

2. Data Logger / Node

Although a variety of data loggers are available from multiple companies, we will only focus on the data loggers (nodes) provided by Decagon Devices Inc. in this module. These loggers are easy to use (plug and play) and do not require complex programming.

2.1. Monitoring Nodes

Decagon Devices Inc. provides three types of Em50 series data loggers: Em50, Em50R and Em50G (Figure 5). These nodes only “monitor” in that they log and transmit data, but have no “control” capability (i.e. they cannot turn devices on and off). The Em50 series of data loggers all have similar functions, but differ in how recorded data is transmitted. The Em50 data logger does not have a wireless communication capacity and data can only be downloaded by direct connection to the data logger. The Em50R data logger has the capacity to transmit recorded data to a data station via radio telemetry (900MHz in the USA). The Em50G data logger, on the other hand, transmits collected data to a cloud server through a cellular network using a SIM (subscriber identity module) card. The data can then be accessed from Decagon’s [ECH2O data](#) server. For information on how to configure the Em50 series data loggers, visit the module [Using ECH2O Utility software](#) or [Using Datatrak software](#). Additional Information is also available from Decagon’s website (www.decagon.com).



Figure 5. Em50 series data loggers (courtesy of Decagon Devices, Inc.)

All three Em50 series data loggers are very easy to use and do not need programming. They are powered by five size AA alkaline batteries and do not require external power source. They have 5 ports for sensors and a communication port via which the data loggers can be connected to a computer and configured. They have a rugged weather-proof external enclosure and are suitable for long term outdoor use. We have had nodes in continuous operation in the field for over 5 years; the only servicing required has been periodic battery changes and firmware updates. Further information about the Em50 series of data loggers is available from [Using ECH2O Utility software](#) and www.decagon.com.

2.2. The Decagon PlantPoint™ System

The PlantPoint™ system that will be released in 2015 has a slightly different configuration. This system consists of three different types of nodes, which look similar, but have distinctly different functions: monitoring (nM50) nodes, control (nC24) nodes, and gateway nodes (Fig. 6). Since the nodes are powered by batteries, they can be placed in production areas where power is not available. nM50 monitoring nodes can be used to connect up to five sensors, and are very similar to the Em50R nodes except they have a greater radio range. nC24 (control) nodes will only accommodate a few sensors, but can be used to control up to four separate relays (devices) from each node.

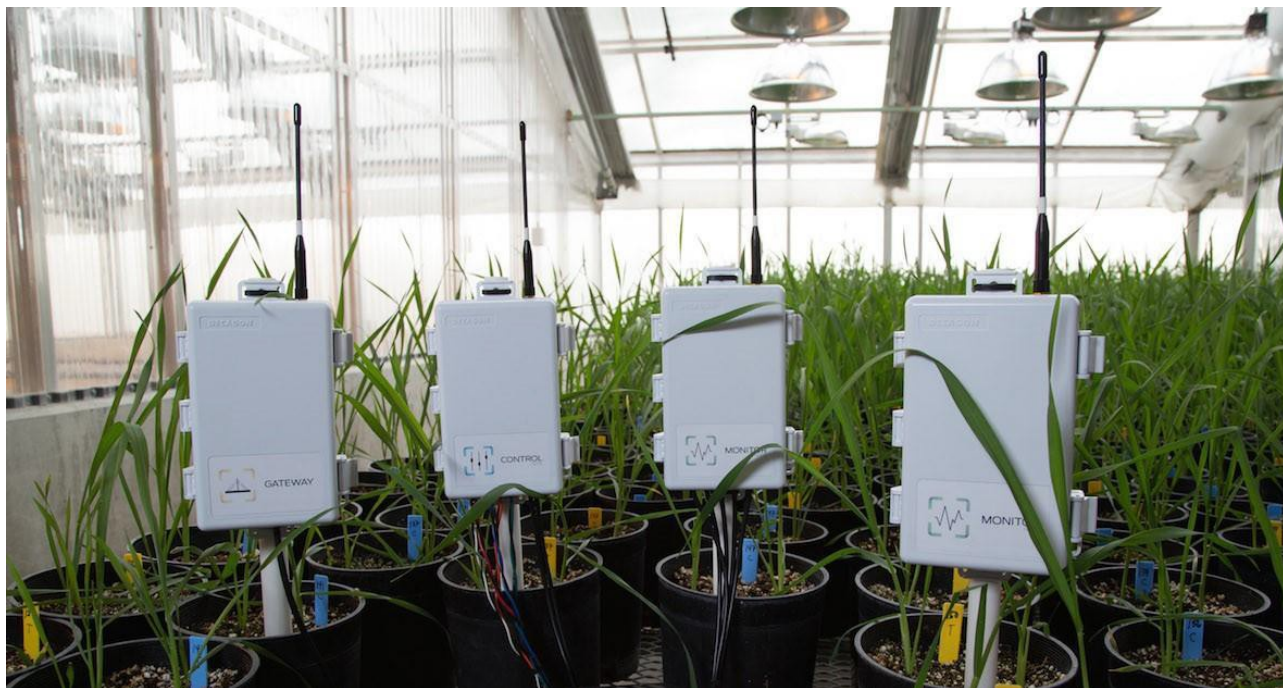


Fig. 6 The commercial wireless network system will have three different nodes. Left to right: a gateway, a control, and two monitoring nodes. (Photo courtesy of Decagon Devices)

The gateway node relays information between the control nodes, monitoring nodes, and the SmartBase station (Fig. 7).

The SmartBase generates a website that can be accessed by internet-enabled devices, such as computers, tablets, or smartphones. This website serves as the graphical use interface.



Fig. 7. The SmartBase appliance is built on an industrial computing motherboard and has no moving parts. The SmartBase generates a webpage that can be accessed online. (Photo courtesy of Decagon Devices).

The website can be customized with a map of a specific greenhouse, nursery or farm and detailed information from each of the nodes can be seen in graphs that summarize the most important information from each node (Fig. 8).

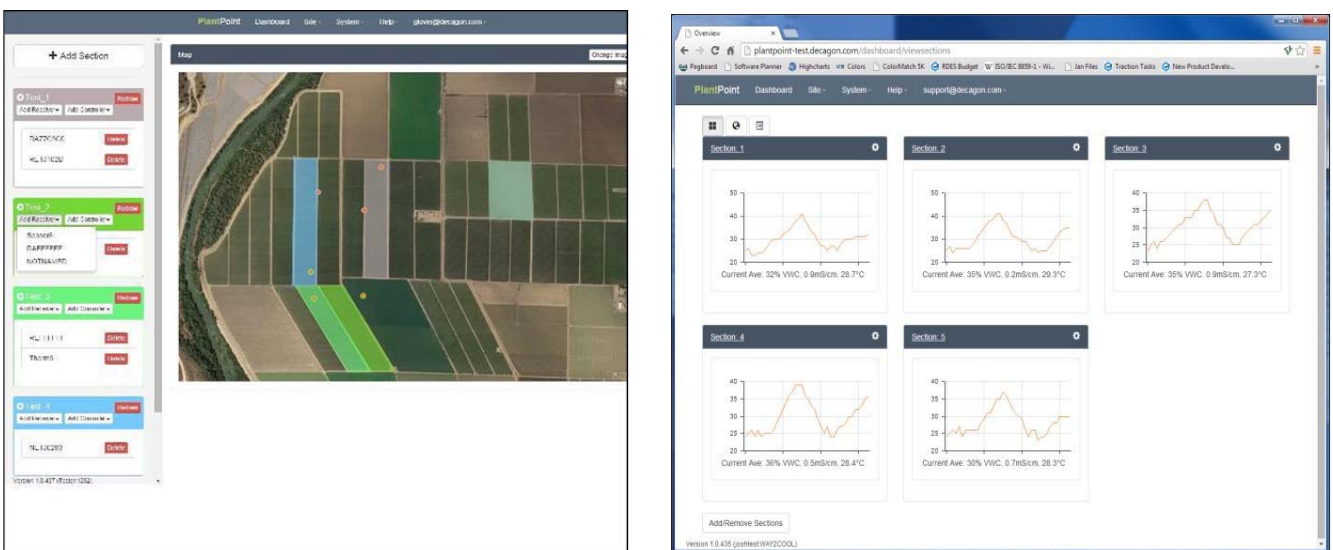


Fig. 8. The graphical user interface of the PlantPoint™ system (Photo courtesy of Decagon Devices).

2.3. Control (nC24) Nodes

As part of the PlantPoint™ system, the nC24 control nodes provide the capability to directly control irrigation events with solenoid valves, based directly on sensor readings, or using model-based information.

There are two version of the nc24 node available from Decagon Devices, Inc.

- **nC24-DC node** – works with 12 V latching solenoids to control irrigation. The power required to turn solenoids on and off comes from the 5 size AA alkaline batteries, making this node suitable for deployment in areas where power is not available.
- **nC24-AC node** – works with 24 V solenoids to control irrigation. An external 24 V AC power is required to turn solenoids on and off, making this node suitable for use in greenhouses.

When working with the Sensorweb™ software program irrigation control can be implemented in two specific ways.

2.3.1. Local irrigation control

This provides irrigation control based either on (a) time or (b) soil moisture sensor readings. Irrigation can be implemented by scheduling windows of time throughout the day when irrigation is desired. The nC24 node turns solenoids on and off based on the windows of time selected by the irrigation manager in Sensorweb™ (Figure 9).

The screenshot shows the Sensorweb™ configuration interface for local irrigation control based on time. The interface includes the following elements:

- Select Irrigation Node/Group:** A dropdown menu showing "B1_2" and a link to "Configure Irrigation Groups ?".
- Select Irrigation Control Source:** A dropdown menu showing "Schedule Only".
- Pulse Type:** A dropdown menu showing "Standard" and a link to "Edit pulse types here".
- Scheduling Instructions:** Text stating "Click on start and end point to create (or delete) schedule below: ? Click here to view all schedules" with an external link icon.
- Schedule Visualization:** A horizontal timeline from midnight to 3am and noon to 3pm. The timeline is marked with vertical red and green lines. Below the timeline, there are blue rectangular blocks representing scheduled irrigation events. A digital clock in the bottom right corner shows "17:15".
- Update Controller:** A button labeled "Update Controller" followed by a red text message: "Maximum irrigation time per day is 0.83 hours".
- Manual Command Section:** Text stating "Send manual command to node B1_2 to turn on irrigation for [] minutes. ? Send Manual Command Now". Below this is a note: "(note: It may take a few minutes for the command to take affect)".

Figure 9. An example of a Sensorweb™ configuration for local irrigation control based on time

Irrigation can also be implemented based on readings (individual or averaged) of soil moisture sensors attached to a specific node. In this case, the nC24 node executes irrigation events for a specified amount of time when threshold soil moisture levels are reached. Repeated irrigation events are then

initiated by the nC24 node until the threshold soil moisture level is reached. In “local” irrigation control, once the desired irrigation scenario is entered into Sensorweb™ and transmitted to the node, the nC24 node can independently execute the command continuously (until modified) even if the Sensorweb™ program is not running on the base computer (for example during power outages).

2.3.2. Global irrigation control

This involves the use of nC24 nodes to implement irrigation based on a variety of growing tools and crop growth models that can be entered into Sensorweb™ (Figure 10).

Simply put, global control can be implemented using data from any sensor connected to any node in the network. It therefore represents a very powerful way to utilize sensor readings on a “farm” scale. Soil moisture sensor data from multiple nodes can be included in an average, to control a specific block; alternatively, only specific sensor data can be used (e.g. decisions based on sensor depth).

Model-based control can also be implemented using this tool, based on reference and crop evapotranspiration (ET_o and ET_c), which are aggregated from other environmental sensors typically installed on a [weather station](#). Sophisticated physiological model-based irrigation (e.g. MAESTRA) has also been successfully used to implement irrigation for container-nurseries. In global irrigation control, the Sensorweb™ program must be running all the time for the irrigation commands to be executed. In instances when Sensorweb™ is not running, the nC24 nodes will revert to a default time-based irrigation setting.

Figure 10. An example of a Sensorweb™ configuration for global irrigation control based on average soil moisture reading of sensors

NOTE: A requirement for integrating nC24 nodes into an irrigation system for irrigation control with 12V-DC and 24V-AC solenoids is that a pressurized water line be available all times. Further information about Sensorweb™ and its irrigation control and other features is given in subsequent sections in this module.