UMass Extension
Greenhouse Crops and Floriculture Program

Fact Sheets
Greenhouse Management / Engineering

Mist and Fog Systems for Propagation

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What is the difference between fog and mist?
Fog particles are generally considered to be less than 50 microns (0.002") in diameter. The particle size typically used in high pressure greenhouse fog systems is about 10 microns. Mist, on the other hand, is particles from 50 to 100 microns. As a comparison, human hair is about 0.004" diameter that equals 100 microns. Breaking one gallon of water into 50 micron droplets will produce about 68 billion droplets of fog.

Injected into the air, tiny water droplets of fog remain suspended until they are evaporated. The smallest particles vaporize almost instantaneously. The larger ones are carried by air currents, gradually becoming smaller until they are vaporized. Mist size particles are heavier and take much longer to evaporate. These are more likely to fall out and wet the plant surface or saturate the growing medium. If they don't evaporate before nighttime, the potential for disease increases.

How fog and mist work for propagation
The humidity in the air affects the evapotranspiration rate from the leaf surfaces. To get good propagation, a balance between humidity and transpiration is needed to allow water and nutrient uptake without excess dehydration. In a crop with a dense foliage canopy and without much air movement, a boundary layer of moisture approaching saturation develops around the plants. If the growing medium is also saturated, there is a potential for problems from fungi, moss, grey mold and fungus gnats.

On the other hand, when the air temperature is high and leaf temperature increases, water loss can exceed the ability of the plant to take up moisture and stress can build up within the plant. The use of fog and mist at this time can reduce the air temperature and increase the humidity within the plant canopy without saturating the plant medium. With more oxygen in the root zone, faster rooting occurs. Once the root system is established, the relative humidity can be reduced.

Experience is usually the best approach to determining the proper humidity level. The following can be used as a guideline:

Establishment phase	60 – 80% relative humidity
Rapid growth phase	55 – 70%
Hardening phase	45 – 50%

Another advantage to the fog system is that foliar feeding, insecticides and fungicides can be applied automatically with a fog system. This saves time and gives a uniform application.

Fog systems
Several methods are used to produce fog. A typical system uses a high pressure pump, distribution piping and nozzles that break the water stream into very fine droplets. Piston pumps are needed to

develop the 800 to 1200 psi pressure to get the 10 to 20 micron size droplets. Most systems available from irrigation equipment suppliers and labeled as fog systems operate on 50 to 60 psi irrigation water and create a droplet size larger than 50 microns. They are really mist systems.

Copper, stainless steel and re-enforced flexible hose are used for piping. Diameter is frequently ¼" or 3/8" as water supply required is only 1 to 2 gallons/hour/nozzle. For propagation, lines of pipe are evenly spaced above the crop area.

Plastic, ceramic and stainless steel are used for nozzles. Nozzles should have anti-drip check valves to prevent dripping after the system shuts off. An integral strainer will keep the nozzle from clogging.

The greatest problem associated with fogging systems is nozzle clogging from chemical and particulate matter. Calcium deposits can coat the inside of the pipe and nozzles reducing flow. Water treatment or the use of rain water or bottled water can solve this problem. Several levels of filtration of particulate matter should be installed.

Fog can also be produced by a system using a high-speed fan with water channeled to the tip of the blades. The shearing action as the water exits the blades produces a fine fog. The fan distributes the fog above the crop canopy. This system has the advantage of less clogging as no nozzles are used but some growers have had to remove the system because of the high noise level.

Water at household pressure, injected through a nozzle into a stream of compressed air will also produce a fine fog. Each nozzle requires both a water and air supply. Different flow rates and droplet sizes can be achieved by adjusting the water and air pressure. Distribution can be through ducts, HAF fans or nozzles evenly space over the crop.

For small areas, some growers have used an electrothermal aspirator with good results.

Fog systems frequently operate with a controller or computer that measures vapor pressure deficit (VPD). The difference between saturation water vapor pressure and ambient water vapor pressure is the VPD and represents the evapotranspirational demand of the surrounding atmosphere as well as the proximity to the dew point. Due to the fact that relative humidity varies with temperature, it is better to manage propagation with VPD. By maintaining the VPD below one, water stress within the plant can be keep at an acceptable level.

Mist systems

A mist system contains piping, nozzles, filter, pressure regulator, solenoid valve and timer or controller. Several types of nozzles are available that develop mist size droplets. These include the deflector or impingement type which operates at 30 – 60 psi water pressure. A leak prevention device (LPD) is frequently added to eliminate dripping. A 100 – 150 mesh strainer in the line will prevent the fine holes from clogging.

Installation should follow the system manufacturer's recommendations. Nozzles can be supported above the bench on risers or suspended from a cable overhead. Most misting nozzles should be placed 3' to 5' above the crop. Spacing is usually on a grid of 3' to 5'. Overlap of 100% or more is necessary to get uniform coverage of the crop.

A solenoid valve is needed to turn the water on and off. The valve should be the type that normally closes with a snap action operation and it should have the same voltage as the time clock or controller. A 24 volt system is safer than a 115 volt one.

Mist systems can be controlled with a time clocks and timer, mechanical sensor, light-operated interval switch (LOIS), humidistat or controller. The time clock governs the time of day the system operates. The timer turns the mist on for several seconds every few minutes (Example: 3 seconds every 3 minutes). The mechanical sensor is usually a screen placed in the plant canopy that collects moisture and turns off a solenoid valve when it gets heavy. The LOIS sensor is mounted next to the glazing and counts the amount of light it receives. On cloudy days it counts slower than on sunny days and triggers the solenoid more frequently. The humidistat is a switch that senses the humidity level of the air and activates the solenoid when the level falls to a preset point. Controllers are made to handle multiple zones and usually operate based on time.

The following are some manufacturers of misting and fogging equipment:

Atomizing Systems, Inc.
1 Hollywood Ave. Bldg #1
Hohokus NJ 07423-1433
Phone: 888/COLDFOG

Jaybird Mfg. Inc.
2595B Clyde Ave
State College PA 16801
Phone: 888/889-4407

Batrow, Inc.
P.O.Box 2276
Short Beach CT 06405
Phone: 203/488-2578

Mee Industries, Inc.
204 W. Pomona Ave.
Monrovia CA 91016
Phone: 800/732-5364

MicroCool
1229 Gene Autry Trail
Palm Springs CA 92264
Phone: 800/322-4364

MicroMist Systems
32032 Dunlop Blvd.
Yucaipa CA 92099
Phone: 909/795-7600

Phytotronics, Inc.
13688 Rider Trail North
Earth City MO 63045
Phone: 314/770-0717

Schaefer Ventilation Equipment
P.O.Box 460
Sauk Rapids MN 56379
Phone: 800/779-3267

Superior Controls, Inc.
24950 Avenue Kearny
Valencia CA 91355
Phone: 661/257-3533

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