Enhancing chickpea irrigation efficiency, yield and sustainability

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Dual-field of view system for spectral data collection operated by Roy Sadeh. Credit: Asaf Avneri

A new study published by the Hebrew University of Jerusalem (HUJI) introduces a non-invasive technique for evaluating chickpea water status, offering farmers a powerful tool to fine-tune irrigation schedules and potentially elevate the sustainability of chickpea cultivation.

This method holds the potential to transform chickpea management, amplifying both crop yields and water efficiency. Its ramifications stretch far beyond the agricultural realm, resonating with global food security efforts and addressing pressing environmental challenges. The work is published in the journal *Precision Agriculture*.

The remote sensing aspect of the project is led by researchers at the Hebrew University, including Dr. Ittai Herrmann from The Robert H. Smith Institute of Plant Sciences and Genetics in Agriculture. Ph.D. candidate Roy Sadeh (HUJI) trained and tested spectral models for quick and non-invasive assessment of chickpea water status based on leaf water potential estimation from space and ground.

The agronomical aspects were covered by Hebrew University Ph.D. student Asaf Avneri under the guidance of Dr. Ran Lati (ARO) and Prof. Shahal Abbo (HUJI) and with Dr. David Bonfil (ARO). This innovative approach holds immense promise for transforming agriculture practices, particularly in regions facing water scarcity.

Chickpeas, also known as garbanzo beans, are a crucial global grain legume, serving as a staple protein source around the world and especially in the Middle East, South Asia and the Mediterranean. The proposed method holds transformative potential for agriculture by enabling farmers to optimize irrigation schedules efficiently.

This could lead to increased crop yields and improved water use efficiency, contributing to resource conservation and reduced environmental impact. Furthermore, the innovation has broader

implications for global food security, showcasing the impact of advanced precision-smart agricultural technologies on sustainable farming practices.

The study, conducted in two farm experiments and two commercial fields, used ground-based hyperspectral imaging and satellite images from the Vegetation and Environment monitoring on New Micro-Satellite (VENmS) program. It aimed to remotely measure leaf water potential of field-grown chickpeas under different irrigation treatments. While doing so, the limited effect of leaf area index on the ability to remotely estimate leaf water potential was revealed.

Roy Sadeh developed spectral estimation models using vegetation indices and machine learning based on all spectral bands. The study demonstrated that the normalized difference spectral index (1600 and 1730 nm) provided the most accurate estimation of leaf water potential among the vegetation indices. The artificial neural network models improved the assessment accuracy and performed similarly well for ground and spaceborne data.

The new method offers significant benefits to farmers by providing a rapid, non-destructive tool to enhance irrigation scheduling in chickpea fields, potentially improving variable rate irrigation management. Additionally, this tool holds promise for physiologists and breeders in screening for drought-tolerant chickpea genotypes, paving the way for sustainable farming practices on a larger scale.

The next step of the project is combining space-borne spectral data to improve leaf water potential estimation is ongoing. Omer Perach (a Ph.D. candidate) has presented very nice preliminary results at a recent conference (ECPA 2023) and the additional paper is currently being written.

More information: Roy Sadeh et al, Chickpea leaf water potential estimation from ground and VENμS satellite, *Precision Agriculture* (2024). DOI: 10.1007/s11119-024-10129-w

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