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New Misters for Propagation: Automation and Water Quality Issues©

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NEW MIST NOZZLES

Older styles of mist nozzles, such as flora mist nozzles, typically produce large droplets of water (Table 1) and have flow rates as high as 11.4 $L \cdot min^{-1}$. Newer options available include fog-type mist nozzles. They may cost up to $10, but have several advantages over traditional mist nozzles. The droplet size produced by fog systems tends to be much smaller than that produced by older mist nozzles (Table 1). The actual diameter of droplets will vary slightly depending on the style of fog nozzle you purchase. But, smaller diameter droplets are a benefit because they have a lower surface area to volume ratio. This means that they evaporate much more rapidly and completely and thus more effectively humidify and cool the air. They also tend to have lower flow rates and would likely waste less water than older nozzles. In some cases, fog nozzles will automatically shut off under low water pressures to prevent water from continually dripping onto substrate and leaf surfaces between mist cycles.

Table 1. Droplet size and flow rate of representative mist nozzles. Information compiled from producer and supplier fact sheets.

Mist nozzle	Droplet size (mm)	Flow rate (L/min)
Flora mist	0.5–1.0	0.27–11.4
Dramm misty mist	0.75–1.5	0.64–1.9
Fog nozzles	50–90	0.11

The drawback to using fog nozzles is that smaller diameter nozzles are typically produced by nozzles with smaller orifices. While some fog nozzles contain built-in filters, these filters may not prevent clogging entirely. They may clog more easily than older nozzles with larger orifices. Thus, water quality concerns may become more of an issue.

WATER QUALITY

For propagation, some of the more important water quality issues include pH, alkalinity, and the removal of biological organisms. Most crop species thrive when the water pH is 5.2 to 6.8; propagators with higher pH water sources may need to inject acids (such as sulfuric acid) to maintain optimum pH levels (Bailey and Bilderback, 1998). Alkalinity, which is the buffering capacity of water, may contribute to problems with high pH. That's because carbonates and bicarbonates present in alkaline water neutralize acidic water. A pH meter does not measure alkalinity, so it is vital to measure both pH and alkalinity of a water source used for propagation.

Figure 1. This reverse osmosis system was installed at a young plant production greenhouse to remove pathogens from water used to irrigate young plants.

Removal of biological organisms may be important if you are recycling irrigation water for propagation and are concerned about the presence of plant pathogens or if you have problems of iron-fixing bacteria in your water. There are several options for sterilizing water to remove living sources of contamination. Reverse osmosis systems are costly, but effective, systems for removing unwanted contaminants. Water is forced through semi-permeable membranes in a reverse osmosis system (Fig. 1).

Another popular water sterilization system uses UV light. A UV-C light source has shorter wavelengths of light than UV-A and UV-B light and damages RNA and DNA in living organisms. Thus, exposing water to UV-C light effectively kills any living pathogens in the water. In practice, water is forced into a chamber containing a lamp that emits UV-C light.

AUTOMATION

Automation of mist benches is broadly categorized into "static" or "dynamic" controls (Hartmann et al., 2002). Static automation initiates mist cycles, typically for a few seconds every minute during the day, using a timer. The drawback of static automation is that timers do not respond to environmental changes such as fluctuations in light, temperature, or relative humidity. In an optimum propagation system, mist cycles should be initiated by changes in the propagation environment or plant need. Dynamic mist automation systems may be ideal because by definition they initiate mist cycles based on environmental changes or plant need.

For irrigation control, soil moisture content sensors initiate irrigation when the amount of water in the substrate drops below a grower-determined set-point (Fig. 2). These sensors reliably and consistently automate irrigation of rooted plants and allow growers to water plants with only the amount of water lost via evaporation and transpiration. Further, using moisture sensors allows for irrigation with little to no leachate. While these sensors are a great option for irrigating rooted plants in larger containers, they are not the best automation option for mist benches. This is primarily because the smallest moisture sensors available are approximately 5 cm (2 inches) long and would be too large for almost all containers used in propagation. Second, un-rooted cuttings will have minimal impact on substrate water status. Moisture sensors will primarily measure water loss due to evaporation from substrates until cuttings have rooted. Thus, it is best to automate mist controls based on environmental factors that drive water loss from leaves, not from the substrate.

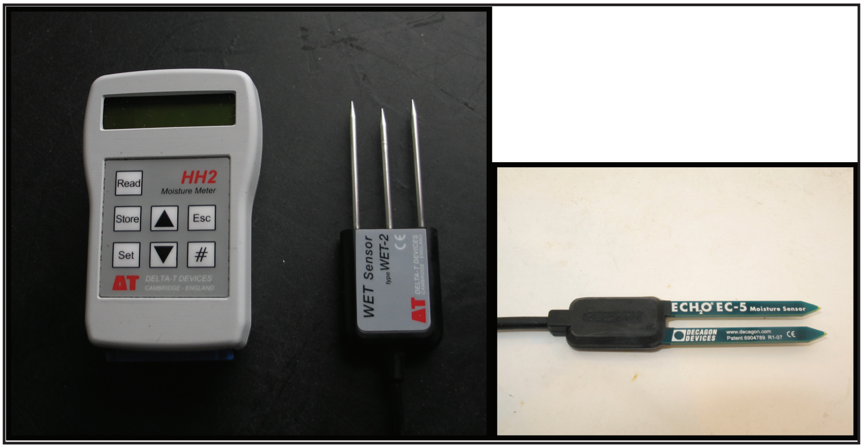

Figure 2. Moisture sensors, such as this hand-held sensor and meter (WET Sensor, Delta T Devices; left) and in-situ sensors (EC-5, Decagon Devices, right) effectively measure substrate moisture content and may be used to monitor or automate irrigation of rooted plants in containers as small as 10-cm pots. However, they are too large for use in propagation.

The three environmental factors that most impact water loss from leaves are light, temperature, and relative humidity. Light, measured using photocells, is often used to automate irrigation. So, on cloudy days, plants will receive mist less frequently than on sunny days. Humidistats, which measure relative humidity, are also often used to automate mist, especially when fog nozzles are producing mist. One of the more effective methods of automating mist cycles involves measuring vapor pressure deficit (VPD). The VPD is the difference between the dew point and the actual relative humidity of the air. It is calculated from air temperature and relative humidity measurements. But, it is more representative of the factors that drive water loss from leaves than temperature or relative humidity measurements alone because warmer air holds more water than colder air. Researchers have developed a computer model that calculates VPD and uses these calculations to automate mist cycles (Geneve et al., 2004). Irrigation computers use models and measurements from relative humidity and temperature sensors in your greenhouse to automate misting. Automating mist cycles via VPD measurements results in a water savings of approximately 38% (Geneve et al., 2004).

LITERATURE CITED

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