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Implementation of Controlled Traffic in the Canadian Prairies: Soil and Plant Dynamics under Simulated and Field Conditions

Kris Guenette and Guillermo Hernandez-Ramirez
Renewable Resources, University of Alberta, Edmonton, Canada

Achieving resiliency in agroecosystems may be accomplished through the incorporation of contemporary management systems and the diversification of crop rotations with pulse crops, such as controlled traffic farming (CTF) and faba beans (Vicia faba L.). As these practices become more common in the Canadian Prairies, it is imperative to have a well-rounded understanding of how faba beans interact with the soil-plant-atmosphere continuum in conditions found in contemporary management systems. Simulated field conditions emulated soil compaction found in both the trafficked and un-trafficked areas of a CTF system, in which the presence of high water availability was shown to offset the negative results of large applications of compactive effort. Furthermore, low water availability exacerbated differences in plant responses between compaction treatments. The simulated treatment of 1.2 gcm-3 coupled with high water content yielded the most optimal results for most measured parameters, with a contrasting detrimental treatment of 1.4 gcm-3 at low water availability. The simulated field conditions were further bridged through an analysis of two commercial sites in Alberta, Canada that compared both trafficked and un-trafficked soil properties. Soil properties such as available nitrogen (AN), pH, soil total nitrogen (STN), soil organic carbon (SOC), bulk density, macroporosity, soil quality S-Index, plant available water capacity (PAWC) and unsaturated hydraulic conductivity (Km) were analysed and compared among trafficked and un-trafficked areas. The measured soil physical and hydraulic properties of bulk density, macroporosity, S-Index, PAWC and Km were shown to be heavily influenced by the CTF traffic regime, while soil nutrient properties of AN, pH, STN SOC were determined to be dependent on both management and landscape features.