

## **The title of Ph.D. Thesis is:**

### **“Studies on soil compaction in relation to some soil characteristics and plant growth”**

دراسات عن اندماج التربة وعلاقته ببعض خواص التربة ونمو النبات.

#### **Abstract:**

To study the effect of soil compaction in relation to some soil characteristics and plant growth, field studies were conducted using different roller passes to the soil surface layer in order to reach five values of soil bulk density (i.e., 1.2, 1.3, 1.4, 1.5, and 1.6 g/cm<sup>3</sup> for site 1 (clayey soil) and 1.3, 1.4, 1.5, 1.6 and 1.7 g/cm<sup>3</sup> for site 2 (loamy sandy soil)) and named compaction treatments: C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> and C<sub>5</sub>, respectively. The different irrigation treatments (I<sub>1</sub>, I<sub>2</sub> and I<sub>3</sub>) were application of irrigation water when available water depletion was 30%, available water depletion was 60% and available water depletion was 90%. The laboratory experiment was conducted using both representative soil samples of site 1 and site 2 in plastic cylindrical containers (17 cm height x 10 cm diameter), in addition to use five compaction treatments (the similar values used in field studies), under the similar water depletion treatments I<sub>1</sub>, I<sub>2</sub> and I<sub>3</sub>. sugar beet crop (*Beta vulgaris*, L) was used an indicator plant for reflection of such treatment upon plant growth, yield, yield quality, consumptive use, water use efficiency and some nutrients status and uptake.

The obtained results could be summarized in the following:

- 1- Effect of soil compaction on some soil physical properties:
  - a) Compaction of the soils increased significantly values each of the soil bulk density, penetrometer reading and fine capillary pores in both sites 1 and 2, and useful pores in site 2.
  - b) Compaction of the soils decreased significantly values each of total porosity, void ratio, air porosity, useful pores and the hydraulic conductivity. The more pronounced effects in such values were observed when applied compaction by high number passes of the used roller was taken place, in particular, in the surface layers of the soils.
- 2- Soil compaction and plant parameter:
  - a) Compaction treatments resulted in highly significant decreases on each of seed germination of sugar beet crop in sites 1 and 2.
  - b) Compacted soils led to a considerable reduction in the sugar beet crop roots (length, diameter, surface area and fresh weight of roots) and shoots (length, fresh weight, dry weight, leaf width and number of leaves per plant.
  - c) Soil compaction decreased crop yield (ton/fed.) of sugar beet in site 1. while it increased in site 2. there are reduction in each of total soluble solids (T.S.S.), sucrose%, top/root ratio, juice purity and sugar yield per/fed. due to increased soil compaction in site 1, while it increased in moderate compaction in site 2.
  - d) Increasing soil compaction decreased consumptive use and water use efficiency. The maximum values of sugar yield (ton/feddan) at 60% depletion from available water.

3- applied compaction under different available water depletion led to reduction in N, P, K, Fe, Mn, Zn, and Cu concentrations in soil and sugar beet plant in site 1.

However, some micronutrients (i.e., Fe, Mn, Zn, and Cu) were increased in the moderately compacted soils in site 2. therefore as a general knowdge of compaction impacts on soil properties and optimum irrigation practices produces a best and crop management for maximum sugar beet yield of satisfactory quality.