University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 1 (2024) PP 185-200

https://jam.utq.edu.iq/index.php/main *https://doi.org/10.54174/szm42027*

Soil Compaction Induced by Different Tillage Systems and its Impact on Growth and Yield of Maize (Zea Mays L.) : A Review

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Abstract

Maize (Zea mays L.) cultivation faces challenges with compaction due to mechanical tillage, which affects the physical properties of the soil necessary for growth. This pressure from interactions between machinery and soil during plowing modifies bulk density, resistance to root penetration, and the amount of penetrating water. Extended tires play a vital role in this process. This chapter examines this complex relationship and focuses on its deleterious effects on corn root growth, nutrient availability, and overall grain performance. Although studies show significant yield reductions under severe stress, the globally agreed critical level remains elusive, and further research into soil dynamic factors affecting maize productivity is warranted. This vision describes strategies for improving agricultural practices in the face of the challenges of mechanized tillage. Soil compaction, one of the major concerns in corn cultivation, profoundly affects plant growth. Mechanical stresses resulting from tillage modify soil properties and affect bulk density, root penetration, and water movement. Compacted soil limits access to air and water and prevents root respiration and nutrient uptake. This multifaceted limitation results in poor seed germination, reduced yield, and increased susceptibility to root diseases. Mitigation strategies include reduced tillage, precision agriculture, conservation tillage, and deep tillage. Although some pressure can be beneficial for fluid retention, excessive levels pose risks. The comprehensive approach includes soil assessment, controlled rotation tillage, cover crops, mechanical aeration, optimal equipment design, and continuous monitoring. Education and adaptive practices are essential for sustainable management of soil compaction.

Keywords: ***Root penetration resistance, Soil characteristics, Critical level, Mitigation strategies***

I. INTRODUCTION

Maize (Zea Mays L.) is considered one of the economically important industrial and fodder crops. Yellow maize production is greatly affected by soil preparation methods and cultivation methods (Imran et al., 2021). Mechanical compaction caused by repeated plowing operations is the most influential factor in the growth and production of yellow maize. Soil compaction results from compaction of tractor tires and agricultural machinery during plowing operations. To improve maize cultivation, the effect of soil compaction caused by mechanized tillage on the movement of water and nutrients and crop growth must be understood (Johnson and Brown, 2019). Mechanical soil compaction caused by the movement of tractors and agricultural equipment is a process that has negative effects on the soil as a result of the convergence and compaction of soil particles, which leads to a reduction in the apparent soil density, total porosity, and soil permeability. The negative impact of soil compaction is not limited only to the physical properties of the soil, but it also has a significant negative impact on