Soil Moisture Sensors for Nursery Production

Historically, irrigation scheduling in production nurseries has been largely a process of observation and 'feel' for the amount of water that needs to be applied. One of the most common refrains heard in the industry is the difficulty irrigation managers have in being able to determine the right amount of water to apply.

There are a variety of available methods used to assist irrigation managers to schedule irrigation. Analysis of rainfall (effective rainfall), evaporation data and physical assessment of the moisture content of the growing media are all methods currently used.

However, it can take many years of experience to determine optimal irrigation practices for a particular production nursery. Some of the methods used can be time consuming due to the need to monitor all areas of the nursery site, while others don't measure the actual amount of available water in the container (rainfall and evaporation data).

In other countries, automated irrigation systems are used in hydroponic and soilless based containerised nursery production. Such systems allow better control of crop growth by monitoring and regulating moisture content, managing its effects on the dilution of nutrient salts and changing pH, and limiting the amount of leachate generated.

There are a wide range of moisture sensors used in broadacre and horticultural systems. These sensors have been developed for soil based systems and, as these growing systems are usually monocultures, the plant water demand is relatively uniform when compared with nursery production.

The most common 'sensor' used in the nursery industry is the 'feel' of the growing media or look of the crop. However, there has been interest shown in the use of soil moisture sensors to automate irrigation scheduling. A project in 2007 investigated what moisture sensors were available, and whether they may work in nursery production. This project then tested four methods of irrigation scheduling to determine if there were any differences in crop growth and water use between the different methods.

The 2007 project identified the use of soil moisture sensors as a viable way of managing irrigation scheduling and improving water use efficiency. The researchers found there are a number of factors that can influence the suitability and effectiveness of these technologies:

- *The irrigation system needs to meet industry Best Management Practice (BMP) benchmarks. If an irrigation system does not apply water uniformly the accuracy of the soil moisture sensors in measuring the moisture content relative to the surrounding containers will be questionable.*
- *The sensor must be able to integrate with existing irrigation controllers, or a new controller will be required. The irrigation controller needs to have the scope and flexibility to use the data provided by the sensor.*
- *The container size must be able to accommodate the physical size of the sensor.*
- *Growing media type can influence the ability of the moisture sensor to sense the moisture level accurately. The amount of air contained in growing mediums is significantly greater than soil, and may reduce the accuracy of the*

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measured data. If organic based media are being used a sensor calibration against the actual moisture content is required. The growing media must have good contact with the sensor, and there needs to be a connection to a rain sensor to override the irrigation once moisture levels reach a predetermined level.

Insertion units are used as a monitoring tool, and have the ability to measure moisture, temperature, and electrical conductivity (EC). These units require little technical experience. In-situ units can be used for monitoring and/or control, but require a higher level of technical expertise, and are generally more expensive. In-situ units can be connected to irrigation controllers to automate the system.

The project assessed five soil moisture sensors against a set of criteria relevant to the practical application of these technologies to nursery production. The criteria used were:

- *Size of sensor to enable them to fit into a growing container.*
- *Type of sensor— volumetric or soil potential sensor.*
- *Robustness and able to provide reliable data.*
- *Financially viable for smaller nursery operators.*
- *Readily available, with after sales technical support.*
- *Simple and easy to use by nursery staff.*
- *Ability to connect to existing irrigation controllers.*

Using the above criteria, two sensors were selected for field trials— the AquaSpy soil moisture sensor, and ECH20 soil moisture sensor (now obsolete, but upgraded replacements available) —both these units are capacitance sensors measuring volumetric moisture content. The trial compared the two moisture sensors against 'standard' timed irrigation (10 minutes 2 times/day), and deficit irrigation scheduling (replacing only the water used by the crop and from evaporation). The petunia crops were grown in 200 mm pots in either a 85%/15% pinebark/ sand or 85%/15% pinebark/coir growing media using drip irrigation. The trial was run in a glasshouse to minimise climatic factors such as rainfall. Modifications hdd to be made to the AquaSpy sensor to enable it to be connected to the Teven Logic® irrigation controller used.

The results from the trial showed timed irrigation applied the greatest volume of water, followed by the deficit treatment with the two sensor treatments using the least amount. The Aquaspy sensor treatment used 53% less water than the timed irrigation, the ECH20 44% less and deficit irrigation 22% less, with no significant differences in growth compared to the timed irrigation.

The investigations into the use of soil moisture sensors reveal that there is potential for the use of these technologies in nursery production, provided certain criteria are met. Optimisation of the irrigation system uniformity to meet BMP standards, and flexibility of control to limit the variation in moisture content across growing areas and between moisture sensors is required to achieve the best results.

The research showed that one of the limiting factors to the uptake of these technologies is the interfacing of the sensors with existing irrigation controllers due to the signal types, coding or connectivity requirements. However, the research was conducted in 2007, and there are likely to have been changes in technology that have addressed these issues.

To fine-tune irrigation trigger points, i.e. the water content of the growing media that would initiate irrigation, an understanding of plant water use and crop factors is required. With limited research having been conducted on appropriate trigger points, determining when to initiate irrigation events would have to be done on a case by case basis, because of the thousands of plant types grown and different production systems used.

For more information refer to Nursery Papers October 2008 Issue No. 8. "Do soil moisture sensors have a role in containerised nursery production?".

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