

**SOIL AND WATER MANAGEMENT  
OF CALCAREOUS SOILS**

By

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**B.Sc. Agric. Sci. (Soils), Cairo University, 2003**

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## 5. SUMMARY AND CONCLUSION

In Egypt, the agricultural production of areas that have both fertile soils and abundant water can not meet the increased population demands. Therefore, less productive soils [i.e. calcareous soils, sandy soils, salt-affected soils and sodic soils) are now being reclaimed for agricultural production and considered to be the primary and important sources for increased food. Additionally, in many irrigated areas, water, is becoming scarcer, thus, the proper soils and water management, as well as agronomic techniques must be taken into consideration in order, to improve their soil properties and existed grown crops production.

Either soil or water management practices can be conducted to grow crops for high profit and to maintain soil fertility in the long run, in addition to provide a suitable medium in which seeds can germinate, roots can grow and supply water and nutrients necessary for crop growth.

To investigate the effects and consequences of soil and water management practices on the soil properties and plant parameters of the grown crops in calcareous soils, some amendments applications and irrigation treatments have been conducted in under Fayoum conditions.

Achieving the current study objectives, field experimentation was set up and conducted along two successive seasons with grown sunflower and barley crops. Three different locations with sandy loam textured which were chosen and

differed in their calcium carbonate contents (i.e. 5-6, 13-15 and 25-30 % CaCO<sub>3</sub>). Such soils are known to impose some soil and water stresses for plants growth and yield of existed grown crops. Four levels of organic manure (i.e. 0.0, 10.0, 20.0 and 30.0 ton/ fed.) were applied as a soil management, and incorporated into the used soils at a depth of 0-20 cm and completed prior to planting. Three different applied available moisture depletion treatments (i.e. 30, 50 and 70 %) were used as a water management, with four replicates. Therefore, the total number was 4 (organic manure application levels) × 3 (available moisture depletion levels) × 4 (replicates) = 48 experimental units in each site. The effects consequences, relations and association of the applied organic manure treatments and/or irrigation treatments and their interaction in all investigated soils along the two successive seasons. Presented and identified have been investigated and established, and the obtained data were clearly. The obtained results may be summarized in terms of a set of conclusions as follows.

#### **A. Some soil properties of calcareous soils as influenced by soil and water management techniques.**

Some studied physical soil properties (i.e. bulk densities, porosities, void ratios, pore size distribution, water retention and transmission) of calcareous soils have been significantly influenced by the used soil and water management techniques. Which resulted in significant decreases of the studied soil bulk density values .However, the studied soil total porosity, void ratio, air porosity, and pore size distribution, shape, geometry

and tortousity were drastically influenced and varied with the applied organic amendments and/or irrigation treatments as a management technique of the investigated calcareous soils. Such applied agro-management practices led to significant increases in, the studied above-mentioned soil physical properties compared to non-treated soils. The obtained bulk density decrease percentages were found to be: 6.15, 7.85 and 8.70% for S<sub>I</sub>, S<sub>II</sub> and S<sub>III</sub>, respectively. In the same time, the magnitudes of the total porosity increases were revealed to be; 8.61, 10.75 and 11.13 % for S<sub>I</sub>, S<sub>II</sub> and S<sub>III</sub> respectively, when organic manure addition increasing from no addition to high addition (30 ton/ fed).

Additionally, the high level of amendments application led to increase percentages of soil air porosities which reached to 22.08, 17.84 and 19.73 % for S<sub>I</sub>, S<sub>II</sub> and S<sub>III</sub>, respectively, The used soil and water management techniques via organic amendments applications and/or available water depletion (irrigation) treatments produced significant increases in the soil water retention, water holding capacity, available soil water content in the root zone environment and water movement of the studied soils compared to the control under conditions of the current study. The available water increase percentages compared to the control (untreated soils) were cleared as; 28.71, 28.94 and 33.65 for S<sub>I</sub>, S<sub>II</sub> and S<sub>III</sub> respectively .Also, increasing organic manure application rate from no- to the high addition levels led to considerable decreases in K<sub>sat</sub> values. The decreased percentages were; 24.57, 17.92 and 22.05%, 29.25,

19.5 and 20.69% and by 23.06, 18.13 and 17.62% for S<sub>I</sub>, S<sub>II</sub> and S<sub>III</sub> for irrigation treatments I<sub>1</sub>, I<sub>2</sub> and I<sub>3</sub>, respectively.

Generally, the more pronounced effects have been detected in the surface layers and after using of the third (high) level of amendments incorporation, either after sunflower or barley planting in soils of the chosen three sites. Therefore, it can be concluded that the used amendments applications and/or irrigation treatments that influence the mentioned studied soil properties may be due to the ameliorative role of such treatments which consider as better agro-management practices to improve such physical properties of calcareous soils.

Moreover, a soil with higher organic matter will normally be more open and less easily over-compacted than one of lower organic matter content. Thus, some soils, especially, calcareous soils ones, are more sensitive to the level of organic materials and on these quite small increases can give greater latitude in soil management. Consequently, organic matter serves as a granulating agent in soils, so that it has beneficial impact on soil aggregation formation. The used organic manure applications produce an effective role in determining the retention function in which they have direct effects due to their hydrophilic nature, and indirect effects refer to the modification of the soil structure and For many agronomic applications and management. the activities of soil microorganisms which reflect upon the soil properties improvement. Therefore, the efficient role of the used soil and water management techniques may clearly take place in ameliorating the physical properties of the studied calcareous



soils.

Considering the vital and efficient role of the used soil and water management techniques in some studied chemical properties, it can be stated that the soil pH, E<sub>Ce</sub> and soluble cations and anions were considerably influenced by using such treatments. The detectable effects were apparently revealed when using the high levels of the organic manure addition at the surface layers. Based mainly on the obtained results of chemical properties as affected by the used soil and water management techniques, it is revealed that, such treatments resulted in ameliorating and reducing the effects of stresses in the studied soils. Therefore, using the soil and water management practices under the current study conditions is urgently necessary to ameliorate both physical and chemical properties of the studied soils.

### **B. The relation between soil and water management and water consumptive use and water utilization efficiency**

The obtained results revealed that the water consumptive use or evapotranspiration has been significantly affected as a result of using the soil and water management techniques through organic amendments applications and/or irrigation treatments.

The water consumptive use (or actual evapotranspiration) values have been decreased with increasing the organic manure addition from no-addition (M<sub>0</sub>) to high addition (M<sub>3</sub>) and the reduction percentages were 14.45, 11.99

and 14.21 % for S<sub>I</sub>, S<sub>II</sub> and S<sub>III</sub> respectively after sunflower crop cultivation. While the decrease percentage in water consumptive use after barley crop cultivation were 24.14, 25.99 and 26.84% for S<sub>I</sub>, S<sub>II</sub> and S<sub>III</sub> respectively.

Also, values of water consumptive use by either sunflower crop or barley crop as a function of irrigation regime were decreased by increasing the available soil water depletion and this behavior may be referred to insufficient soil moisture for plants irrigated whenever the available soil and water depletion was high.

The obtained results showed that the used soil and water management techniques through organic amendments applications and/or irrigation treatments (available water depletions) resulted in sensible and detectable variations in the water utilization efficiency by either sunflower or barley crops. The obtained water utilization (WUE) values as a function of manure applications, irrigation treatments and their interaction in soils of the three chosen sites along the period of the current study, and they represent ;30.95, 47.62 and 78.57% ( increasing percentages) for the applied manure treatments M<sub>1</sub>, M<sub>2</sub> and M<sub>3</sub> compared to M<sub>0</sub> (control ) at S<sub>1</sub>. However, the increased percentages were; 26.32, 52.63 and 84.21% and by 33.33, 83.33, 122.22 for the applied manure treatments, M<sub>1</sub>, M<sub>2</sub> and M<sub>3</sub> compared to M<sub>0</sub> (no – addition) at S<sub>2</sub> and S<sub>3</sub> for sunflower crop, respectively, While these increases of water use efficiency after barley crop cultivation when applied organic treatments increased from M<sub>0</sub> (control) to M<sub>3</sub> (30 ton/fed.) were; at S<sub>1</sub>,

28.44, 40.37 and 62.39% and by 34.44, 51.11 and 68.89% at S<sub>II</sub>, and by 33.33, 42.39 and 72.27% at S<sub>III</sub>.

The available water depletion (50%) gave the highest water utilization efficiency compared to the control and other two irrigation treatments.

Therefore, the current study revealed that all water relations and growth, as well as yield of sunflower and barley crops are closely related to each other and have been influenced with the climatic conditions, crop parameters, development stages, applications of some amendments, available soil water depletions, soil and water management techniques and soil properties, in addition to irrigation and drainage practices.

### **C. Impact of the used soil and water management techniques on some parameters of grown sunflower and barley crops.**

As far as the current study is concern, reflections, impacts and consequences of the used soil and water management practices on some parameters of sunflower and barley crops have been clarified. In this respect, the used soil and water management in calcareous soils under the current investigation resulted in significant increases in the plant height (cm), and seeds yield of sunflower (ton/fed.). Also, such treatments led to significant increases in plant height (cm), grain yield (ton/fed.), and straw yield (ton/fed.) of barley crop. The more pronounced increase in either plant height or crop yield of both sunflower and barley crops was clearly detected when using the high

addition of organic application and/or the irrigation treatment whenever the available soil water depletion was 25%. However, the irrigation treatment, I<sub>2</sub> (50% available water depletion) produced the best water utilization efficiency of sunflower and barley crops.

The noticeable increase in both plant height and grain yield of sunflower crop and/or barley crop may be attributed to the ameliorative role of the used organic manure applications and/or irrigation treatments and due to the reflection of the soil improvement on the existed grown crops.

#### **D. Impact of the used soil and water management techniques on economic income of grown sunflower and barley crops**

The obtained results revealed that the I<sub>1</sub> (30%ASMD) and the treatment M<sub>3</sub> (30 ton/fed.) are the best treatments, where; the economic income increased and the percentage of increases were; 38% and 23% compared to control treatment M<sub>0</sub> for sunflower and barley crops, respectively of these study under Fayoum conditions.

Such indicated previous findings, statements and conclusions must be taken into account in order to obtain high productivity of the grown crops under similar conditions of the current study with satisfactory quality, In addition to the above-mentioned conclusions, it can be said that the obtained results of some studied plant parameters of sunflower and barley crops as influenced by the used soil and water management techniques

were found to be consistent with each other and with that of the studied soil physical and chemical properties, and water consumptive use, as well as water utilization efficiency.