Influence Of Berseem, Wheat And Maize Cropping And Three Soil Amendments On Soil Physical Properties

El-Sayed, S. A. M.
Soil and Water Science Department, Faculty of Agriculture, Al-Azhar University, in Assiut.

ABSTRACT

In this study the effects of crop species, amendments, and water quality(SAR) on alteration of selected physical properties of a silty clay soil were compared. Crops grown in lysimeters and compared with a noncropped control were Berseem (clover) (*Trifalium alexandrinum*) cv. Giza 6, wheat (*Triticum aestivum* L.) cv. Sakha 8, and maize (*Zea mays* L. in the single cross hybride variety Giza 10). Soil amendments included a check, gypsum ($CaSO_4 . 2 H_2O$), phosphogypsum [$CaSO_4 . 2 H_2O$ with < 1% (W/W) P], and $Mg Cl_2$. Lysimeters were irrigated with water having either a total dissolved soils (TDS) concentration of $0.75 gL^{-1}$ and a sodium adsorption ratio (SAR) of 1.15(WQ_1) or TDS of 1.65 g L^{-1} and SAR of 7.01(WQ_2) until three wheat crops were successively grown. The presence of a crop caused a significant increase in bulk density in all lysimeters and a significant decrease in total porosity, compared with the uncropped control treatments. Wheat caused the greatest decrease in total porosity, followed by Berseem (clover), then maize. Total porosity decreased nearly 0.1 m^3m^{-3}. The result showed a significant increase in number of micropores (< 0.149×10^{-2} mm radius) and a disproportionately greater decrease in number of macropores (<1.49×10^{-2} mm radius). Soil water release characteristics differed among the different crop treatments. Neither amendment treatment nor irrigation water quality had a significant effects on either porosity, pore-size distribution, or bulk density. Results of this study indicate that crop selection and rotation may affect the significance of surface applied amendments used for reclamation and leaching of Na^+ in salt affected soils.

INTRODUCTION

Soil salinization is occurring on a global scale. Throughout the northern great plains, saline seep development has increased in dryland agricultural areas, while some irrigated soils have solinized. Landowners continuously seek methods to reclaim salt affected soils. Proposed methods include tile drainage and leaching of excess salts, application of amendments to displace exchangeable Na^+, use of crop rotations, and management of recharge areas. Various crops have been reported to improve permeability and promote the removal of Na^+ and salt from the soil (Robbins, 1986 and Daoud, 2005). This approach may be the only efficient and economically feasible soil reclamation strategy for dryland farmers or those with limited available water resources.

Cropping can play a significant role in reclamation of saline and alkali soils. Besides crop varieties, proper crop rotations are essential for achieving continued improvement of saline and alkali soils (Yadav, 1975 and El-Sayed, 1997a). Saraswat *et al.* (1972) and El-Ashtar (2005) suggested that alternating crops such as barley and rice will accelerate the reclamation process. Ayers *et al.* (1951) and El-Sebsy (2004) suggested that barley, can be one of crops planted on land that is being reclaimed from excess salts or alkali.

Beneficial effects of plants in reclamation are not well understood but appear to be related to : i) the physical action of plant roots, ii) the addition of organic matter, iii) the increase in dissolution of $CaCO_3$, and iv) crop uptake of salts (Hoffman, 1986 and Saad and Sinha, 2005).

Limited work has been conducted on the influence of root activity on the physical structure of soil or the subsequent effect on water movement. Gibbs and Reid (1988) and Mohamed and El-Sayed (2003) reported that crop species can cause significant alterations in soil structure. Several works found improvements in structure under ley and pasture grasses (Skidmore *et al.*, 1975; El-Sayed *et al.*, 2001 and Abdel-Mawly and El-Sayed, 1999a and c). Deterioration of structure has been reported to occur under arable crops such as wheat (*Triticam aestivum* L.), barley (Low, 1972), Soybean [*Glycine max* (L.) Merr.], and corn (*Zea mays* L.) (Wilson and Browning, 1954; El-Sayed, 2002 and Ghaly and El-Sayed, 1997b).

Ojeniyi (1978) and El-Sayed and Abdel-Mawly (1999e) found that barley resulted in lower macroporosity, smaller aggregates, and lower mean void size relative to uncropped areas. Skidmore *et al.* (1986) and El-Sayed (1999f) found that growing sorghum produced larger pore sizes, faster water infiltration, and greater saturated hydraulic conductivity (*K*sat.) than growing wheat. These differences were attributed to differences in root or microbial activities. Reid and Goss (1981) and Ghaly and El-Sayed (1997b) postulated that differences in aggregate stability between crop species result from contrasting root patterns, especially the proportion of lateral roots, since release of organic materials occurs mainly near the root tip. Yadav (1975) and Abdel-Mawly and El-Sayed (1999b) reported that the extensive root system of paddy rice loosened the soil, making it more permeable to leaching of salts.

Sodium saturation and clay dispersion are frequently associated with salinization. Soils leached with NaCl solutions had lower K and were compacted to lower void ratios than those leached with $CaCl_2$ solutions (Waldron *et al.*, 1970 and El-Sayed, 1995a,b and c).

Most reclamation efforts focus on replacing soil adsorbed Na^+ with Ca^{++} or Mg^{++}, both of which contribute to aggregate stability and improved drainage. Many works have proposed the use of Ca^{++} or Mg^{++} rich amendments for sodic soil reclamation (Dollhopf, 1988 and Richards, 1954). Few investigations have been undertaken to define the interactive effects of cropping systems, water quality, and soil amendments on soil properties during reclamation. Works that have been completed has reported conflicting results.

The objective of this study was to determine the effect of several crop species and amendments combinations on some soil physical properties, specifically total porosity, pore size distribution, bulk density, and moisture release characteristics of an irrigated silty clay soil. Effects of irrigation water quality were also investigated.

MATERIALS AND METHODS

Preparation of lysimeters :-

Soil used in this study was silty clay collected from four areas of an irrigated Berseem(clover) field (0-25 cm depth) from Kafr El-Dawar city , Behera Governorate .

The soil was air dried, ground, and passed through a 3 mm sieve. Sieved soil was uniformly packed to a dry bulk density of 1.07 Mg m^{-3} into 15 cm diam. by 0.5 m long polyvinyl chloride lysimeters to which a bottom cover with a drainage hole was attached. A 13 mm layer of washed gravel was placed over a fine mesh nylon screen in the bottom of each column and overlaid with a 13 mm layer of washed sand before packing the soil into the columns .Selected physical and chemical characteristics of the soil were measured (Table 1). Chemical analysis were performed on water saturated paste extracts, according to procedures outlined by Page *et al.* (1982).

Table 1. The main physical and chemical of the used soil .

Property	Preexperiment value
Electrical conductivity	2.47 dS m^{-1}
Sodium adsorption ratio	5.36
Saturation water content	0.68 m^3m^{-3}
Bulk density	1.07 Mg m^{-3}
pH	8.27
Exchangeable Na^+ percentage	6.9%
Cation exchange capacity	24.7 c mol_c kg^{-1}
Alkalinity	208 mg kg^{-1}
$CaCO_3$ content	5.2×10^{-3} kg kg^{-1}

Experimental design and treatments :-

The lysimeters were arranged as a complete factorial, randomized block design, with three replicates. Main treatment included three crop species and an uncropped treatment, three soil amendments and a control, and two irrigation water quality treatments.

In order to minimize variability attributable to environmental conditions within the greenhouse,Ministry of Agric.&Land reclamation, Kafr El-Dawar city,Behera Governorate, each block of 32 lysimeters was placed on a wheeled platform, and each block was rotated and relocated within the entire design prior to each irrigation.

Each of the chemical amendments was incorporated into the top 10 cm of soil in the lysimeter. Amendment treatments included : i) gypsum at 12.9 Mg ha^{-1}, ii) phosphogypsum at 12.8 Mg ha^{-1}, iii) Mg Cl_2 at 10.5 Mg ha^{-1}, and iv) no amendment (control). Phosphogypsum, a by product of the manufacture of H_3PO_4 from phosphate rock ore, contains < 1% (W/W) P (from factory of superphosphate ,Mankabad ,Assiut Governorate ,Egypt) while having a dissolution rate 10 times greater than gypsum (Keren and Shainberg, 1981). Amendment rates were calculated from preexperiment measurements of ESP and CEC of the soil, to reduce ESP 7% throughout the length of the lysimeter. This reduction was selected with the intent of the resultant ESP being equivalent to that of the same soil previously managed under nonirrigated conditions.

Lysimeters were irrigated to field capacity prior to planting,weighed immediately following the cessation of drainage to obtain estimates of lysimeter weight at field capacity for subsequent calculations of water application volumes.

Crop treatments included : "Giza 6" Berseem (clover); "Sakha 8" wheat; and "Giza 10" maize in the single cross hybride.Seeds were planted and covered with 10 mm of soil and the lysimeters were covered with plastic sheet to promote germination. Three successive wheat crops were grown. No additional planting of Berseem(clover) or maize was done. All crops were harvested when wheat reached the soft dough stage,coinciding with each fifth irrigation, for a total of three harvests during the experiment.

Irrigation water simulating the composition of past (low Na and salt) or anticipated future (high Na and salt) .Water was applied to lysimeters approximately biweekly, for 15 irrigations. Water quality treatments were designated as WQ_1 for past and WQ_2 for future water quality simulations. Ionic speciation analysis were performed to ensure that the solutions would not be supersaturated with respect to $CaCO_3$. Water quality criteria are presented in (Table 2). Each lysimeter was individually irrigated, using a supply reservoir and a drip emitter. Different volumes of irrigation water were applied to each crop, at each irrigation, to provide a constant leaching fraction of ≈ 0.13. Lysimeters were weighed before each irrigation and average evapotranspiration was calculated for each crop to determine the amount of water necessary to achieve the desired leaching fraction.

Posttreatment soil analysis :-

Following the crop cycle, all lysimeters were sampled, using a hydraulic probe. In addition, six intact soil cores, measuring 5 cm diam. by 2.5 cm in length, were collected from the top 10 cm of each lysimeter to measure soil bulk density, water release characteristics, and pore size distribution by methods outlined by Klute (1986). Chemical analysis were performed to determine postexperimental soil saturated paste extract EC and SAR throughout the entire depth of the lysimeters.

Table 2. Ionic composition of irrigation water treatments.

Water quality treatment	Constituent											
	Ca^{2+} C mol L^{-1}	Mg^{2+} C mol L^{-1}	Na^{+} C mol L^{-1}	K^{+} C mol L^{-1}	Cl^{-} C mol L^{-1}	HCO_3 C mol L^{-1}	SO^{2-}_4 C mol L^{-1}	Total dissolved solids mg L^{-1}	Electrical conductivity dS m^{-1}	Sodium adsorption ratio	Adjusted sodium adsorption ratio	pH
WQ1 – past	0.50	0.33	0.24	0.03	0.09	0.23	0.77	747	0.97	1.15	2.50	8.3
WQ2 - future	0.50	0.40	1.49	0.02	0.55	0.38	1.46	1647	2.21	7.01	16.6	8.5

Statistical analysis :-

Statistical analysis were performed using SAS (SAS Institute, 1987). Analysis of variance for a three-way interaction of crop, amendment, and water quality was performed on the data. Because of lack of significant interactions, emphasis was placed on main-treatment effects.

RESULTS AND DISCUSSION

Effects of treatments on soil physical properties were observed after the first irrigation. Infiltration rate appeared to decrease with each successive irrigation of some treatments. Infiltration (not measured) of lysimeters planted in wheat and treated with either gypsum or no amendment appeared to decrease significantly by completion of the third irrigation. This was evidenced by prolonged ponding as the experiment continued. Although several lysimeters treated with phosphogypsum began to exhibit ponding, no ponding was observed in lysimeters planted in wheat and treated with $MgCl_2$. Water quality treatments did not appear to affect ponding (Daoud, 2005).

Large surface cracks, macropore channels, and root binding appeared to cause channeling of irrigation water through the soil and down the sides of the lysimeters planted with maize. This channeling, which did not occur in other cropped or uncropped treatments, became evident after the third irrigation (El-Sayed, 2002).

Bulk Density:-

Significant main-treatment effects on postexperimental soil bulk density are illustrated in(Fig.1). Effects of the crops on bulk density were greater than the effects of the amendments . Water quality treatments did not show a significant effect on bulk density. Presence of a crop caused the surface soil bulk density to increase significantly above the bulk density of the uncropped columns. The magnitude of the effect of the crops on increasing bulk density was ranked as follows : wheat > Berseem (clover) = maize > no crop.

The bulk density after three successive wheat cropping was 1.24 Mg m^{-3}, compared with 1.07 $Mg^{-3}m^{-3}$ for the original soil. Bulk density increased from 1.07 Mg m^{-3} prior to the experiment to only 1.09 Mg m^{-3} in the uncropped treatment. The slight increase in bulk density in the uncropped lysimeters relative to the original soil was probably due to dispersion and settling of soil particles during and following each irrigation (Mohamed and El-Sayed, 2003).

The condition of the soil at the beginning of the experiment was similar to that which might be found in the surface horizon of a recently tilled agricultural field. The soil was relatively well aggregated, uniformly dry, and loosely packed, as evidenced by the initially low bulk density of 1.07 Mg m^{-3}. Greater bulk densities are commonly found below the tillage zone under field conditions. Because of the low initial bulk density and initially high total porosity percentage, it is reasonable to assume the decrease in bulk density due to crop treatments was caused in part by settling of the soil within the lysimeters on wetting and should have occurred with all crop treatments. Because the soil physical properties differed significantly between the cropped and uncropped treatments, settling due to wetting alone was not the sole reason for these differences, although greater volumes of irrigation water were applied to the cropped treatments than to the uncropped treatments (El-Sayed and Ghaly,1996)

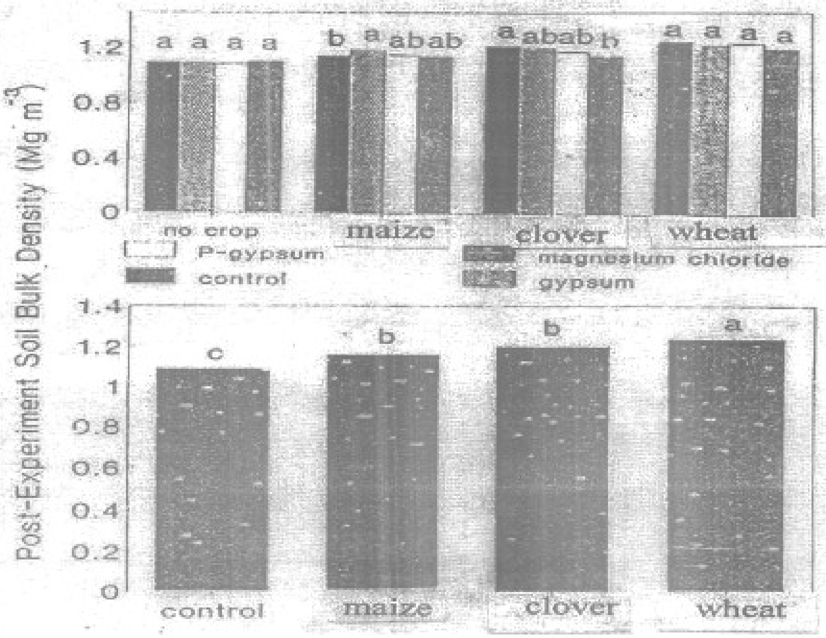

Fig. 1. Effects of crop × amendment (top) and crop (bottom) on post-experiment soil bulk density, compared with pretreatment bulk density of 1.07 Mg m^{-3}. Statistically significant differences of means indicated by Duncan grouping, α < 0.05.

Effects of amendments on bulk density varied significantly between maize and Berseem (clover) lysimeters. Addition of Mg Cl_2 resulted in significantly lower bulk density than the control treatment within the Berseem (clover) crop. Conversely, gypsum increased the bulk density of soils cropped to maize.The amendments caused no significant differences in bulk density of the uncropped or wheat-cropped lysimeters (El-Sayed, 1999f and 2005).

Numerous studies reported significant effects of gypsum in modifying soil physical and chemical properties. Calcium, provided through dissolution of gypsum, displaces Na^+ adsorbed on the soil exchange sites, thereby leading to aggregation and simultaneous leaching of Na^+ in solution. One would assume that phosphogypsum, having a much greater surface area than gypsum, would be more effective than the latter at displacing Na^+ and promoting aggregation. Similarly, Mg Cl_2, being highly soluble, is a source of readily available divalent Mg^{2+} cations for exchange with Na^+ on the exchange complex. In this study, the lack of consistently significant ameliorative or stabilizing effects of either gypsum or phosphogypsum on bulk density, particularly in the uncropped lysimeters, was probably due to the limited leaching that occurred in this treatment. The observed effects of $Mg Cl_2$ were probably due to its high solubility and ability to be rapidy leached and displace Na (El-Sayed, 1997a and Mohamed,2005).

Moisture-Release Characteristics:-

Moisture-release characteristics were determined using undisturbed soil cores and a pressure plate apparatus. Gravimetric water content and bulk density were used to calculate volumetric water contents from – 0.01 to – 0.1 MPa potential (Fig.2). All surface soils ,from cropped lysimeters, had significantly greater volumetric water contents than the uncropped soils at the same potential. Soil from lysimeters irrigated with **(WQ_2)** quality water had significantly greater volumetric water contents at a specific potential than soil from lysimeters irrigated with **(WQ_1)** quality water (El-Sayed, 1999g and Mokabel,2005).

Pore-Size Distribution:-

The pore volume occupied by selected pore-size ranges was calculated. Macropores were defined as pores having radii > 1.49×10^{-2} mm and micropores were defined as pores having radii < 1.49×10^{-2} mm. Figure(3)shows the volume of pore space occupied by macropores and micropores. Neither total porosity nor pore size distribution differed significantly due to amendment treatment (Table 3).

All surface soils from lysimeters in which crops were grown had less total pore volume and a smaller percentage of pore volume in macropores than uncropped soil. The soil from the maize lysimeters had more macropores than soils planted with wheat or Berseem (clover). Lysimeters cropped with wheat had a greater volume of micropores than soils planted with maize or Berseem (clover). Irrigation with (WQ2) quality water decreased macroporosity below the macroporosity percentage of columns irrigated with (WQ1) quality water, although the difference was not significant.

Pore-size distributions of the postexperimental soils are presented in (Table 3) as the percentage of total porosity occupied by pores of various radii. The difference in volume of macropores among the crop treatments was greater than the magnitude of differences in volume of micropores among the crop treatments. This suggests that changes in bulk density and total porosity due to crop treatments were a result of collapse of macropores with a subsequent (but not linear among treatments) increase in micropore volume (Knany *et al.*, 2005).

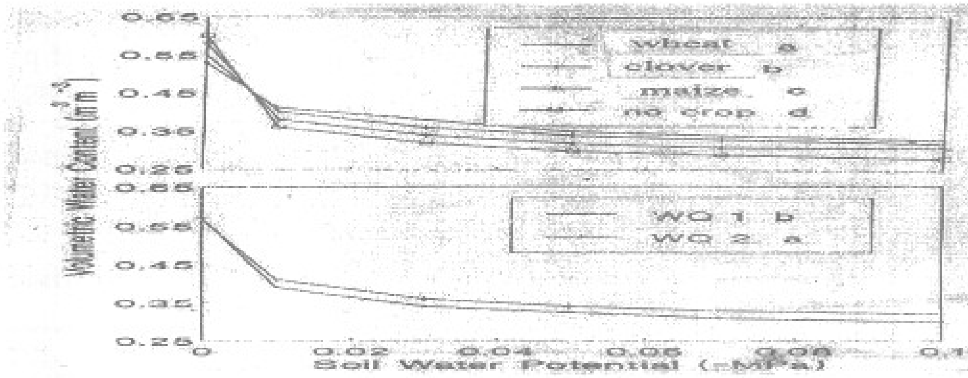

Fig. 2. Effects of crop (top) and water quality (WQ_1 and WQ_2, bottom) on soil water-release characteristics of postexperimental soil cores. Volumetric water content at saturation was estimated. Statistically significant differences of means indicated by Duncan grouping, $\alpha < 0.05$.

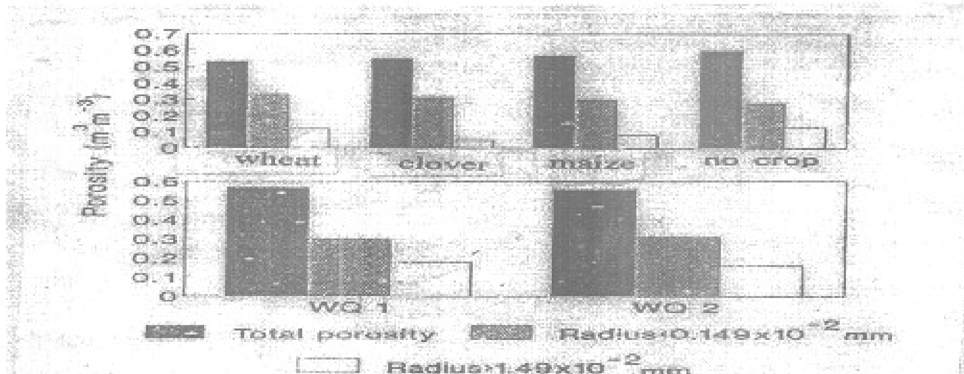

Fig. 3. Postexperiment total pore, macropore (radius > 1.49×10^{-2} mm), and micropore (radius < 1.49×10^{-2} mm) volumes of undisturbed soil as affected by crop (top) and water quality treatment (bottom).

Reasons for crop effects on reducing total pore volume and macropore volume can only be speculated. Presence of a growing crop resulted in significantly greater amounts of water being added to the cropped lysimeters than to the uncropped lysimeters (Table 4). Similarly, a greater amount of water was removed from the cropped lysimeters. Treatments that resulted in the largest leaching fractions (maize, no crop, and $MgCl_2$) caused the smallest losses of total and macropore space and the smallest increases in bulk density. Plant consumptive use, combined with repeated irrigation and drainage, probably improved displacement of

Na^+ on the exchange complex, whereas continuously high soil water contents and prolonged wetting may have caused soil dispersion and pore collapse or consolidation of the soil. In addition, treatments with the largest leaching fractions may provide conditions most conductive to Na^+ displacement and removal by leaching, followed by aggregation. Previous reclamation studies have documented the necessity of adequate leaching to ensure reclamation effectiveness of surface-applied amendments.

Table 3. Effect of crop and water quality treatments on postexperiment pore-size distribution (percentage).

Pore radius range × 10^{-2} mm	Total porosity occupied by pores in radius range					
	Crop				Water quality	
	No crop (%)	Wheat (%)	Berseem (clover) (%)	Maize (%)	WQ_1 (%)	WQ_2 (%)
> 1.49	37.8a	21.5a	25.5a	30.8a	31.1a	28.2a
1.49-0.45	7.6b	9.3b	9.9b	8.8b	8.3b	9.3b
0.45-0.30	2.4c	3.9b	2.9c	2.7c	2.9c	3.0c
0.30-0.21	2.7c	1.7c	1.8c	1.7c	2.4c	1.6c
0.21-0.15	2.4c	1.7c	2.6c	1.7c	2.2c	2.2c
< 0.15	47.1a	61.9b	57.2a	54.3a	53.2a	55.8a
Total porosity, m^3m^{-3}	0.60c	0.53a*	0.55ab	0.57b	0.57a	0.56a

***Total porosity values followed by the same letter are not significantly different according to Duncan grouping, $\alpha < 0.05$.**

The apparent effect of a living crop on reducing hydraulic conductivity was most evident in columns planted with wheat. Aggregation seemed to deteriorate after repeated irrigation. Significant differences due to crop may have also resulted from differences in plant rooting patterns of the various crops. Maize is a robust crop, which quickly developed a full canopy and placed heavy evapotranspirational demand on the soil water. The extensive, fibrous root system of maize may have contributed a substantial amount of organic matter to the soil, binding the soil particles, and maintaining aggregate stability and greater macroporosity.

Table 4. Treatment effects on postexperimental soil chemical characteristics of saturated past extracts, measured leaching fractions, and water use during three crop cycles.

Treatment	Leaching (a) Fraction	ET (b)	(SAR)	(EC)dS/m	EC / SAR
Crop :					
No crop	0.133a	39a	4.6b	4.1c	0.89c
Wheat	0.123b	136b	4.6b	3.1b	0.67a
Berseem	0.100a*	134b	3.9a	2.8a	0.72b
Maize	0.138c	167c	4.6b	3.2b	0.70b
Amendment :	0.125b	119a	5.1b	2.8b	0.55a
Control	0.113a	130a	4.0a	4.0c	1.00b
$CaSO_4 . 2H_2O$	0.123b	126b	3.7a	4.0c	1.08b
P-$CaSO_4$	0.133c	123cb	4.8b	2.4a	0.50a
Mg Cl_2					
Water quality :					
WQ_1	0.117a	122b	1.6a	2.5a	1.56b
WQ_2	0.131b	108a	7.3b	4.0b	0.55a
Preexperiment			5.4	2.5	

(a) Defined as the ratio of irrigation leachate volume/applied volume (dimensionless).

(b) Evapotranspiration.

* Mean values within a column followed by the same letter are not significantly different, according to Duncan grouping $\alpha < 0.05$.

Although wheat crop quickly developed during the first crop cycle, deteriorating soil conditions during the experiment resulted in poorer wheat performance with each successive crop. Postexperiment electrical conductivity of soil from the lysimeters planted to wheat was significantly higher than postexperiment electrical conductivity of soil from lysimeters planted to Berseem (clover) (Table 4). This elevated soil salinity level may have been partially responsible for the poor perform- ance of wheat during the third crop cycle. In contrast, the Berseem (clover) crop developed more slowly, and placed little evapotranspir- ational demand on the lysimeters prior to the third crop cycle. The net result was that the water use for the Berseem and wheat crops did not differ significantly during the course of the study, although the two crop treatments had significantly different leaching fractions.

The significant reduction in macropore volume caused by irrigation with **(WQ_2)** quality water was attributed to the relatively high Na concentration and uniform dispersion throughout the soil. Previous studies have quantified the deleterious effect of Na on soil structure (Waldron *et al.*, 1970 and El-Sayed and Abdel-Mawly, 1999d and e),although it is not clear whether swelling or dispersion is the cause of reduced permeability of sodic soils.

Differences in water use and leaching fractions had a significant effect on soil chemical properties, particularly the EC/SAR relationship of the postexperimental soils (Table 4). The uncropped lysimeters had a postexp- eriment EC/SAR ratio that was significantly different from the three crop treatments. The greater EC/SAR ratio in the surface of uncropped lysimeters may have contributed to a more stable soil structure than in cropped lysimeters. Rapid leaching of salts from the columns cropped with wheat during the first crop cycle probably created a low electrolyte concentration and high ESP, leading to clay dispersion, swelling and structural change (Al-Nabulsi and Sheikhany, 2004 and Othman *et al.*, 2004).

CONCLUSIONS

A greenhouse experiment was conducted at Kafr El-Dawar city Behera Governorate ,Ministry of Agric. & Land reclamation ,to study the interactive effects of crop species, surface applied amendments, and irrigation water quality on soil physical and chemical properties. Significant differences in measured parameters were determined to be the result of treatments and experimental methods. The most contributory factors appeared to be variations in soil water contents and leaching fractions, effects of plant roots and physiological characteristics of the various crops, and quality of the applied water.

Irrigation with relatively high Na^+ concentration water reduced surface soil macroporosity more than irrigation with relatively low Na^+ concentration water. Cropping caused an increase in soil bulk density and a decrease in macroporosity. Wheat had a more adverse effect on soil structure than did Berseem (clover) or maize. Lysimeters planted to maize had the greatest soil macroporosity of the crop treatments.

My hypothesize that the decrease in porosity and increases in bulk density were the result of the combined effects of aggregate dispersion and pore collapse, followed by consolidation of the soil during successive wetting and drying cycles. Treatments with well-established and rapidly growing crop canopies had significantly greater amounts of irrigation water applied than the control treatment. This probably resulted in a greater amount of soil settling than in the uncropped lysimeters. Similarly, the uncropped lysimeters, which showed little alternate wetting and drying, maintained the greatest porosity and greatest macropore percentage.

Maize had the greatest evapotranspiration and most rapid soil drying between irrigations. Maize quickly developed a robust plant and full canopy. This rapid drying of the soil appeared to promote formation of large cracks and a greater percentage of macropores. Lysimeters planted to maize also had the greatest leaching fraction, which may have provided the best opportunity for Na^+ displacement, leaching, and soil aggregation. This is much different from the apparent way the wheat and Berseem (clover) crops developed, leading to slow, uniform drying of the soil. Because of the study design, whereby leaching fractions were maintained at a uniform, relatively low level, leaching volumes may have been insufficient to sustain reclamation.

Rapid soil drying appears to minimize pore collapse and consolidation of the soil, whereas slow and uniform soil drying resulted in significant greater pore loss. Results of this study suggest that uncropped conditions, and crops such as maize ,may be the best combination of conditions to gain maximum efficiency of amendment applied to reclaim saline or sodic soils.

REFERENCES

Abdel-Mawly, S.E. and S.A.M. El-Sayed (1999a). Studies on water requirement, different plant densities on yields of some mungbean varieties under semi-arid conditions. Egypt. J. Appl. Sci., 14 : 169-188.

Abdel-Mawly, S.E. and S.A.M. El-Sayed (1999b). Relationship between alkalinity and iron deficiency on the growth, nodulation and nitrogen fixation of mungbeans inoculated with different *Bradyrh- izobium* strains. Assiut J. Of Agric. Sci. ,30 : 81-100.

Abdel-Mawly, S.E. and S.A.M. El-Sayed (1999c). Relationship between soil alkalinity and zinc deficiency of maize plants grown on sodic soil. Egypt. J. Appl. Sci., 14 : 304-318.

Al-Nabulsi, Y.A. and H. Sheikhany (2004). Kallar grass (*Leptochloa fusca* L.) for bio-reclamation of saline-sodic soil. Alex. Sci. Exch. J., 25 : 689-699.

Ayers, A.D.; J.W. Brown and C.H. Wadleigh (1951). Salt tolerance of barley and wheat in soil plots receiving several salinization regimes. Agron. J. ,3: 307-310.

Daoud, A.M. (2005). Yield response and mineral composition of wheat in relation of the applied silicon under saline environment. Alex. Sci. Exch. J., 26 : 385-395.

Dollhopf, D.J. (1988). Long-term effects of physiochemical amendments on plant performance at a bentonite minespoil in the Northern Great Pli]ains. Montana Agric. Exp. Stn. Reclamation Res. Publ., 87-93. Montana State Univ., Bozeman.

El-Ashtar, A.E.F. (2005). Effect of saline irrigation water on some soil properties and salt tolerance of new wheat genotypes. Alex. Sci. Exch. J. ,26 : 106-112.

El-Sayed, S.A.M. (1995a). Manure decomposition during aerobic and anaerobic condition. Menofiya J. Agric. Res. ,20 : 777-788.

El-Sayed, S.A.M. (1995b). Sewage sludge as a phosphorus amendment in Egyptian soils. Soils & Water Res. Inst. Agric. Res. Center Conf. On-Farm irrigation and Agroclimatology 2-4 January, 1995. Paper No.44. pp.653-667.

El-Sayed, S.A.M. (1995c). Alkali soil Amended with farmyard-manure and pyrite. Menofiya J. Agric. Res., 20 : 827-840.

El-Sayed, S.A.M. (1997a). Influence of salinity on growth, yield, nutrient uptake and biological nitrogen fixation in guar. Egypt. J. Agric. Res., 75 : 1-14.

El-Sayed, S.A.M. (1999f). Effect of uptake of trace elements by rice on a gypsum amended sodic soil in New Valley Governorate. Egypt. J. Soil Sci., 39 : 281-289.

El-Sayed, S.A.M. (1999g). Forage cowpea growth as influenced by soil amendments of sewage sludge and heavy metals in field. J. Agric. Sci. Mansoura Univ., 24 : 5119-5128.

El-Sayed, S.A.M. (2002). Effectiveness of some nitrification inhibitors in soils amended with sewage sludge compost. Inter. Conf. for Develop. And the Envir. In the Arab World, March, 26-28, 2002. pp.223-236.

El-Sayed, S.A.M. (2005). Relationship between soil amended with manure and emissions of nitrogen oxides. Alex. Sci. Exch. J. ,26 : 199-210.

El-Sayed, S.A.M. and S.E. Abdel-Mawly (1999d). Effect of urease inhibitor (P-Benzoquinones) in an alkali soil on rice production. J. Agric. Sci., Mansoura Univ., 24 : 3213-3225.

El-Sayed, S.A.M. and S.E. Abdel-Mawly (1999e). effectiveness of *Bradyrhizobium* strains for peanut under different salinity concentrations. Assiut J. Of Agric. Sci., 30 : 101-115.

El-Sayed, S.A.M. and A.A. Ghaly (1996). Effect of K-uptake under saline conditions for rice crop in New Valley Governorate. J. Agric. Sci., Mansoura Univ., 21 : 3401-3408.

El-Sayed, S.A.M.; A.M. Abo El-Wafa and H.A.I. Salem (2001). Salinity-calcium interaction in wheat and barley plants. J. Agric. Sci., Mansoura Univ., 26 : 6607- 6621.

El-Sebsy, A.A. (2004). The effect of irrigation intervals and varieties of grain sorghum on growth, yield and consumptive use of water. Alex. Sci. Exch. J., 25 : 199-211.

Ghaly, A.A. and S.A.M. El-Sayed (1997b). Effect of soil sodicity on growth, yield, chlorophyll and some biochemical parameters in guar. J. Agric. Sci., Mansoura Univ., 22 : 1187-1195.

Gibbs, R.J. and J.B. Reid (1988). A conceptual model of changes in soil structure under different cropping systems. Adv. Soil Sci., 8: 123-149.

Hoffman, G. (1986). Guidelines for reclamation of salt-affected soils. Applied Agric. Res., 1 : 65-72.

Keren, R. and I. Shainberg (1981). Effect of dissolution rate on the efficiency of industrial and mined gypsum in improving infiltration of a sodic soil. Soil Sci. Soc. Am. J., 45: 103-107.

Klute, A. (ed.) (1986). Methods of soil analysis. Part 1. 2nd ed. Agron. Monogr. 9. ASA and SSSA, Madison, WI.

Knany, R.E.; A.S.M. El-Saady and R.H. Atia (2005). Effect of organic matter and irrigation management on corn yield, environment and water saving. Alex. Sci. Exch. J., 26 : 322-328.

Low, A.J. (1972). The effect of cultivation on the structure and other physical characteristics of grassland and arable soils. J. Sci. Food Agric., 27: 571-582.

Mohamed, W.H. (2005). Modeling plant nutrient availability in seawater irrigation. J. Adv. Agric. Res. (Fac. Agric. Saba Basha). 10 : 801-810.

Mohamed, A.A. and S.A.M. El-Sayed (2003). Effect of different applications of soil amendments and slow-release nitrogen fertilizer on soil enzymes and microflora activities. J. Agric. Sci., Mansoura Univ., 28 : 687-701.

Mokabel, M.A. (2005). Water consumptive use and water utilization efficiency of some pea cultivars grown in two organic based media. J. Adv. Agric. Res. (Fac. Agric. Saba Basha). 10 : 349-366.

Ojeniyi, S.O. (1978). Tilth structure and soil physical conditions. Ph.D. diss. Univ. of Adelaide, South Australia.

Othman, S.A.; S.A. Hegab and A.E.A. Abd El-Razek (2004). Combined effect of organic manure and/or gypsum, as soil conditioners and N-fertilization on maize-silage yield and quality and some soil physical characters. Alex. Sci. Exch. J., 25 : 679-688.

Page, A.L.; R.H. Miller and D.R. Keeney (ed.) (1982). Methods of soil analysis. Part 2. 2nd ed. Agron. Monogr. 9. ASA and SSSA, Madison, WI.

Reid, J.B. and M.J. Goss (1981). Effect of living roots of different plant species on the aggregate stability of two arable soils. J. Soil Sci., 32: 521-541.

Richards, L.A. (1954). Diagnosis and improvement of saline and alkali soils. USDA Agric. Handb. 60. U.S. Gov. Print. Office, Washin- gton, D.C.

Robbins, C.W. (1986). Sodic calcareous soil reclamation as affected by different amendments and crops. Agron. J., 78: 916-920.

Saad, A.F. and A.K. Sinha (2005). Water budget and water use efficiency in paddy fields under different irrigation regimes. Alex. Sci. Exch. J., 26 (3): 282-289.

Saraswat, S.N.; P.S. Marwaha and P. Lal (1972). Use of crops and other organic materials in the reclamation of saline and alkali soils. Agric. Agron. Ind., 5: 8-13.

SAS Institute (1987). SAS/STAT Guide for personal computers. Version. 6 ed. SAS Inst. Cary, NC.

Skidmore, E.L.; W.A. Carsteson and E.E. Branbury (1975). Soil changes resulting from cropping. Soil Sci. Soc. Am. Proc., 39: 64-67.

Skidmore, E.L.; J.B. Layton; D.V. Armbrust and M.L. Hooker (1986). Soil properties as influenced by cropping and residue management. Soil Sci. Soc. Am. Proc., 50: 415-419.

Waldron, L.J.; J.L. McMurdie and J.A. Vomocil (1970). Hydraulic conductivity of an isotropically compressed soil. Soil . Soc. Am. Proc., 34: 393-396.

Wilson, H.A. and G.M. Browning (1954). Soil aggregates as affected by cropping systems. Soil Sci. Soc. Am. Proc., 10: 51-57.

Yadav, J.S.P. (1975). Improvement of saline alkali soils through biolog- ical methods. Indian For. (July), pp.385-395.

الملخص العربى

تأثير زراعة البرسيم والقمح والذرة ومحسنات التربة على صفات الأرض الطبيعية

سعيد عباس محمد السيد

قسم علوم الأراضى والمياه – كلية الزراعة – جامعة الأزهــر بأسيوط

تنشأ الأراضى الملحية والقلوية نتيجة لرى مساحات كبيرة بمياه ملحية. ونظام زراعة المحاصيل يشجع بفاعلية إضافة محسنات التربة لإستصلاح هذه الأراضى .وهذة المحاصيل المنزرعة وجودة الميــاه المضافة للرى كلهاعوامل تعمل على تغيير الصفات الطبيعية للأراضى .ولقد تم زراعة مجموعــة مــن المحاصيل فى Lysimeters ومقارنتها بالكنترول (أرض غير منزرعة)،وهذة المحاصيل هـــى البرســيم المصرى صنف جيزة (٦) ، والقمح صنف سخا (٨) والذرة الشامية صنف جيزة (١٠) هجــين فــردى وكانت محسنات التربة هى الجبس الزراعى ، وجبس زراعى مضاف إليه فوسفور ، وكلوريد الماغنسيوم .وقد استخدم فى الرى مياة تحتوى على TDS مــواد صــلبة ذائبة كلية بتركيز $0.75\ g\ L^{-1}$ حتى تركيز $1.65\ g\ L^{-1}$ ، SAR من 1.15 إلى 7.01 حتى نمو ثلاث محاصيل من القمح بنجــاح . وقــد ســببت وجــود المحاصــيل المنزرعة زيادة معنويــة فــى الكثافــة الظاهـــرية للتربــة لجميعالليــسيمترات Lysimeters ، ونقص معنوى فى المسامية الكلية مقارنة بالمعاملة الكنترول (الأرض الغير منزرعــة) وقد سبب محصول القمح نقصا كبيرا فى المسامية الكلية يتبعها البرسيم المصرى ثــم الــذرة الــشامية. المسامية الكلية نقصت بمقدار $0.1\ m^3m^{-1}$ ، وأوضحت النتائج حدوث زيادة معنوية فى أعــداد المــسام الصغيرة ، مع تفاوت ونقصان كبير فى أعداد المسام الكبيرة. يتحرر المــاء الأرضـــى تبعــاً لإخــتلاف معاملات المحاصيل .ولقد أوضحت المعاملات أن محسنات التربة ، وجودة المياه ليس لها تأثيراً معنويــاً لكل من المسامية ، وحجم المسام ، والكثافة الظاهرية .كما أوضحت نتائج هذه الدراســة أن المحــصول المختار ، والدورة الزراعية تؤثر تأثيراً معــنوياً على محــســنات التربــة المــستخدمة فــى عمليــات الإستصلاح ، والراشح من Na ، والأملاح الموجودة بالتربة .