

Prediction of Soil Compaction using Conventional Tillage Systems under Different Operating Conditions

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Abstract. The field experiment was conducted in the College of Agriculture - University of Basra in Karma Ali located in the south of Basra city. The soil was of a clay-silty texture. The study aims to evaluate the negative impact of primary plowing equipment (moldboard plow, disk plow, and chisel plow) on the physical properties of the soil by studying soil compaction indicators such as soil resistance to penetration, soil bulk density, and total porosity. Three plowing depths (15, 20, and 25) cm and three forward speeds of the tractor (0.45, 0.75, and 1.05) m s⁻¹ were used. Intelligent computing was introduced to predict results and simulate soil compaction through the use of Design Expert software. The results showed that there is an effect of all studied factors on the variables of soil physical properties. The effect on the soil penetration resistance characteristic of the type of plow was greater than the depth, and the depth was greater than the forward speed, as the soil penetration resistance was (4.53, 3.84, and 3.23) MPa for the moldboard plow, disc plow, and chisel plow, respectively. As for the effect of increasing the depth, it was 27%, while the effect of increasing the forward speed was 24%. As for the bulk density of the soil, the effect of the type of plow was also greater than the effect of the increase in depth, and the increase in depth was more effective than the increase in the forward speed, as the bulk density was (1.68, 1.52, and 1.48) g.cm⁻³ for the moldboard, disc, and chisel, respectively. As for the effect of depth, it reached 7%, while the effect of speed reached 5%. As for the total porosity of the soil, the effect of the plow type was greater than the depth, and the greater the depth than the forward speed, as the total porosity reached (43, 41, and 35) % for the moldboard, disc, and chisel plow, respectively. The increase in depth led to a decrease of 7%, and the increase in velocity led to a decrease of 4% in the index of total soil porosity. As for the predicted results, the amount of convergence between the field calculated and predicted results was (96, 95, 95) % for soil penetration resistance, bulk density, and total soil porosity, respectively.

Keyword. Soil penetration resistance, Bulk density, Total soil porosity, Soil compaction.

1. Introduction

Soil compaction, due to the heavy traffic of agricultural machinery and vehicles in the agricultural fields, has reduced the production of most agricultural crops all over the world, as soil compaction is a form of the physical characteristics of the soil that indicates the deterioration of the soil condition by changing the structure of the soil and reducing the permeability of water and air and reduces of root penetration [1-4]. It is estimated that around 68 million hectares of soils worldwide are affected by soil compaction from vehicular traffic. Compaction is responsible for soil degradation in Europe (33

