hydraulic conductivities between plow layers and subsoils. Laddha and Totawat, (1997) found that, deep tillage practices were superior to shallow tillage treatment. Disc and chisel plough significantly reduced the bulk density and increased soil porosity and consequently hydraulic conductivity. Cassel and Nelson, (1985), Messing and Jarvis, (1993) stated that seasonal variations in hydraulic conductivities occur through root development, earthworm activity, and other natural processes such as shrinking and swelling. It is often assumed that greater organic materials (OM) content in the soil will result in higher hydraulic conductivity. Paustian et al., (1997) found that tillage enhances decomposition of soil organic matter by mixing of plant residues into the soil, increasing aeration, and enhancing dry-wet cycles. In general, the combination of tillage and manure significantly improved soil Carbon and Nitrogen. (Joann and Chi Chang, 2002). Long–term farmyard applications can contribute to nutrient accumulation, particularly phosphorous (P), Kaddah, (1976) found significantly increase in Wheat yield resulted form soil chiseling in two directions. Ali and El- Hamshari, (1984) concluded that Wheat production could be increased with improvement of tillage and management of saline-sodic soils. Laddha and Totawat, (1997) found that, yields of Sorghum and grain under the intercropping system were significantly increased as a result of deep tillage.

The general objectives of this study were to determine the influence of different tillage practices at different depths under the application of Farmyard manure alone and\or in combination with Bio-fertilizer on some soil physical and chemical properties as well as soil availability of macronutrients and their influences on crop yield.

MATERIALS AND METHODS

A field experiment was conducted at Nubaria Agricultural Experimental Station through the winter season (2004\2005) and summer season 2005 to study the impact of some soil management practices such as plough depth and Bio-organic materials on the characteristics of calcareous soil and its productivity. The experiment was laid out in a split design with three replicates. The plough depth was placed in the main plots, while the addition of Farmyard manure and Bio-fertilizer were placed in the sub plots. For this purpose, chisel plough was used for the depth of 20 cm. While, subsoiler was utilized for the depths of 40 cm and 60 cm. Organic materials and Bio-fertilizer treatments were as follows:

1- Control (without addition) donated as (CONT)
2- Farmyard manure (10 m^3/f) donated as (FYM1)
3- Farmyard manure (20 m^3/f) donated as (FYM2)
4- Inoculatation with Bio-fertilizer donated as (BIO)
5- Farmyard manure (10m^3/f) + inculcation with Bio- fertilizer donated as (FYM1*BIO).

Some physical and chemical characteristics of the initial soil were determined and shown in Tables (1, 2).

Commercial Bio-fertilizers "Cerealine" for wheat and "nitrolin" for sorghum that added by inoculating the seeds before sowing. These Biofertilizers supplied from the Ministry of Agricultural. The previous treatments were mixed with the surface layers by hatchat. Then, the area was sown by wheat (Triticum vulgare) C.V Giza 168 and sorghum (Sorghum Sudanese L.) C.V Giza 15 for two successive growth season (2004-2005) under surface irrigation system. The recommended doses of macro-nutrients were added for both crops.

Table (1): Some chemical properties and particle size distribution of the initial studied soil.

Soil depth (cm)	Soil Chemical Properties										
	Sp %	Ec (dS\m)	pH	Soluble cations (meq/L)				Soluble anions (meq/L)			
				Ca^{++}	Mg^{++}	Na^+	K^+	CO_3^-	HCO_3^-	Cl^-	SO_4^{--}
0-20	42.00	6.97	8.17	27.80	11.90	41.60	1.08	-	19.30	29.60	33.48
	Particle size distribution										
0-20	Coarse sand %			Fine sand %			Silt %	Clay %	CaCO₃ %	Textural calss	
	11.10			22.80			24.20	41.90	27.03	Clay loam	

Table (2): Some physical properties, organic matter content and available NPK of the initial studied soil.

Soil depth (cm)	Ks (m/day)	Total aggregates (%)	MWD (mm)	OM (%)	Available N(ppm)	Available P(ppm)	Available K(ppm)
0-20	0.33	61.00	0.81	0.74	25.40	10.90	113.10
20-40	0.30	63.44	0.78	0.54	23.10	7.10	105.30
40-60	0.22	63.60	0.77	0.50	15.40	5.90	94.80

Ks : Saturated soil hydraulic conductivity (m/day).
MWD : Mean weight diameter (mm).
OM : Organic matter content (%).

After harvesting the wheat and sorghum crops respectively, disturbed and undisturbed soil samples were collected at the selected depths of the studied soil. The disturbed soil samples air-dried and ground to pass a 2mm screen. The collected disturbed soil samples were subjected to the particle size analysis as described by Gee, Bander, (1986). The total $CaCO_3$ was determined gasiometrically as cited by Nelson, (1982). Soil chemical analyses were carried out according to Page *et al.*,(1982).

The undisturbed soil samples were used to determine some physical properties. The wet sieve analysis was performed and wet sieving devices as described by Kember and Rosenau, (1986), determined the water stable aggregates. A set of sieves of 2, 1, 0.5, 0.25, 0.125 and 0.063 mm diameter were used. Mean weight diameter (MWD) was calculated using the following formula according to De - Leenheer and De - Boodt, (1959)

$$MWD = \sum_{I=1}^{n} Xi\ Wi$$

Where: MWD is the mean weight diameter (mm).
Wi is the proportion by weight of a given size fraction of aggregates (g) and Xi is the near average diameter of that fraction (mm).

The saturated hydraulic conductivity (Ks) was determined with constant head method at laboratory according to (Klute and Direksen, 1986). Plants of each plot were cut, air-dried and the grain yields (kg/f) were achieved.

RSULTS AND DISCUSSIONS

1-Electrical conductivity (Ec)

Data presented in Table (3) show that the values of (Ec) of initial soil decrease as the soil depth increases. Results reveal also that after harvesting wheat, using the subsoiler plough for the depth of 60 cm intensified the (Ec) values of the deeper soil layers (40-60 cm) for all organic materials treatments. After harvesting Sorghum, there are no clear differences between (Ec) values under the effect of plough and /or organic materials.

2- Soil organic matter content

The results in Table (4) indicate that, the organic matter content of the top soil layers (0-20 cm) increases as the rate of farmyard manure application increases. For this reason, the maximum values of organic matter content are obtained under the rate of (20 m^3/f) Farmyard manure. This increase is attributed to the high content of organic matter in the applied farmyard manure. In general, the organic matter content of the studied soil is reduced by increasing the soil depth. These results are corresponding with that obtained by (Awad *et al.*, 2003 and El- sedfy *et al.*, 2005).

Table (3): EC (dS/m) of the soil extract (1:5) as affected by plough depth and organic materials addition.

Corp	Plough depth (cm)	Soil depth (cm)	Organic materials treatments				
			CONT	FYM1	FYM2	BIO	FYM1*BIO
Wheat	20	0-20	0.29	0.34	0.34	0.04	0.36
	40	0-20	0.28	0.37	0.29	0.29	0.30
		20-40	0.32	0.36	0.29	0.33	0.36
	60	0-20	0.27	0.29	0.30	0.31	0.29
		20-40	0.31	0.41	0.33	0.56	0.30
		40-60	0.36	0.51	0.46	0.56	0.54
Sorghum	20	0-20	0.24	0.26	0.28	0.28	0.30
	40	0-20	0.26	0.26	0.26	0.21	0.26
		20-40	0.24	0.30	0.26	0.23	0.27
	60	0-20	0.28	0.26	0.30	0.26	0.30
		20-40	0.26	0.26	0.31	0.28	0.26
		40-60	0.27	0.39	0.31	0.31	0.36

Table (4): Organic matter content (%) as affected by plough depth and organic materials addition.

Corp	Plough depth (cm)	Soil depth (cm)	Organic materials treatments				
			CONT	FYM1	FYM2	BIO	FYM1*BIO
Wheat	20	0-20	1.14	1.56	1.74	1.27	1.47
	40	0-20	1.14	1.34	1.54	1.27	1.31
		20-40	0.80	1.09	0.94	0.80	0.85
	60	0-20	1.14	1.58	1.63	1.33	1.44
		20-40	0.55	1.00	1.02	1.00	0.89
		40-60	0.53	0.76	0.74	0.54	0.67
Sorghum	20	0-20	1.16	1.68	1.81	1.29	1.61
	40	0-20	1.14	1.34	1.47	1.27	1.34
		20-40	0.80	0.94	1.03	0.89	0.94
	60	0-20	1.20	1.54	1.68	1.41	1.57
		20-40	0.58	1.07	1.07	0.67	1.09
		40-60	0.56	0.96	1.03	0.60	0.67

Regarding the effect of plough depth on soil organic matter content, data reveal that the maximum values of organic matter content are attained for surface soil layers under using chisel plough. This is may be due to the effect of tillage practice on increasing worm population and soil aeration that intern hasten the decay of organic materials. This is desirable because current crops benefit from nutrients released from the decomposition of organic matter. These results were in agreement with the results of (Burwell et al., 1968).

3-Soil Structure

Aggregates stability is often measured a specific aggregate size class, which is not a measurement of a whole soil structure. In agricultural soils, tillage practices and organic materials application are the major factors involved soil structure (Kay, 1990, Joan and Chi Chang, 2002). Data presented in Tables (5 and 6) indicate that soil structure parameters i.e. water stable aggregates (WSA), total aggregates (T.Agg.) and mean weight diameter (MWD) are increased as a result of tillage practices and adding of organic materials to calcareous soils compared with untreated ones.

Due to the (WSA) distribution, data reveal that aggregates having a diameter (8-2mm) are found to be the abundant size especially in the surface soil layers. Hence, the highest values of large aggregates are recorded for surface soil layers that received (20 m^3/fed) farmyard manure and tilled by chisel plough for (20 cm) plough depth than the sub soiler one under Wheat crop. This effect can be arranged as follows: FYM2> FYM1> FYM1*BIO > BIO > CONT. While the fine aggregates having diameter (0.25- 0.063 mm) have an inverse trend. These findings are in agreement with Haynes and Naidu, (1998).

The obtained results reveal that, the values of (T.Agg.) and (MWD) are increased in the tilled soil. In this connection, the highest values of these parameters are attained for surface soil layers (0-20 cm) which tilled by chisel plough for (20 cm) plough depth compared to the soils that untilled or tilled by subsoiler one. The soil that treated by organic materials achieved appreciable increase in (T.Agg.) and (MWD) where the highest values of these parameters are recorded for (FYM2) and (FYM1*BIO) treatments under Wheat and Sorghum crops respectively. This finding can be attributed to the effect of tillage practices in increasing drying and rewetting process that increase the break down the impervious layers and increase the aggregates susceptibility to formation. In addition, the role of organic materials and their decomposition products as binding agent in enhancing aggregation process and production suitable structure parameters. (Kay, 1990, Joan and Chi Chang, 2002).

Table (5): Total aggregates, aggregates size distribution of water stable aggregates and Mean weight diameter (MWD) as affected by plough depth and organic materials addition under wheat crop.

Plough Depth (cm)	Treatments	Soil Depth (cm)	Water Stable Aggregates 8-2 mm	2-1 mm	1-0.5 mm	0.5 - 0.25 mm	0.25-0.125 mm	0.125-0.063 mm	Total Aggregates %	MWD mm
20 (cm)	Before planting	0-20	4.66	6.70	10.38	11.48	14.17	13.61	61.00	0.81
		20-40	3.80	7.97	10.89	16.82	17.57	6.39	63.44	0.78
		40-60	4.51	4.84	11.46	17.58	15.62	9.59	63.60	0.77
	CONT	0-20	9.80	7.12	10.33	11.67	12.40	8.21	59.54	1.26
	FYM1	0-20	27.95	10.63	10.70	8.12	8.21	3.26	68.87	2.45
	FYM2	0-20	37.56	8.70	7.84	6.84	6.24	7.81	75.00	2.82
	BIO	0-20	16.23	8.40	11.44	10.47	12.94	6.25	65.73	1.66
	FYM1*BIO	0-20	19.32	12.26	9.05	8.87	15.84	5.26	70.70	1.82
40 (cm)	CONT	0-20	8.47	8.31	12.45	13.97	10.58	8.40	61.41	1.17
		20-40	5.28	9.15	10.03	12.40	13.24	9.43	59.51	0.94
	FYM1	0-20	37.57	9.07	11.01	8.50	6.79	5.58	78.52	2.73
		20-40	10.23	9.87	14.17	10.64	9.48	5.83	82.86	1.38
	FYM2	0-20	39.61	9.61	10.00	7.76	10.46	3.05	80.48	2.80
		20-40	12.39	21.75	15.74	9.08	7.04	6.55	72.54	1.54
	BIO	0-20	19.32	12.36	9.05	8.87	15.84	5.26	70.70	1.82
		20-40	6.87	7.26	12.22	12.19	12.57	12.57	63.68	0.98
	FYM1*BIO	0-20	21.41	6.64	9.56	8.60	8.21	11.31	65.73	1.98
		20-40	9.80	7.12	10.33	11.67	12.40	8.21	59.54	1.26
60 (cm)	CONT	0-20	9.47	5.74	8.92	10.75	8.38	9.96	53.22	1.30
		20-40	5.75	6.28	11.11	9.86	8.56	9.18	50.75	1.04
		40-60	4.51	4.84	11.46	17.58	15.62	9.59	63.60	0.77
	FYM1	0-20	20.14	10.20	13.97	10.72	10.32	8.39	73.75	1.81
		20-40	24.94	8.30	10.74	10.46	8.99	8.78	72.21	1.31
		40-60	4.77	11.67	19.82	14.80	10.69	5.32	67.07	0.96
	FYM2	0-20	23.96	6.37	7.69	10.71	11.70	10.03	70.46	2.02
		20-40	11.63	8.29	10.92	9.35	7.57	10.98	58.74	1.44
		40-60	9.70	9.02	12.94	19.07	7.09	7.62	65.44	1.24
	BIO	0-20	9.09	5.10	8.40	8.13	9.17	10.60	50.48	1.29
		20-40	7.76	7.56	15.97	15.85	10.22	10.44	67.79	1.05
		40-60	4.51	4.84	11.46	17.58	15.62	9.59	63.60	0.77
	FYM1*BIO	0-20	16.23	8.40	11.44	10.47	12.94	6.25	65.73	1.66
		20-40	5.75	6.28	11.11	9.86	8.56	9.18	50.75	1.04
		40-60	4.71	5.85	11.86	15.24	7.50	6.19	51.35	0.95

Table (6): Total aggregates, aggregates size distribution of water stable aggregates and Mean weight diameter (MWD) as affected by plough depth and Organic Materials addition under Sorghum crop.

Plough Depth (cm)	Treatments	Soil Depth (cm)	Water Stable Aggregates						Total Aggregates (%)	MWD (mm)
			8-2 mm	2-1 mm	1-0.5 mm	0.5 - 0.25 mm	0.25- 0.125 mm	0.125- 0.063 mm		
20 (cm)	Before planting	0-20	7.03	6.27	11.19	14.45	9.98	8.99	57.90	1.05
		20-40	29.41	8.62	9.56	8.53	8.28	3.62	68.03	2.53
		40-60	30.57	8.07	8.51	6.65	6.42	4.02	64.23	2.73
	CONT	0-20	8.82	6.52	7.97	9.87	18.42	9.28	60.88	1.11
	FYM1	0-20	17.52	10.16	10.63	10.39	12.01	8.01	68.71	1.71
	FYM2	0-20	8.28	7.41	11.66	11.55	12.54	7.99	59.43	1.16
	BIO	0-20	4.57	3.14	5.27	8.47	16.89	4.70	43.04	0.89
	FYM1*BIO	0-20	24.63	9.93	11.73	10.33	9.83	6.45	72.89	2.10
40 (cm)	CONT	0-20	19.42	7.03	10.50	9.94	13.28	8.42	68.58	1.42
		20-40	21.60	7.23	8.26	9.61	9.91	5.19	61.79	2.12
	FYM1	0-20	13.51	9.15	11.19	10.58	11.42	7.72	63.56	1.52
		20-40	17.52	10.16	10.63	10.39	12.01	8.01	68.71	1.71
	FYM2	0-20	6.21	3.40	6.12	7.62	17.57	5.75	46.67	1.02
		20-40	10.30	7.27	10.57	12.91	11.43	8.80	61.27	1.28
	BIO	0-20	9.13	7.14	11.59	11.05	7.75	10.53	57.18	1.25
		20-40	7.36	5.85	8.28	11.92	12.11	8.22	53.74	1.10
	FYM1*BIO	0-20	5.55	4.73	8.20	9.88	15.29	5.57	49.21	0.98
		20-40	4.51	4.84	11.46	17.58	15.62	9.59	63.60	0.77
60 (cm)	CONT	0-20	16.91	6.38	9.18	11.40	8.47	10.59	62.93	1.71
		20-40	10.02	4.33	7.21	11.05	16.34	8.16	57.10	1.23
		40-60	4.57	3.14	5.27	8.47	16.89	4.70	43.04	0.89
	FYM1	0-20	22.79	7.56	10.36	10.68	8.72	6.87	66.98	2.08
		20-40	14.07	6.94	9.68	13.30	11.28	9.71	64.98	1.48
		40-60	11.82	6.23	9.83	12.31	9.10	8.68	57.97	1.43
	FYM2	0-20	13.23	7.42	9.98	9.80	8.97	10.27	59.67	1.53
		20-40	6.21	3.40	6.12	7.62	17.57	5.75	46.67	1.02
		40-60	3.80	7.97	10.89	16.82	17.57	6.39	63.44	0.78
	BIO	0-20	11.30	9.73	11.67	10.69	12.71	6.59	62.68	1.39
		20-40	8.28	7.41	11.66	11.55	12.54	7.99	59.43	1.16
		40-60	7.36	5.85	8.28	11.92	12.11	8.22	53.74	1.10
	FYM1*BIO	0-20	4.13	2.01	N.S	3.27	2.84	N.S	7.55	0.30
		20-40	3.90	N.S	N.S	N.S	N.S	N.S	N.S	0.29
		40-60	7.30	N.S	N.S	N.S	N.S	N.S	N.S	N.S

The influence of cropping system on soil aggregates is a function of potential of the plant roots in aggregates formation as well as destruction.

Generally, data in Tables (5 and 6) show that the formation of large and intermediate aggregates sizes of (8-2mm), (2-1mm) and (1-0.5mm) are higher under Wheat crop than that under Sorghum crop. In addition, the highest values of (T.Agg.) and (MWD) are recorded for soils that tilled by chisel plough and treated with (FYM2) and (FYM1*BIO) under Wheat and Sorghum crops, respectively. This may be due to the effect of both tillage depth and application of organic materials that were conducted before Wheat planting. Tisdall and Oades, (1979) and Skidmore et al., (1986); confirmed these finding. They found that aggregation from Wheat plots were stable and less erodible than the aggregates from Sorghum plots. They concluded that, the greater amounts of organic matter under Wheat crop as aggregates become larger, supporting the idea that microaggregates are bound together by organic matter into larger macro- aggregates. This finding is agreement with Sabrah, (1975) and Tisdall and Oades, (1979); they concluded that Sorghum roots play a vital role in the distribution of (WSA). The pressure and penetration of Sorghum root hairs into larger aggregates diameters introduce points of weakness leading to aggregate degradation. This led to break down of large aggregates to smaller one.

4-Saturated hydraulic conductivity (Ks)

Many soil properties are known to influence soil hydraulic conductivity such as soil texture, soil structure, soil porosity and organic matters (Selem, 1983). The effect of different tillage depthes and organic materials at different application rates on saturated hydraulic conductivity are presented in Table (7). Results reveal that, the usage of both chisel plough for the depth (20 cm) and subsoiler plough for soil depth (40 cm) and (60 cm) intensified the (Ks). This may be due to breaking up the impervious layers by subsoiler plough, which led to improve water movement into the soil.

Table (7): Saturated Hydraulic Conductivity (m/day) as affected by plough depth and organic materials addition.

Corp	Plough Depth (cm)	Soil Depth (cm)	Organic Materials Treatments				
			CONT	FYM1	FYM2	BIO	FYM1*BIO
Wheat	20	0-20	0.85	1.12	1.38	0.94	1.16
	40	0-20	0.44	0.69	0.59	0.51	0.72
		20-40	0.41	0.52	0.57	0.47	0.52
	60	0-20	0.43	0.70	0.75	0.47	0.69
		20-40	0.39	0.53	0.58	0.42	0.50
		40-60	0.30	0.42	0.46	0.33	0.40
Sorghum	20	0-20	0.83	0.98	1.13	0.90	1.04
	40	0-20	0.41	0.63	0.66	0.46	0.65
		20-40	0.37	0.47	0.52	0.43	0.47
	60	0-20	0.39	0.64	0.68	0.43	0.63
		20-40	0.35	0.48	0.53	0.38	0.45
		40-60	0.27	0.38	0.42	0.30	0.36

Data indicate also that, the highest value of (Ks) is attained for soil that tilled by chisel plough compared to subsoiler. Hence, (Ks) decrease by increasing soil depth. These finding are in agreement with (Zein Al-Din, 1985 and Millard et al., 1995). Where, they concluded that the increase in (Ks) values might be attributed to tillage practice that improve the soil water penetration and consequently water intake rate increase. Minimum tillage increased worm population causing the formation of numerous channels, which improved (Ks). Concerning the effect of organic materials treatments, results showed that, the highest values of (Ks) are recorded for (FYM2) treatment under both Wheat and Sorghum respectively. The values of (Ks) tend to increase under Wheat crop than Sorghum crop. Hence, the highest value of (Ks) (1.38 m\day) is recorded for soil that tilled by chisel plough for (20 cm) plough depth and (FYM2) treatment under Wheat Crop. This is may be due to increasing organic matter content, which in turn leads to improve soil aggregation status in the soil. This can explained as, in a well aggregated soil, a good combination of size, arrangement and stability of aggregates could give a wide range of pore sizes with and between aggregates. This assures adequate drainage, Ks and plant available water for plant growth. (Messing and Jarvis, 1993)

5- Available NPK of soils as affected by plough depth and organic materials addition.

5-1 Available N:

Due to the effect of organic materials addition on the soil content of available N (ppm), the results in Table (8) clarify that the available N content intensified as the rate of applying farmyard manure increased. Where, the highest content of available N of the top soil layer was achieved by applying (20 m^3/fed) farmyard manure. This high content may be due to the decomposition of organic matter and release of nutrients in the available form (Awad et al., 2003).

The available N content of the top soil layer increased from (30.30 ppm) as a mean value for control treatment to (35.67 ppm) for the soil that inoculated by Bio-fertilizer. This is because the Bio-fertilizer includes symbiotic nitrogen fixing bacteria particularly, Azotobacter and Azospirillum that are considered from the most important organisms that played a vital role in soil fertility (Boddy et al., 1991). These results were corresponding with the results of (El-Sedfy, 2002 and El- Sedfy et al., 2005).

Concerning the effect of plough depth on available N of the studied soil, data in Table (8) show that the content of available N (ppm) of the top soil layers increases, as a mean value from (25.4 ppm) for initial soil to (34.56 ppm) after harvesting Wheat under two plough types. The highly increment may be attributed to tillage that help to increase worm population and aerate the soil to hasten the decay of organic matter. This is a desirable effect because it is help the current crop to benefit from nutrients released during the decomposition of organic matter (Burwell *et al.*, 1968). It was found that the available N content of the soil decreased when the soil depth had increased as affected by either plough depth or organic materials addition.

Table (8): Available Nitrogen (ppm) as affected by plough depth and organic materials addition.

Corp	Plough Depth (cm)	Soil Depth (cm)	Organic Materials Treatments				
			CONT	FYM1	FYM2	BIO	FYM1*BIO
Wheat	20	0-20	30.80	33.40	40.40	34.70	33.40
	40	0-20	29.30	33.40	38.50	35.90	34.70
		20-40	26.30	30.80	34.70	32.30	30.70
	60	0-20	30.80	35.10	38.50	36.40	33.00
		20-40	27.60	31.60	33.90	33.40	29.20
		40-60	19.30	22.10	23.40	23.40	22.20
Sorghum	20	0-20	27.70	30.00	36.40	31.20	30.00
	40	0-20	26.40	30.00	34.70	32.20	31.20
		20-40	23.40	27.70	31.20	29.10	27.60
	60	0-20	27.70	31.60	34.70	32.80	29.70
		20-40	24.80	28.40	30.50	30.00	26.30
		40-60	17.40	20.00	21.10	21.10	20.00

5-2 Available P:

The results in Table (9) reveal that the soil content of available P (ppm) shows the same trend of available N. Hence, the available P of the top soil layer intensified as the rate of organic materials addition increased. Therefore, the maximum increment of P content is obtained by applying (20m^3/fed) farmyard manure. However, the application of Bio-fertilizer had no effect on the P availability of calcareous soil. Therefore, the minimum content of available P is (14.35 ppm) as a mean value which achieved by applying Bio-fertilizer.

Concerning the effect of plough depth on available P content of the soil, it was noticed that the higher increment of available P content is attained for top soil layers after harvesting of Sorghum than the other one after harvesting Wheat. This can be attributed to the effect of tillage practice on decay of organic materials application that increased by time. Therefore, most of nutrients released during the decomposition of organic matter. These results were in agreement with (Whalen and Chi Change, 2001). In general, the values of available P content declined by increasing the soil depth.

Table (9): Available phosphorus (ppm) as affected by plough depth and organic materials addition.

Corp	Plough Depth (cm)	Soil Depth (cm)	Organic Materials Treatments				
			CONT	FYM1	FYM2	BIO	FYM1*BIO
Wheat	20	0-20	12.00	23.00	25.80	14.80	21.80
	40	0-20	16.00	23.00	25.30	14.80	18.78
		20-40	12.00	6.49	7.81	13.30	10.90
	60	0-20	16.14	24.50	26.60	13.44	21.82
		20-40	7.10	15.70	12.16	9.62	13.44
		40-60	6.75	13.30	10.90	8.66	12.10
Sorghum	20	0-20	18.60	24.38	25.90	19.70	24.38
	40	0-20	18.78	22.96	25.30	20.16	24.38
		20-40	16.90	17.50	16.90	16.10	17.50
	60	0-20	17.44	22.96	25.84	19.10	20.16
		20-40	15.30	14.13	15.70	16.14	16.13
		40-60	5.90	12.90	12.60	5.90	10.88

5-3 Available K :

Results in Table (10) reveal that, soil available K (ppm) content has the same trend of available P content. It is noticed that available K content of the top soil layers exceeded when the rate of farmyard manure addition had increased. Consequently, the available K content of the top soil layer increased from 110.83 ppm for control treatment to 118.3 ppm by applying (20 m^3/fed) farmyard manure after Wheat harvesting. This increase may be due to the decomposition of organic materials and release of nutrients in the available form. Awad et al., (2003) achieved similar results. The same trend of available K content for the top soil layers is obtained after Sorghum harvesting.

Table (10): Available Potassium (ppm) as affected by plough depth and Organic Materials addition.

Corp	Plough Depth (cm)	Soil Depth (cm)	Organic Materials Treatments				
			CONT	FYM1	FYM2	BIO	FYM1*BIO
Wheat	20	0-20	117.00	132.00	136.50	120.90	126.40
	40	0-20	113.10	128.70	128.70	99.45	117.00
		20-40	107.25	111.15	107.25	93.60	102.38
	60	0-20	102.38	89.70	89.70	87.80	93.60
		20-40	89.70	84.80	84.80	84.80	87.80
		40-60	76.05	78.00	84.80	74.10	78.00
Sorghum	20	0-20	113.10	124.80	140.40	120.90	136.50
	40	0-20	102.38	93.60	107.25	105.30	113.10
		20-40	99.45	89.70	97.50	102.38	107.25
	60	0-20	99.45	93.60	105.30	87.75	111.00
		20-40	93.60	87.75	102.38	87.75	99.45
		40-60	89.70	78.00	93.60	84.80	87.75

5-4 Wheat and Sorghum yield as affected by plough depth and organic materials addition:

Data presented in Table (11) clarify that the usage of subsoiler plough for the depth of (60 cm) and the application of farmyard manure (20 m^3/fed) realized the highest increment of Wheat grain and straw yield (kg/fed) compared with control and (BIO) treatments. This increment may be attributed to break up the impervious soil layers by subsoiler plough and improvement of soil physical and chemical properties such as organic matter, structure status, and hydraulic conductivity. This in turn, enhances water movement into the soil, increases the stored water for longer periods for plant roots, and consequently, increases the availability of soil macronutrients, especially in the top soil layers. These findings are in agreement with Achara and Sharma, (1994)

Table (11): Effect of Plough and Organic Materials on Wheat grain and straw yield

Plough Depth (cm)	Wheat Grain yield(Kg/f)					Wheat Straw Yield (Kg/f)				
	Organic Materials Treatments					Organic Materials Treatments				
	CONT	FYM1	FYM2	BIO	FYM1*BIO	CONT	FYM1	FYM2	BIO	FYM1*BIO
20	1909.67	2267.67	2475.33	2044.33	2340.67	3298.33	3797.00	4720.67	3774.33	3970.67
40	2004.67	2346.33	2620.67	2061.00	2061.00	3331.67	2886.27	4777.00	4004.00	3970.67
60	2111.33	2498.00	2710.33	2212.00	2212.00	3393.67	4267.00	4911.33	3981.67	4441.00

Data in Table (12) reveal that, plough depth has no effect on grain and stalk yield of Sorghum. While, the addition of (FYM1*BIO) treatment achieved the maximum increment of Sorghum grain yield. This increment may be due to the increase in organic matter content, consequently increase nutrients availability and improvement of soil physical properties of the top soil layers.

Table (12): Effect of Plough and Organic Materials on Sorghum grain and stalk yield

Plough Depth (cm)	Sorghum Grain yield (Kg/f)					Sorghum Stalk Yield (Kg/f)				
	Organic Materials Treatments					Organic Materials Treatments				
	CONT	FYM1	FYM2	BIO	FYM1*BIO	CONT	FYM1	FYM2	BIO	FYM1*BIO
20	1026.67	2036.67	3023.33	9130.00	1510.00	3166.67	3226.67	3600.00	3216.67	2566.67
40	1093.33	2093.33	2950.00	5206.67	5626.67	2416.67	2613.33	3216.67	3626.67	3426.67
60	1083.33	2350.00	2483.33	1283.33	9143.33	3156.67	3616.67	3276.67	3526.67	3440.00

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تأثير عمليات الخدمة و إضافة المواد العضوية على بعض خواص وإنتاجية الأراضى الجيرية

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الملخص العربى

أجريت تجربة حقلية بمحطة البحوث الزراعية بالنوبارية خلال الموسم الشتوى (٢٠٠٤-٢٠٠٥) والموسم الصيفى (٢٠٠٥) لدراسة تأثير عمليات الخدمة وخاصة أعماق الحرث المختلفة مع إستخدام المواد العضوية كمحسنات للتربة مثل سماد المزرعة و السماد الحيوى على خواص الأراضى الجيرية وإنتاجيتها.لذا صممت التجربة باستخدام القطع المنشقة بثلاث مكررات حيث أستخدم المحراث الحفار لعمق(٢٠سم) ومحراث تحت التربة لعمق(٤٠سم) و (٦٠سم). وكان عمق الحرث فى القطع الرئيسية بينما كان سماد المزرعة المستخدم بمعدلات (١٠،٢٠م^{3} /ف) منفردا أو مخلوطا بالسماد الحيوى بمعدل (١٠م^{3} /ف) فى القطع تحت الرئيسية.

أوضحت النتائج المتحصل عليها أن عمليات الحرث و إضافة المواد العضوية أدتإلى تحسن ملحوظ لخواص الأرض وكذلك محصول القمح و الذرة الرفيعة . فقد زادت نسبة التجمعات الأرضية الثابتة ونسبة التجمعات الكلية ومتوسط أوزان الأقطار المكافئةفى حالة محصول القمح عن محصول الذرة الرفيعة. كانت أعلى قيمة لنسبة التجمعات الأرضية الكبيرة ذات الأقطار (٨-٢مم) , متوسط أوزان الأقطار المكافئة(MWD) ومعامل التوصيل الهيدروليكى المشبع(Ks) كالأتى (٣٩,٦١%), (٢,٨٢ مم) ,(١,٣٨ م/يوم) على التوالى للأرض التى حرثت بالمحراث الحفار لعمق (٢٠سم) مع إضافة سماد المزرعة بمعدل (٢٠م^{3}/ف) وذلك تحت محصول القمح. كما أدى إستخدام محراث تحت التربة لعمق (٦٠سم) لزيادة معامل التوصيل الكهربى(Ec) لطبقات التحت سطحية للتربة (٤٠-٦٠ سم) لكل معاملات المادة العضوية بينما زاد محتوى

المادة العضوية بزيادة معدل إضافة سماد المزرعة وذلك فى الطبقات السطحية للأرض (٠-٢٠ سم).

وجد أن أعلى محتوى للنتروجين و الفوسفور الميسر للأرض التى حرثت بالمحراث الحفار لعمق (٢٠سم) مع إضافة سماد المزرعة بمعدل (٢٠م٣/ف) بينما تحقق أعلي محتوى للفوسفور الميسر فى الطبقات السطحية للأرض بعد حصاد الذرة الرفيعة .

كان أعلى محصول للقمح من الحبوب والقش عند إستخدام محراث تحت التربة لعمق (٦٠ سم) وإضافة سماد المزرعة بمعدل (٢٠م٣/ف) بينما كان أعلى محصول من الحبوب للذرة الرفيعة عند إستخدام محراث تحت سطح التربة مع إضافة سماد المزرعة بمعدل (١٠م٣/ف) ومخلوطا بالسماد الحيوى.