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Effect of Chisel & Rotary Cultivator and Organic Manure Application on Improving the Properties of Calcareous Soil

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A FIELD experiment was carried out at Ras Sudr Experimental Station, South Sinai to study the effect of chisel ploughing, rotary cultivator and farmyard manure application on improving the properties of calcareous soil and the productivity of sorghum plants grown under irrigation with highly saline water. The experiment was carried out in a split plot design with six treatments of tillage methods which were the main treatments (no-tillage, rotary cultivator, chisel ploughing 10 cm, chisel ploughing 20 cm, chisel (10cm) + rotary cultivator and chisel (20cm) + rotary cultivator). The sub treatments were farmyard manure (control, FYM_1 at rate of 10 ton/fed and FYM_2 at rate of 20 ton/fed.

The obtained results revealed that tillage system or farmyard manure treatments caused a significant decrease in soil bulk density, pH, and EC. The rate of decrease differed with the used tillage system and farmyard manure. The best treatment was chisel 20cm + rotary cultivator treatment and FYM_2 (20 ton/fed)). The rate of decrement depended upon tillage system and the application of farmyard manure. On the other hand, organic matter content and the concentration of macronutrients (N, K and P) were increased significantly with increasing the application rate of farmyard manure. While data clearly appeared that no-tillage treatment resulted in higher accumulation of organic matter content than the plowed soil. The combined effect of tillage system and farmyard manure decreased the soil organic matter content. The highest value of organic matter was recorded for the combined treatment of no-tillage treatment with FYM_2 treatment.

Difference in tillage system or the application rate of farmyard manure led to significant increase in the yield of sorghum and N, K and P content in plants. Under the different studied tillage systems, incorporating farmyard manure increased sorghum yield. The best treatment which increase the yield was the application of 20 ton/fed. (FYM_2) under chisel 20cm + rotary cultivator treatments followed by the treatment of 10 ton/fed (FYM_1) with the same treatments of tillage.

Different of tillage systems emphasized the role of applied organic manure on improving physical and chemical soil properties and consequently, increase the concentration of (N, K and P) in the calcareous soil.

Keywords: Calcareous soil, Tillage Systems, Organic manure, Sorghum Plants, Bulk Density, Organic matter, macronutrients (NKP)

The sustainable agriculture and development in the arid and semi-arid areas lead to use modern techniques which directly affected the different agricultural activities, starting from soil tillage under a completely system called "completely soil protective tillage system"

Conservation tillage can improve soil properties and soil quality such as improving organic matter content, soil aggregation and lack of generation (Teodor, 2005), however, crop response to conservation tillage can be widely variable. Griffith *et al.* (1992) showed an increase in organic matter with no-tillage continuous corn after seven years in two soil types. The increase in organic matter was largest near the surface while decreased with increasing the depth. So, choosing a tillage system depends on local soils, climate condition and rotation. Untilled soils usually have higher bulk densities (less pore space) than tilled ones. With continued use conservation tillage, changes occur in the soil, which may improve root growth in the soil. As organic matter increases near the surface, aggregation and air movement improves (Wood & Edwards, 1992).

Harmati (2003) illustrated that the changes in soil water regime and moisture dynamics resulted by regular tillage to a depth of 18-20 cm showed a gradual changes, and could be significant improvement with application of gypsum.

By changing the soil tillage system from a ploughing system to a ploughless system with shallow cultivation or direct drilling, nearly all physical, chemical and biological properties of the soil may be affected. El-Maghraby (2001) and Ali *et al.* (2004) reported that tillage leads to improve soil chemical properties such as EC, pH, and N, P and K concentration. Also, Rasmussen (1999) reported that moisture content and organic matter of soil increased in top soil under no-tillage system (ploughless tillage). Carter (1996) showed that the both soil organic matter content and quality in the tillage profile were influenced by the type of primary tillage, due to differences in placement and incorporation of plant residues between mould board and chisel ploughing .

Sustaining calcareous soil productivity depends on maintaining favorable properties of biological, soil physical and nutritional status that enhance plant growth. In this respect, the use of optimum tillage in combination with soil conditioners as farmyard manure, town refuse, poudrette, crop residue.... etc could be utilized for this purpose (El-Maghraby , 2001 and Ali *et al.*, 2004) . On the other hand, application of soil conditioners into the production system may be one of the best ways to ensure sustained soil productivity in the semi-arid regions (Unger, 1984 and El-Maghraby, 2001).

Alvarez *et al.* (1995) indicated that organic matter is a major which is influenced by tillage. In the no-tillage and chisel tillage systems, crop deribs accumulated within the top 5 cm of soil, especially in the no-tillage system. Consequently, organic carbon was 42-50% higher in the no-tillage soil than in the soil from the plow and chisel tillage systems. Lopez & Pardo (2001) showed that the values of the total soil organic carbon storage after eleven years stored in the no-tillage was 1.1 Mg ha^{-1} greater than that in the conventional tillage plots.

Long-term no-tillage or reduced tillage systems have shown to increase soil organic matter content of the soil surface layer as a result of various interacting factors, such as increase residue return, less mixing and soil disturbance, higher soil moisture content, reduced surface soil temperature, proliferation of root growth and biological activity, and decreased risks of soil erosion (Pankhurst *et al.*, 2002 and Blevins & Frie , 1993).

Therefore, the aim of the present investigation is to study the role of tillage systems (no-tillage, chisel tillage and rotary cultivator) either individually or combination and the addition of organic manure on improving the properties of calcareous soil and the productivity of sorghum plants grown under irrigation with highly saline water.

Material and Methods

A field experiment was carried out at Ras Sudr Experimental Station, South Sinai, to study the effect of chisel plowing and rotary cultivator on the efficiency of farmyard manure application in improvement the both calcareous soil properties and the yield of sorghum plant irrigated with highly saline water (4000) ppm. The experimental soil is highly calcareous (53.8 % $CaCO_3$), highly saline (EC of 12.6 dSm^{-1}) and sandy loam in texture. The dominant cations and anions were sodium and chloride, respectively. The experiment was carried out in a split plot design with four replicates and six treatments of tillage method which were the main treatments. The tillage treatments are described as follow:

1)-no-tillage, 2)- rotary cultivator (rot. cult.): reducing soil tillage to depth of 5-10cm . 3)- Chisel plowing 10 cm ($chisel_1$): soil tillage to maximum depth of 10 cm. 4)- chisel plowing 20 cm ($chisel_2$): soil tillage to maximum depth of 20 cm. 5)- chisel (10cm) + rotary cultivator (denoted as $chisel_1$ + rot. cult). 6)- chisel (20cm) + rotary cultivator (denoted as $chisel_2$ + rot. cult). Rotary cultivator worked on breaking down the upper layer of soil to depth of 5-10 cm. The sub treatments were farmyard manure as follow: control, without applied farmyard manure, farmyard manure at the rate of 10 ton/fed (FYM_1) and farmyard manure at the rate of 20 ton/fed (FYM_2). The organic manure mixed with the upper layer of soil in every plot during tillage practices, the area of each plot was 3x3.5m (1/400 fed). Table 1 represents the analysis of farmyard manure.

TABLE 1. Some chemical properties of the used farmyard manure.

Moisture	OM	Total C	Total N	C/N ratio	Total						
					P	K	Fe	Mn	Zn	Cd	Pb
%					%		ppm				
45.00	15.46	8.97	0.59	15.2:1	0.18	1.14	5842	638	86	0.8	8

Sorghum (*Sorghum bicolor* L. Monech) was planted at June, 2006. All plots were fertilized with super phosphate (15.5 % P_2O_5) at the rate of 200 kg. during soil preparating, ammonium nitrate (33.5% N) at the rate of 150 kg./fed in three equal does (the first was at sowing, the second was at thinning while the third was applied two weeks after tinning) and potassium sulphate (48% K_2O) at the rate of 48 kg/fed was applied after thinning.

Sorghum plants were harvested at the end of August. All plants were harvested from each plot to determine the fresh and dry matter yield and statistically analyzed (Snedecor & Cochran, 1967). Plant samples were ground and wet ashed to determine N, P, K, Fe, Mn, and Zn contents (Chapman & Pratt, 1961 and Cottnie, 1980). After harvesting, soil samples from experimental plots (20cm) were collected for the determination of EC, pH, total nitrogen, exchangeable K, available P using the methods described by Page *et al.* (1982). Bulk density (BD) was determined using the core method as described by Black (1983).

Results and Discussion

Effect on treatments on soil properties

Soil bulk density

Soil bulk density is probably the most frequently measured soil quality parameter in tillage experiments (Cannell & Hawes, 1994). Fig. 1a and 1b show the influence of tillage systems and soil organic manure treatments on soil bulk density. It is clear that all tillage systems decreased significantly the soil bulk density. The rate of decrease is differed from tillage system to another. The lowest values were associated with $chisel_2$ + rot.cult treatment followed by $chisel_1$ + rot.cult treatment. The rate of decrement blew no-tillage reaches 9.46 and 6.41 % in the same treatments after harvesting, respectively. These results were in agreement with those reported by Rasmussen (1999) and Van Muysen & Govers (2002). Regarding the effect of farmyard manure, similar trend was obtained, where the values of bulk density decreased significantly with increasing application of farmyard manure. The rates of decrease are depended on the rate of the applied farmyard manure, where they amount to 17.20 and 12.69% in FYM_2 treatment over the control and FYM_1 treatments, respectively. Similar

results were obtained by Abou Yuossef *et al.* (2007) and Antwerpen *et al.* (2000), who reported that soil bulk density was reduced by increasing soil organic manure.

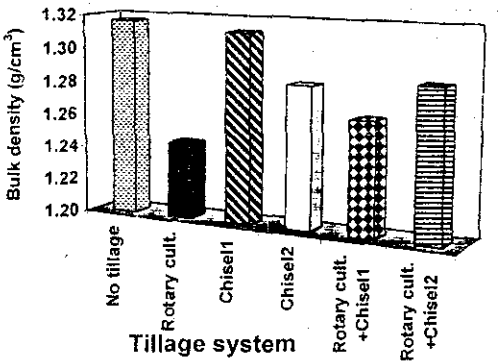

Fig.1a. Effect of tillage systems on bulk density of soil .

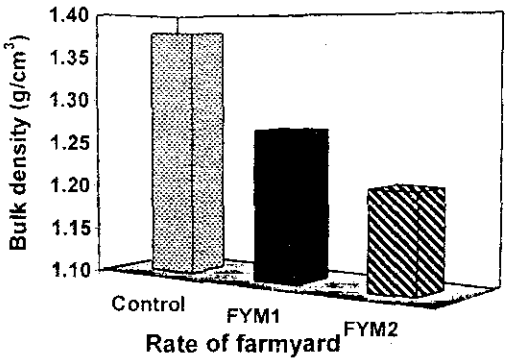

Fig.1b. Effect of farmyard manure on bulk density of soil .

The interaction effect of tillage systems and farmyard manure treatments on soil bulk density is shown in Table 2. The application of farmyard manure supports to tilled calcareous soil led to significant decrease in soil bulk density. Where the combined treatment of ($chisel_2$ + rot.cult. with FYM_2) was the effective treatment for decreasing soil bulk density. The rate of decrement below the no-tillage + control reaches 19.58 % for $chisel_2$ + rot.cult. under FYM_2 treatment. Generally, tillage system emphasized the role of organic manure on decreasing soil bulk density.

TABLE 2. Effect of the interaction of tillage systems and farmyard manure treatments on some physical and chemical soil properties.

Treatments	No tillage	Rotary cult.	$Chisel_1$	$Chisel_2$	$Chisel_1$ + Rotary cult.	$Chisel_2$ + Rotary cult.
	Bulk density (g/cm^3)					
Control	1.43	1.37	1.42	1.41	1.34	1.30
FYM_1	1.31	1.19	1.27	1.24	1.31	1.29
FYM_2	1.21	1.18	1.25	1.20	1.15	1.28
	EC (dS/m)					
Control	17.80	14.15	13.95	13.69	13.43	13.59
FYM_1	11.88	13.05	12.81	12.40	12.14	12.14
FYM_2	11.21	11.88	12.40	12.09	11.11	10.45
	pH					
Control	7.77	7.71	7.65	7.62	7.58	7.62
FYM_1	7.65	7.57	7.59	7.57	7.57	7.53
FYM_2	7.54	7.58	7.58	7.55	7.52	7.42
	OM content (%)					
Control	0.61	0.90	0.91	0.83	0.66	0.66
FYM_1	1.70	1.50	1.46	1.42	1.33	1.08
FYM_2	1.99	1.84	1.84	1.71	1.71	1.25

Factor	Statistical analysis LSD at 5% level			
	Bulk	EC	pH	OM
FYM	0.02	0.89	0.001	0.03
Tillage	0.03	1.72	0.002	0.03
FYM x Tillage	0.06	2.19	0.007	0.06

Soil EC and pH

Data in Fig. 2a&b and 3a&b clearly appear that the values soil EC and pH were remarkably affected by tillage systems and / or application of farmyard manure. With respect to the effect of tillage systems, data clearly appear that soil pH and EC values decreased significantly with all the used tillage systems. The rate of decrease differs from tillage system to another. The effective treatment is $chisel_2$ + rot.cult. treatment. This may be rendered to the favorable effect of tillage on some soil physical and chemical properties (El-Maghraby, 2001). Concerning farmyard manure, data show that the EC values decreased significantly below the control in the soil samples taken after harvesting by 14.07 and 20.17 % for FYM_1 and FYM_2 treatments respectively. The reduction in EC values resulting from FYM may be due to improve the physical properties of calcareous soil as structure permeability and infiltration rate. Consequently, more salts can be leached out from the upper depth of the soil and moves downward with the movement of water (El - Maghraby, 2001).

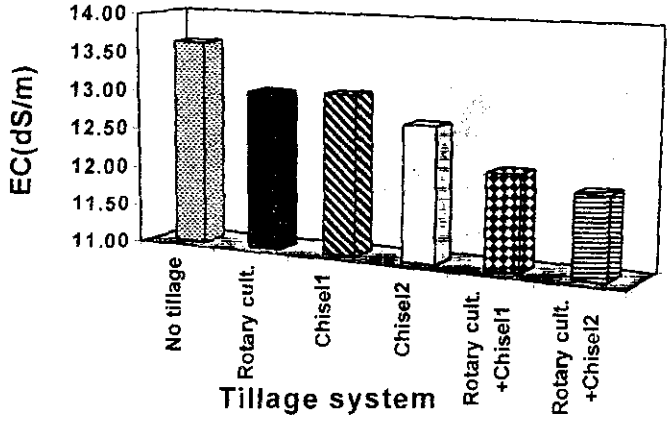

Fig. 2a. Effect of tillage systems on electrical conductivity of soil .

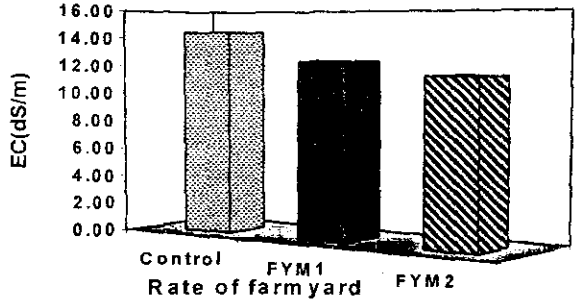

Fig. 2b. Effect of farmyard manure on electrical conductivity of soil .

From the aforementioned results, it could be deduced that the interaction effects between tillage systems and farmyard manure application as shown in Table 2 enlarge the decrease in soil pH and EC values. The tillage systems emphasize on decomposition of organic manure and formation organic and inorganic acids which work to reduce soil pH and EC values. Soil pH and EC values decreased with applying organic manure at any treatment of tillage system. Generally, the effective combined treatment to improve pH and EC of soil is FYM_2 with $chisel_2$ + rotary cult. followed by FYM_2 with $chisel_1$ + rotary cult. treatment. Such results stand in harmony with those reported by Ali *et al.* (2004) and El-Maghraby (2001).

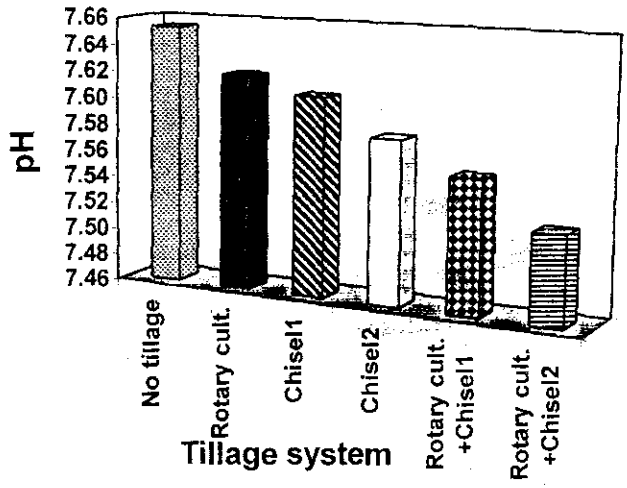

Fig. 3a. Effect of tillage systems on soil pH .

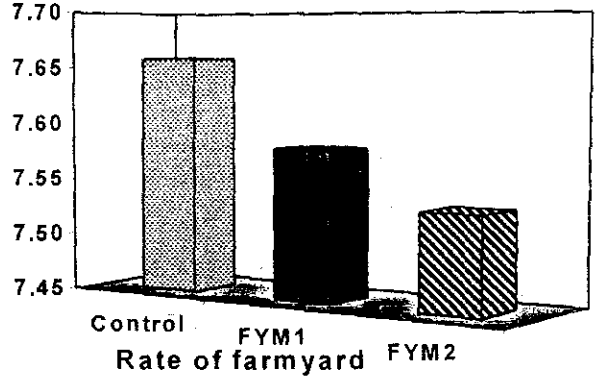

Fig. 3b. Effect of farmyard manure on soil pH .

Soil organic matter content

Regarding the effect of tillage system treatments, data in Fig. 4a clearly appeared that no-tillage, rot. cult. and chisel treatments resulted in an accumulation of organic matter in the soil. Under no-till, higher content of O.M is found compared with plowed soil. The organic matter contents were 1.39, 2.09, 7.91, 13.95and 30.47 % in no-tillage treatment than in the other treatments rot. cult., $chisel_1$, $chisel_2$, $chisel_1$ + rot. cult. and $chisel_2$ + rot. cult., respectively, where organic matter content decreased significantly under different soil tillage systems. Similar results were achieved by Alvarez *et al.* (1995) and Carter (1996) who reported that reduced tillage can enhance the organic matter content soil surface (0-15cm) in comparison to conventional tillage.

On the other hand, data in Fig. 4b indicated that the application of farmyard manure increase of the soil content of organic matter. in the soil. The highest value of O.M. content is associated with the FYM_2 treatment where the percentages of increase reached 126.26 and 85.78 % over the control and FYM_1 treatments, respectively. The positive effect of increasing application of FYM on soil organic matter content may be due to the higher initial content of organic matter in the applied manure (Table 1).

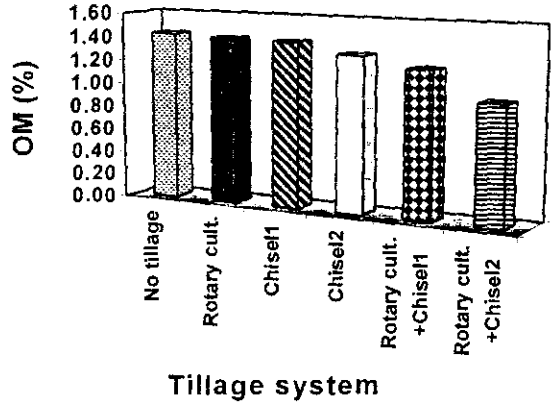

Fig. 4a. Effect of tillage systems on soil organic matter content.

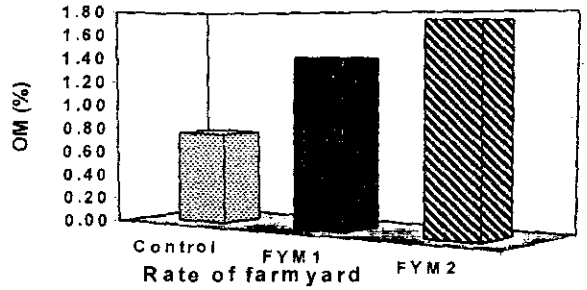

Fig. 4b. Effect of farmyard manure on soil organic matter content.

From the above mentioned results, it could be deduced that the combined effect of tillage systems and soil manuring decreased soil organic matter content. The highest value of organic matter is recorded with the combined treatment of no-tillage and the higher rate of farmyard manure (20 ton/fed). While the lowest value is observed in the combined treatments of $chisel_2$ + rot. cult. with FYM_1 (10 ton/fed). This may be referred to the favorable effect of tillage on enhancing some soil physical and chemical properties which increase the decomposition of organic manure (El-Maghraby, 2001).

Soil macronutrients (N,K and P)

Data in Fig. 5 and Table 3 indicated that total N as well as the exchangeable of K and availability of P are affected favorably by the tilled systems and application of farmyard manure. Treatment of $chisel_2$ + rot. cult. recorded the effective treatment followed by $chisel_1$ + rot. cult. The magnitudes over no-tillage are 34.52, 84.37 and 43.58 % due to $chisel_2$ + rot. cult. for N, K, and P, respectively. Similar results were achieved by El-Maghraby (2001) and Ali *et al.* (2004).

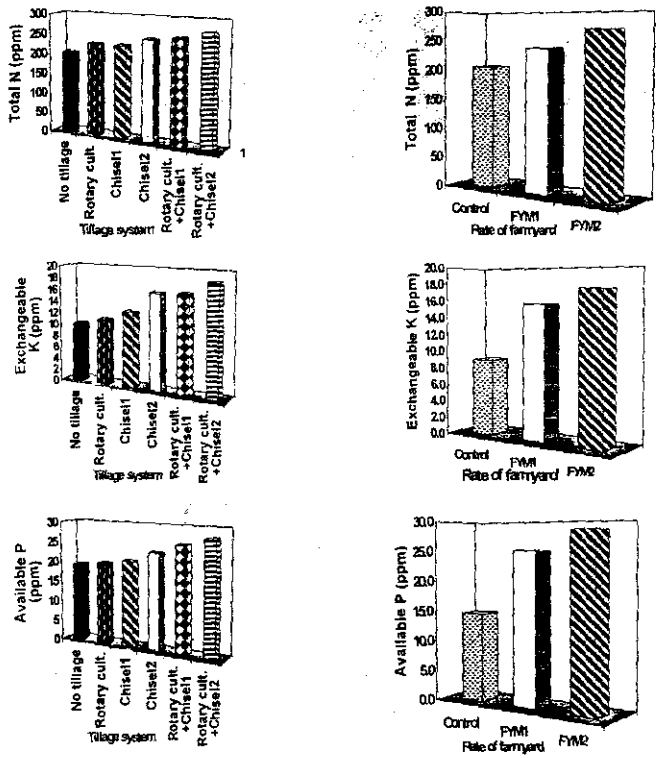

Fig. 5. Effect of tillage systems and farmyard manure treatments on total N, exchangeable K and available P in soil.

The addition of FYM_1 and FYM_2 increased significantly soil nutrients availability, however, the rate of increase is differed from one element to another. The highest values of such nutrients are found, in most cases, in FYM_2 treatment. The increase over the control due to FYM2 reached 31.36, 95.56 and 95.07 % for N, K and P, respectively. This may be referred to the higher initial content of such nutrients in the used farmyard manure (Table 1), besides it's effect on lowering soil pH values through the biodegradation of such materials by microorganisms (Dahdoh and El Hassanin, 1994).

From the aforementioned results, it could be concluded that the interaction effects between tillage system and added organic manure as shown in Table 3 enlarge the increase in total nitrogen, exchangeable of K and availability of P in the soil. This increase is significant for all elements. The best combined treatment to improve N, P and K status is $chisel_2$ + rot. cult. with FYM_2 treatment followed by $chisel_1$ + rot. cult. with FYM_1 treatment. This means that different tillage systems emphasize the role of applied soil conditioners on improving physical and chemical soil properties and consequently increase total N, availability of K and P values in the soil.

TABLE 3. Effect of the interaction of tillage systems and farmyard manure treatments on total N, exchangeable K and available P in soil.

Treatments	No tillage	Rotary cult.	$Chisel_1$	$Chisel_2$	$Chisel_1$ + Rotary cult.	$Chisel_2$ + Rotary cult.
	N (ppm)					
Control	188.07	188.07	195.30	227.33	209.77	230.43
FYM_1	202.53	237.67	237.00	240.00	253.00	268.67
FYM_2	217.00	258.33	253.17	274.87	305.87	318.27
	K (ppm)					
Control	6.53	7.87	9.27	10.28	9.99	10.23
FYM_1	10.73	11.76	13.90	18.60	18.90	20.98
FYM_2	12.92	13.64	15.09	19.56	20.31	24.44
	P (ppm)					
Control	11.18	12.80	13.32	16.53	16.98	17.24
FYM_1	22.21	22.69	23.25	24.30	28.48	30.83
FYM_2	24.30	24.56	26.25	29.79	32.14	34.75

Factor	Statistical analysis LSD at 5% level		
	N	K	P
FYM	3.69	0.53	0.78
Tillage	3.96	0.81	0.77
FYM x Tillage	9.03	1.28	1.92

Effect of treatments on sorghum yield and its nutrients content

Different its tillage systems or application rates of farmyard manure leads to significant increase in the yield of sorghum (Fig. 6a and b) , this may be due to the beneficial effects of such treatments on the physicochemical properties of soil which favorably affect plant growth, soil structure, available water and soil salinity.

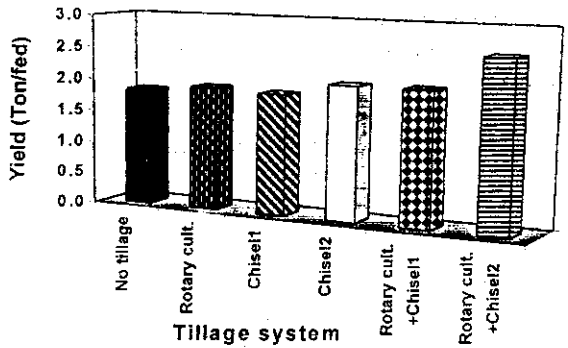

Fig. 6a. Effect of tillage systems on sorghum yield.

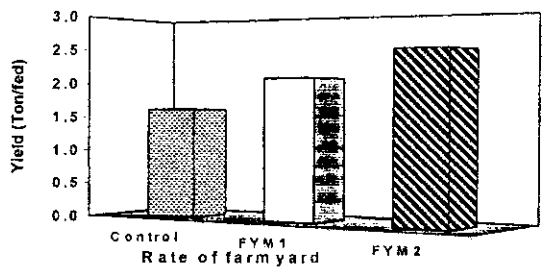

Fig. 6a. Effect of farm yard manure on sorghum yield.

Under different tillage systems, incorporating farmyard manure increases sorghum yield. Data in Table 4 showed that the application of farmyard manure is more effective under the different tillage methods. The best treatment to increase the yield is the application of 20 ton/fed. (FYM_2) under chisel + rotary cult. followed by the treatment of 10 ton/fed (FYM_1) with the same treatment of tillage.

TABLE 4. Effect of the interaction of tillage systems and farmyard manure treatments on the yield of sorghum.

Treatments	No tillage	Rotary cult.	$Chisel_1$	$Chisel_2$	$Chisel_1$ + Rotary cult.	$Chisel_2$ + Rotary cult.
	Yield (Ton/fed.)					
Control	1.44	1.51	1.38	1.73	1.63	2.01
FYM_1	1.88	2.06	1.57	2.08	2.10	2.77
FYM_2	2.16	2.17	2.67	2.39	2.50	3.02
Factor	**Statistical analysis**					
	LSD at 5% level					
FYM	0.05					
Tillage	0.08					
FYM x Tillage	0.12					

Regarding the effect of the experimental treatments on the N, K and P contents in sorghum plant, data in Fig. 7 indicated that tillage treatments increase the N, K and P contents in sorghum plant with different magnitudes. Where $chisel_2$ + rotary cult. treatment recorded the higher magnitude than the other tillage treatments. Also, N, K, and P contents are affected particularly by the rate of the applied organic manure. Increasing the application rate of farmyard manure increases significantly N, K and P contents in the same figure. The rate of increase differed from one element to another, however the highest values of elements were found in the treatment of higher application of manure, where the highest rates of increment over the control reached by 18.71, 37.75 and 27.21 % for N, K and P contents under FYM_2, respectively.

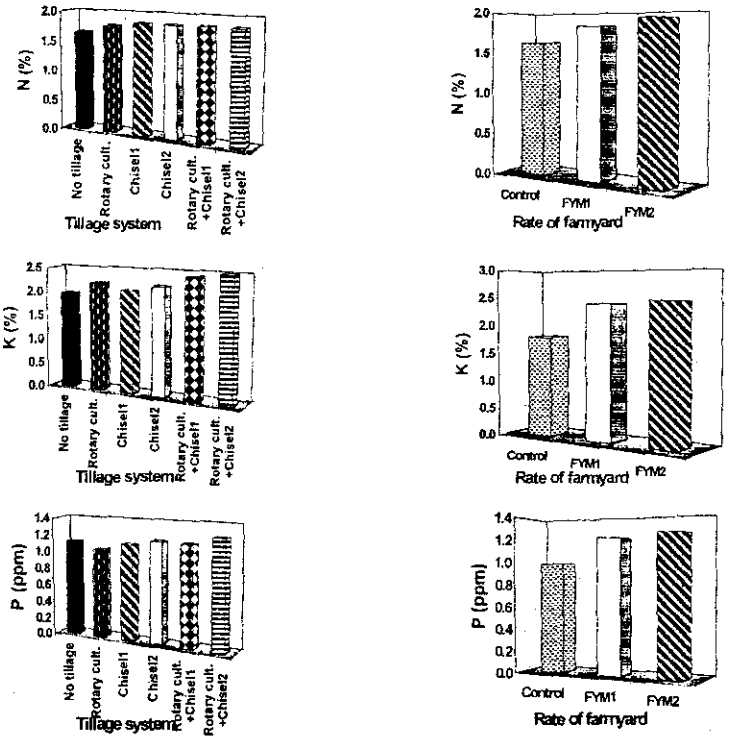

Fig.7. Effect of tillage systems and farmyard manure treatments on the concentration of macronutrients (N, K and P) of sorghum plants.

On the other hand, the application of farmyard manure led to increase in content of N, K and P in sorghum plant under all tillage treatments (Table 5). The positive effect of the studied treatments on increasing the nutrients is a true reflection- as previously mentioned- by improving some physical and chemical properties of the calcareous soil under investigation (Table 3).

TABLE 5. Effect of the interaction of tillage systems and farmyard manure treatments on micronutrients (N, K and P) of sorghum plants.

Treatments	No tillage	Rotary cult.	$Chisel_1$	$Chisel_2$	$Chisel_1$ + Rotary cult.	$Chisel_2$ + Rotary cult.
	N (%)					
Control	1.53	1.68	1.59	1.63	1.67	1.66
FYM_1	1.63	1.78	1.94	1.90	1.91	1.87
FYM_2	1.79	1.88	2.00	1.98	1.94	2.01
	K (%)					
Control	1.39	1.96	1.45	1.75	2.02	2.20
FYM_1	2.27	2.29	2.37	2.39	2.56	2.57
FYM_2	2.22	2.38	2.41	2.42	2.69	2.72
	P (ppm)					
Control	0.86	0.91	0.99	1.01	1.06	1.08
FYM_1	1.23	1.08	1.16	1.21	1.22	1.34
FYM_2	1.27	1.13	1.21	1.31	1.23	1.35

Factor	Statistical analysis		
	LSD at 5% level		
	N	K	P
FYM	0.02	0.04	0.02
Tillage	0.04	0.05	0.02
FYM x Tillage	0.04	0.11	0.04

Conclusions

The influence of soil tillage systems on improving soil properties such as bulk density, electrical conductivity and soil pH appear to be significant. Different tillage systems emphasized the role of applied organic manure on improving physical and chemical soil properties and consequently increase nutrients (N,K and P) in the calcareous soil. Using the chisel plow followed by the rotary cultivator led to more efficient calcareous soil manipulation and increases the sorghum yield as compared with the no-tillage.

References

Abou Yuossef, M. F., Ali, M. H. and El-Kot, A. S. (2007) Evaluation of sugar cane filter mud as a soil conditioner under irrigation with saline water. *Annals. of Agric. Sci. Moshtohor* **45**(1): 469-487.

Ali, M.H., Ali, A.A., Kilany, M.A. and Alaga, M.D.(2004) Interaction effect between tillage depth and soil conditioners on calcareous soil productivity under irrigation with saline water. *Egypt. J. Appl. Sci.* **19**(3): 399-414.

Alvarez R., Diaz, R.A., Barbero, N., Santanatoglia, O.J. and Blotta, L. (1995) Soil organic carbon, microbial biomass and CO_2–C production from three Tillage systems. *Soil and tillage Research* **33** : 17- 28.

Antwerpen, R.V., Meyer, J.H. and Meyer, E. (2000) Soil compaction in the South African sugar industry – a review. *Proc. S. Afr. Sugar Technol. Ass.* **74**: 101-108.

Black, C. A.(1983) *"Methods of Soil Analysis"*, Part 182, Soil Sci. Soc. And Am. Jne. Pub., Madison, Wisc., U.S.A.

Blevins, R.L. and Frie, W.W.(1993) Conservation tillage: An ecological approach to soil management. *Advances in Agronomy* **51**:33-78.

Cannell, R. Q. and Hawes, J. (1994) Trends in tillage practices in relation to sustainable crop production with special reference to temperate climates. *Soil Tillage Res.* **30**: 245-287.

Carter M.R. (1996) Characterization of soil physical properties and organic matter under long-term primary tillage in a humid climate. *Soil and Tillage* **38**: 251-263.

Chapman, H. D. and Pratt, P. F. (1961) *"Methods of Analysis for Soils, Plants and Water"*, pp.150-152, Univ. California. Div., Agric. Sci., California, U.S.A.,

Cottenie, A. (1980) Soil and plant testing as a basis of fertilizer recommendations. FAO Soils Bull., 38/2, Rome.

Dahdoh, S.A. and El-Hassanin, A.S. (1994) Combined effects of organic source, irrigation water salinity and moisture level on the growth and mineral composition of barley grown on calcareous soil. *Desert Inst. Bull.* **44** (2): 247-264.

El-Maghraby, S.E. (2001) Influence of tillage depth and organic residue placement on calcareous soil productivity under irrigation frequencies with high saline water. *Egypt. J. Appl. Sci.* **17**(2): 331-349.

Griffith, D.R., Moncrief, J. F., Eckert, D.J., Swan, J.B. and Breitbach, D.D. (1992) Crop response to tillage systems. pp. 25-33. In Conservation tillage systems and management: crop residue management with no-till, ridge-till, mulch-till. 1st ed., MWPS-45, Mid West Plan Service, Ames, Iowa.

Harmati, I. (2003) Changes in the major characteristics of a calcareous solonchak soil after amelioration with gypsum in a 33-year long-term experiment. *Agrokemia es Talajtan* **52** (1-2): 21-34.

Lopez, F.C. and Pardo, M.T. (2001). The impact of tillage systems and crop rotations on carbon sequestration in a Calcic Luvisol of central Spain 1 World Congress on conservation Agriculture Madrid, October,2001 pp. 1-5.

Page, A. L., Miller, R. H. and Keeney, D.R. (1982) "*Methods of Soil Analysis*", Part 2, Soc. of Agron., Madison.,Wis.,USDA.

Pankhrust, C.E., Krikby, C.A., Hawke, B.J. and Harch, B.D. (2002) Impact of a change in tillage and crop residue management practice on soil chemical and microbiological properties in an cereal-producing red duplex soil in NSW. *Australia Biology and Fertility of Soils* **35**: 189-196.

Rasmussen K.J. (1999) Impact of ploughless soil tillage on yield and soil quality: A Scandinavian review. *Soil & Tillage Research* **53**: 3-14 .

Snedecor, G. W. and Cochran, W.G. (1967) *"Statistical Methods"* , 6th ed., Iowa State Univ., Press Amr, Iowa, U.S.A.

Teodor RUSU (2005) The influence of minimum tillage systems upon the soil properties, yield and energy efficiency in some arable crops. *J. Central European Agriculture* **6** (3): 287-294.

Unger, P. W.(1984) Tillage and residue effects on wheat, sorghum and sunflower grown in rotation. *Soil Sci. Soc. Am. J.* **48**: 885-891.

Van Muysen, W. and Govers, G. (2002) Soil displacement and tillage erosion during secondary tillage operations: The case of rotary harrow and seeding equipment. *Soil and Tillage* **65**: 185-191.

Wood, C. W. and Edwards, J. H. (1992) Agroecosystem management effects on soil carbon and nitrogen. *Agric. Ecosystems Environ.* **39**: 123-128.

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تأثير المحراث الحفار والعزاقة الدورانية وإضافة المحسنات العضوية فى تحسين خواص الأراضي الجيرية

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أقيمت تجربة في محطة بحوث راس سدر جنوب سيناء لدراسة تأثير المحراث الحفار والعزاقة الدورانية على كفاءة استخدام سماد المزرعة في تحسين خواص التربة وإنتاجية نبات السورجم النامي تحت ظروف الري بمياه عالية الملوحة. وكان تصميم التجربة في قطع منشقة في ستة معاملات من الخدمة (بدون خدمة – العزاقة الدورانية – حراثة حفار (١٠سم) وحراثة حفار (٢٠سم) – حراثة حفار ١٠ سم مع العزاقة الدورانية – حراثة حفار ٢٠ سم مع العزاقة الدورانية). بينما كانت معاملات سماد المزرعة ثلاث معاملات وهى بدون تسميد – ١٠م^{٣}/للفدان – ٢٠م^{٣}/ فدان.

وقد أوضحت النتائج المتحصل عليها ما يلي:
أدت كل من معاملات سماد المزرعة ونظم الحرث إلى نقص معنوي في قيم الكثافة الظاهرية للتربة ودرجة التوصيل الكهربي ودرجة حموضة التربة وقد اختلف معدل النقص تبعا للمعاملة سواء كانت معاملات سماد المزرعة أو نظم الحرث. وقد سجلت المعاملة حراثة حفار ٢٠سم مع العزاقة الدورانية أحسن المعاملات بالنسبة لنظم الحرث والمعاملة ٢٠م^{٣}/فدان لسماد المزرعة أحسن المعاملات بالنسبة للتسميد العضوي.

زاد معدل محتوى الارض من المادة العضوية والعناصر الكبرى (النيتروجين والبوتاسيوم والفوسفور) زيادة معنوية مع زيادة معدلات التسميد العضوي. بينما أظهرت النتائج أن عدم الخدمة أدى إلى تراكم المادة العضوية أكثر من التربة المخدومة.وقد أدت المعاملة المشتركة بين نظم الخدمة والتسميد العضوي إلى نقص محتوى التربة من المادة العضوية وكانت أعلى القيم هى المعاملة بدون خدمة مع اضافة ٢٠م^{٣} سماد عضوى للفدان.

أدت كل معاملات الخدمة والتسميد العضوي إلى زيادة معنوية في إنتاجية نبات السورجم وكذلك محتوى النبات من عناصر النيتروجين والبوتاسيوم والفوسفور. وأدى اندماج معاملات الخدمة مع التسميد العضوي إلى زيادة كفاءة محسن التربة (السماد العضوى) في زيادة معنوية لإنتاج نبات السورجم ومحتواه من العناصر وكانت أفضل النتائج هي معاملة الحراثة حفار مع العزاقة في وجود تسميد عضوي بمعدل ٢٠م^{٣}/ فدان.

وأدت نظم الخدمة المختلفة الى زيادة كفاءة السماد العضوى وزيادة دوره فى تحسين بعض الخواص الطبيعية والكيميائية للاراضى الجيرية وبالتالي زيادة محتواها من النيتروجين والبوتاسيوم والفوسفور حيث كانت أفضل المعاملات هي استخدام حراثة حفار تبعها العزاقة الدورانية مقارنة بنظام عدم الخدمة الذى يقلل من نمو الجذور والنبات.