Determining Alfalfa (*Medicago sativa* L.) Root Structure Architecture Using an AI-Driven Mobile Application

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Roots are essential for acquiring water and nutrients to sustain and support plant growth and anchorage. However, they have been studied less than the aboveground traits in phenotyping and plant breeding until recent decades. In modern times, root properties such as morphology/topology/distribution and root system architecture (RSA) have been recognized as increasingly important traits for creating more and higher quality food in the "second Green Revolution". To address the paucity in RSA and other root research, new technologies such as artificial intelligence (AI) are being investigated to fill the increasing demand to improve plants via root traits and overcome currently stagnated genetic progress in stable yields. To help address the current and growing need to objectively and quickly identify/ phenotype RSA directly from the field, we developed a mobile application capable of sampling and analyzing root image data that then reports its results in real-time. The major benefits to this application and approach are manifold but perhaps most importantly; 1) it puts the power of location-agnostic AI-driven image analysis into the hands of stakeholders such as producers and research scientists, and 2) produces quicker and less error-prone results than humans and/or past methods to investigate RSAs. Additionally, this mobile application aims to propel RSA research closer to objective phenotyping by removing human bias by employing AI-driven models capable of detecting subtle differences in RSA which are imperceptible/undetectable to unaided humans.