LIGHT AND TEMPERATURE SENSITIVE MIST CONTROLLERS

BRUCE MOESEL
American Plant Products and Services, Inc
9200 Northwest 10th Street
Oklahoma City, Oklahoma 73127

Abstract. This paper details available methods of controlling mist propagation systems with environmental sensing. Control objectives, similarities, differences, and interrelationships with fog systems, sprinkler cooling, and watering controllers are discussed.

MIST SYSTEMS

Misting is the primary traditional method of controlling transpiration loss and foliar overheating for propagation. Misting is now being replaced in many propagation applications by fog.

Fog or atomized mist systems provide better control of air moisture content for desired results in controlled environments; however, fog systems have limitations in shade house and outdoor areas where wind tends to carry off the extremely fine fog particles before the fog can effectively alter the propagation microclimate. Fog is also much more expensive than mist systems so mist will be in use for years to come.

Mist systems with larger particle sizes can be used to get water droplets to the leaf surfaces within a propagation area; subsequently the water droplets evaporate increasing the air moisture content in the leaf microclimate and cooling the leaf surface. The objective of mist systems is to maintain turgidity and reduce stress during propagation.

PRIMARY CONTROL OBJECTIVES

Control objectives for propagation mist, propagation fogging, fog cooling, sprinkler cooling and watering are listed because of the interrelationships between them in actual operations. Systems are interdependent because all consume water and require constant operating pressures to provide uniformity. Mist, sprinkler cooling, and watering can involve the same physical water application system used with a change in control (and sometimes a nozzle change) for different stages of growth. Fog systems can be used simultaneously for both propagation and cooling as needed with the proper controls.

Propagation mist. Very short durations of time (usually 3 to 15 seconds) should be used for misting. The time length for each zone should be selected to provide the shortest "on" time required to achieve acceptable uniformity of foliar wetting.

Time between mist starts should vary as needed to provide the desired balance among:

1. Air moisture content in the foliar microclimate
2. Temperature of the leaf surface
3. Soil wetting
4. Water consumption
5. Standing water in misting area.

Propagation fogging or humidification with humidity generating fans. Duration of fog system application should be balanced among the following (given in priority order):

1. Long enough duration to provide uniform results
2. Short enough to prevent foliar, soil, or floor wetting
3. Short enough to prevent wetting due to sensor lag (time required for sensors to record actual conditions)
4. Long enough to provide the desired maximum air moisture content
5. Subsequent stages of fog started and run in accordance with these guidelines if the initial stage(s) running continuously cannot maintain a high enough air moisture level

Time between fog system starts should vary as needed to:

1. Start as much time in advance of requirement as needed to allow for system charging if required
2. Maintain the desired minimum air-moisture content

Fog cooling. Duration of fog system application should be balanced between the following in priority order:

1. Timed short enough to prevent unwanted foliar, soil, or floor wetting
2. Timed to account for sensor lag
3. Limited by a maximum air moisture content
4. Timed long enough to reduce the temperature to the lowest cooled temperature desired
5. Subsequent stages of fog started and run in accordance with these guidelines if the initial stage(s) running continuously cannot maintain a low enough temperature

Time between fog-system starts should vary as needed to:

1. Start as much time in advance of requirement as needed to allow for system charging if required
2. Maintain the desired maximum temperature

Sprinkler cooling. Short duration times (usually 3 to 45 seconds) should be:

1. Long enough to charge the lines and provide full pressure to sprinklers

2. Least amount of time required to achieve acceptable uniformity of foliar wetting

Time between starts should vary as needed to provide the desired balance among:

1. Temperature of leaf surfaces
2. Air-moisture content in the foliar microclimate
3. Minimal water consumption
4. Minimal soil wetting

Watering. Long application times (typically 15 minutes to 12 hours) should be:

1. Short enough to prevent unnecessary run-off of water (may require multiple application per day)
2. Long enough to charge the system fully and provide acceptable uniformity of water application
3. Least amount of time required to achieve media or root wetting desired

Time between starts should vary as needed to:

1. Allow for system charging if required
2. Maintain the desired minimum medium or root-moisture content

MEASUREMENT METHODS

Direct Sensors

Air-Moisture sensors:

1. Humidistats with hair elements (slow)
2. Wet bulb/dry bulb sensors (high maintenance)
3. Electrical sensors that vary resistance with humidity changes (expensive, high maintenance)

Wetted surface and media-moisture content sensors:

1. Screen-weight switch (high maintenance)
2. Pot-weight scale switch (high maintenance, not sensitive enough for mist)
3. Media-moisture content sensors (require soil wetting, and time to react)
4. Electrical sensors that vary resistance with surface water changes (high maintenance)

Plant sensors (for future—not economically viable now)

1. Plant-tissue-moisture content sensors
2. Plant tissue temperature

Indirect sensors

Predictors:

1. Light: most effective predictor of stress change, reacts to sun level and weather
2. Air temperature: helpful in indicating high stress times in conjunction with light sensing
3. Wind speed and direction: expensive, helpful for outdoors
4. Time: poor predictor, even multiple timing changes per day cannot keep pace with stress changes

Present Optimum

Controller sensing and control method. Existing sensor capabilities and costs are such that the direct sensors are best only for selected installations. Relative humidity sensing is needed for fog systems, and large water systems need to be controlled by electronic soil-moisture sensors.

Misting applications utilize water droplets too large to enable a relative humidity sensor to react quickly enough to prevent overwetting. Soil-moisture sensors require soil wetting which is not desired with misting systems. Surface-water sensors require extremely high maintenance, which makes them unsuitable for most horticultural applications where time is also short.

Each of the direct sensing methods also requires one or more sensors per zone, which is not feasible for multiple zone applications.

Indirect sensors that can be used to predict when to mist offer several advantages for misting system control. Light, temperature, ambient relative humidity and wind are "universal stress agents" that are relatively constant for any group of propagation zones. Therefore, one sensor package can be used to control multiple zones of misting. Each zone may contain a different type of plant at a different stage of growth, but the controller can control many zones independently relative to the "universal sensors".

The most important of these stress agents is light, followed by high temperatures. Relative humidity and wind as stress agents have a larger effect on outdoor propagation than on controlled-environment propagation where they are more constant.

Computer controllers can provide excellent control based on the "universal stress sensors" or with direct sensors for specific applications. These computer controllers also have the analytical capabilities to utilize new control methods like saturation vapor pressure deficit control, which may replace relative humidity control for fog applications. Record keeping, future expansion, new sensors and growing methods are additional reasons for large propagators to consider the large investment for computer controllers. Many propagators do not have the budget available to invest in a computer controller and yet still need better control than is possible with timers.

A controller that uses light and temperature in combination with a timed mist on interval can provide excellent control that approximates ideal control. This controller can be economical to buy and will require very little maintenance. Light- and temperature-sensitive mist controllers provide for excellent mist control at a cost only slightly higher than time clocks. These controllers save valuable time for the propagator who no longer has to readjust the time interval several times a day or live with lower stands and less growth.

There are many excellent mist controllers presently available. We are preparing a listing of most of the readily available controllers. This listing will provide easy to follow comparisons among controllers and will detail most features and benefits. These comparisons with manufacturers' prices will provide a controller selection reference to guide you to the controllers that will best serve your needs. This "Controller Selection Reference" can be requested by writing to me, Bruce Moesel at the following address:

American Plant Products & Services, Inc.
9200 N.W. 10th
Oklahoma City, OK 73127
or call me at 1-800-522-3376 or 1-405-787-4833.

THE USE OF HUMIDIFAN IN PROPAGATION

DANIEL C. MILBOCKER

Hampton Roads Agricultural Experiment Station
1444 Diamond Springs Road
Virginia Beach, Virginia 23455

Research was begun in 1974 at the Hampton Roads Agricultural Experiment Station to minimize or eliminate the weaknesses found within accepted propagation practices. Eliminating the application of excess water and its resultant soaking and cooling of the propagation medium was the primary objective of this research. The result was the introduction of ventilated high humidity propagation.

THE CONCEPT OF VENTILATED HIGH HUMIDITY PROPAGATION

Ventilated high humidity propagation is a method of propagation in which cuttings are maintained under controlled temperature and humidity. Temperature is maintained at a determined point by controlling the amount of solar-heated air that is exhausted.