Measures Amount of Water in Tree Trunks so Irrigation Can Be Optimal for Productivity While Preventing Waste

This device and software improves agricultural water use efficiency while better maintaining the health and productivity of trees. The global commercial agriculture irrigation market is expected to reach $4.3 billion by 2023; the smart irrigation market should reach $1.5 million by 2022. Available irrigation systems for orchards and groves are based on a fixed interval schedule or use a limited number of soil moisture sensors to determine when to water trees. The former can waste water, as it does not account for environmental factors, while the latter relies on a limited number of sensors that usually poorly represents the variability in soil moisture levels. Likewise, available monitoring systems are expensive, labor intensive and either measure too slowly to detect accurate moisture efficiently or are not scalable for large growers' needs.

Researchers at the University of Florida have developed software and a device that measures tree moisture content in real-time through rapid and robust measurements, making smart irrigation management in commercial agriculture possible while saving resources.

Application

Real-time tree water uptake monitoring system to optimize tree health and watering schedules in large-scale groves and orchards

Advantages

- Monitors the real-time water status of a tree trunk, detecting early water stress, distinguishing it from other types of biotic stresses
- Measures tree moisture precisely due to less sensitivity to the ambient temperature variation, enabling accurate irrigation decisions
- Integrates with existing irrigation control systems, making it a cost-effective addition
- Low power requirements, minimizing battery and charger size
Technology

This monitoring system uses Granier thermal dissipation probes to observe sap flux density and to estimate transpiration in individual trees. Two probes, installed in a woody trunk one above the other, used heat to determine sap flow. Instead of observing sap flux, however, UF researchers insert probes into a tree to determine the amount of water present in the trunk. A new algorithm and signal condition system developed by University of Florida researchers omits the effect of ambient temperature and measures water content every five minutes (this interval can be changed), allowing real-time, accurate data. The device is easy to install, is relatively low cost and scalable for large commercial orchards. With a user-friendly monitoring display that shows the tree water status, producers can estimate the needs of their trees and make more accurate and earlier decisions for irrigating trees before they suffer water stress. Scientists have used a prototype system in citrus trees in different locations in Florida, yielding hourly and daily water status reports to demonstrate feasibility and efficacy.

Inventors

Reza J. Ehsani, Ph.D., was an associate professor and precision agriculture specialist in the Citrus Research and Education Center at the University of Florida. Dr. Ehsani earned his Ph.D. in biological and agricultural engineering at the University of California at Davis. His research interests include engineering systems for agriculture, automation and intelligent machines for agriculture, precision agriculture and horticulture and mechanical harvesting machines and robots.

Azadeh Alizadeh is a Ph.D. candidate at the University of Florida. Her research focuses on developing tools and techniques for early detection of water stress as well as a model for estimating sap flow based on water uptake rate sensor.

Arash Mohammadi Toudeshki, Ph.D, was a postdoctoral researcher at the University of Florida. He earned his Ph.D. and master's degree in electrical engineering from Universiti Putra Malaysia. Dr. Toudeshki's research focuses on the development of centimeter and sub-centimeter sized sensors, and both analog and digital electronics signal condition systems for biological and agricultural purposes.

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