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Smarter Irrigation Management: Wireless Sensor Systems

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Abstract Text:

Concern over the intensive use of groundwater, deterioration of surface waters and various state and federal nutrient and water management regulations, are making us reexamine the efficiency of water and nutrient management strategies in the Nursery and Greenhouse Industry. Water is an integral component of any nutrient management strategy, particularly when inefficient irrigation can move soluble nutrients from the container to surface waters. At present, best management practices (BMP) for irrigation include cyclic or intermittent scheduling, utilizing several irrigation events a day to increase the percentage of applied water held by the substrate, and in turn, help maintain adequate moisture levels in the substrate. However this current BMP does not take into account actual water requirements of the plant and irrigations are still scheduled using subjective assessment methods. There are presently several moisture sensors (tensiometers, gypsum blocks, etc.) with the ability to sense soil moisture, but few are practical and effective in soilless substrates, where nutrient leaching is prevalent. Past research has shown that Time Domain Reflectometry (TDR) can effectively reduce water input and nutrient leaching, but this system is too complicated and user-unfriendly for commercial use. We are now integrating TDR-type technology in the form of capacitance probes (Decagon Devices, Pullman, WA) with a multi-hop wireless data logging and control system developed by the Carnegie Mellon Robotics Institute. After calibrating sensors to a specific substrate, the integrated probe/node system is able to precisely monitor and control irrigation schedules based on substrate moisture content and daily plant water requirements. While this system is not yet available commercially, we have shown with an experimental 12-node, 48 sensor network that we can precisely apply irrigation applications to various species, maintain optimum plant growth and significantly reduce leachate volumes, compared to timed cyclic irrigation, the current BMP.

Impact Statement:

In the Nursery and Greenhouse Industry, water is an integral component of any nutrient management strategy, particularly when inefficient irrigation can move soluble nutrients from the container to surface waters. Recent research studying new soil moisture sensors has determined that water availability in horticultural soils can be monitored. Additionally, when these sensors are integrated into wireless data/control systems, optimal moisture levels can be maintained within the root environment. Research shows that the use of this technology can reduce water appplication and nutrient runoff by half.