Soil Properties and Maize Growth as Affected by Subsoiling and Traffic-Induced Compaction

Marwan N. Ramadhan[1] and Murtadha A. A. Alfaris[2]

[1,2] Department of Agriculture Machines and Equipment, College of Agriculture, University of Basrah, Basrah, Iraq.

[1]E-mail: marwan.ramadhan@uobasrah.edu.iq

Abstract. Many of the current farm management methods that utilize production techniques tend to add to the soil compaction problem. The compaction from wheel traffic is a key source of soil deterioration in contemporary agriculture. Limited studies have been conducted over the heavy soil of Iraq's southern regions to understand soil compaction under the current condition, and its effect on crop growth and yield. An experiment was conducted at two locations; with the goal of determining the effects of tractor traffic on soil parameters, plant development, and maize production. Compaction treatments included no traffic, t0; 8 tractor traffic, t8; 16 tractor traffic, t16; and 24 tractor traffic, t24. To reduce soil compaction's negative impacts, two degrees of subsoiling have been investigated, nonsubsoiled (NonSub) and subsoiled (Sub) plots. The results showed that bulk density values through 10 to 40 cm soil profile after tractor traffic at both locations increased with increasing levels of compaction. Hydraulic conductivity of saturated soil cores showed a general trend of decreasing at both locations with increasing levels of compaction by tractor traffic. Maize plant height, 500-grain weight, and root mass throughout both growing locations were also lower with wheel traffic treatments compared to the control treatment. Maize yields with wheel traffic were significantly lower by 7.039, 19.120, 34.187% at the first location and by 7.291, 15.147, 26.862% at the second location for the t8, t16, and t24 than yields with the t0 treatments. On the other hand, subsoiling was found to mitigate the adverse effect of tractor traffic in the topsoil and in the subsoil that led to a favour effect on soil bulk density and saturated hydraulic conductivity. The subsoil treatment increased plant height at both growing locations due to the greater exploitation of root system at the subsoiled plots which increased 500 grain weight and eventually maize yield by 16.215 and 23.762% over nonsubsoiled treatment. Tractor traffic on agricultural soils must be planned in order to minimize its detrimental impacts, as demonstrated by the findings of this experiment. Tractor traffic below 16 passes, under the experiment condition, is convenient for effective maize cultivation. In addition, subsoiling can be a choice for alleviating compaction.

Keywords. Bulk density, Grain weight, Hydraulic conductivity, Root growth, Yield components.

1. Introduction

Modern agriculture has seen a rise in the utilization of agricultural machines to perform cultural practices. Field traffic, can cause soil compaction. Since tractors are used more often than most other farm equipment, wheel traffic compaction is a common problem. Modern agriculture is concerned about soil compaction because of the growth in size and weight of the equipment frequently employed