VENTILATED HIGH HUMIDITY PROPAGATION

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Abstract. The concept of ventilated high humidity propagation is described as well as the equipment necessary for its operation. Vegetative cuttings were rooted with this sytem of propagation by providing them with a mechanically humidifed atmosphere. Solar heating, the primary problem of high humidity propagation, was controlled by shading and ventilation. This system also minimized the problems of more conventional types of propagation.

Ventilated high humidity propagation is a concept of propagation developed by the author to improve cutting propagation. Saturation and evaporative cooling of the propagation medium are problems of mist propagation with solutions involving almost every conceivable types of heating and combination of propagation medium applied to some form of misting. The obvious solution to these problems is to apply less water as smaller droplets but this solution creates a greater problem of nozzle plugging. The reduction of evaporative cooling through the use of enclosures further increased saturation and introduced the problem of heat entrapment. Thus the problems of mist propagation did not lead to any changes that evolved into anything other than mist systems until this research was undertaken.

Even though minimized, the problems of mist persist. The popularity of mist as a means of propagation despite its problems is due to its adaptability to automation. Automated systems have the distinct advantage of yielding reproducible results with a minimum of labor. Further improvement of propagation required considerable divergence from the commonly accepted concepts of mist as well as improvement over approximately 40 years of mist research. Such divergence was also discouraged by the difficulty in finding satisfactory equipment for testing new ideas.

Research on the concept of ventilated high humidity propagation was begun in 1974 as a novel means of reducing the amount of water applied and for controlling the solar heat accumulating in enclosures. The resultant rooting of cuttings was very promising but existing equipment was expensive, inadequate, and unreliable. After six years, the first commercially feasible humidifier for ventilated high humidity propagation was built. Now equipment is available from several manufacturers as automated and reasonably reliable systems for commercial propagation. Because of its recent introduction, ventilated high humidity propagation is understood by relatively few propagators. My intent is to explain this concept in practical terms and describe existing equipment for making this concept a feasible propagation system.

Ventilated high humidity propagation is a fairly descriptive title for this concept of propagation. Ambient air is continuously humidified during the daylight hours to replace the air around the cuttings as it is heated by solar radiation.

Outside air, which is below 100% relative humidity, is humidified by mixing an excess of small water deposits with it as it enters the greenhouse. The smaller the droplets, the more energy required to make them. Hence, the tendency is to use larger droplets and carry them on a fairly high velocity wind current until they evaporate to satisfactory smallness. The wind current, by being directed over the cuttings, aids in the removal of solar heated air from among cuttings. The excess of droplets is necessary to restore high humidity as the air is being heated. High quality fog requires much slower wind velocities because of the much greater surface area of the larger number of small droplets exposed to air.

Solar heat is the primary problem of summer propagation. Sunlight impinges upon the cuttings and propagation medium and is converted to heat. This heat creates a hot microclimate among the cuttings that lowers the humidity and wilts the cuttings. This heat has to be continuously removed or must be prevented from forming by shading. In practice, both methods are used. At least 200 foot candles of light are necessary for the cuttings. Therefore shading is used to eliminate unnecessary heating and ventilation removes any excess heat. Air movement replaces the need for shading and is most necessary where droplet sizes are large and shading is minimal.

Exhaust ventilation completes the concept and must be adequate for removal of heated air. Generally exhaust vents are located either at the opposite end from the ambient air intake or in a higher position. The exhaust fans or vent openings may be thermostatically controlled to maintain a temperature near the optimum for root initiation.

Temperatures in excess of 90°F are considered inhibitory to root initiation and in excess of 100°F as destructive of new roots that have already grown. Hence, the temperature can be beneficially maintained near 90°F during root initiation when high temperature favors root initiation. Lowering the temperature by increasing the ventilation after root initiation favors root growth and conditions the plant for growth on its own.

Successful propagators have used this concept by installing humidification equipment at the intake vents and at intervals throughout the length of a greenhouse. Hot air was vented at the opposite end by a 3000 to 4000 cu ft/min thermostatically controlled exhaust fan. Fifty to 70% shading was used on greenhouses during the summer and all other vents were closed. Ground beds or flats at ground level have been more successful than raised benches, particularly mesh covered benches. Heat rising from under and between benches lowered the humidity at the bench level resulting in wilted cuttings. The success of fall and winter propagation depended upon the amount of solar radiation. The best results were obtained with little or no shading during cool sunny weather. Humidification was reduced to very low levels to prevent excessive dripping from the greenhouse ceiling when the weather was too cool to operate the fan. While rooting was slower than during the summer, no supplemental heating was required during nonfreezing weather.

The high pressure fog developed by the Mee Industries equipment (see page 100) is excellent for this type of propagation. By concentrating the nozzles at the air intake, a blanket of fog is formed which drifts over the cuttings as it traverses the length of the greenhouse. Nozzles at intervals throughout the greenhouse replenish the fog and maintains high humidity. Because the water is dispersed as a true fog, only slow movement of the fog is necessary to remove heat from among the cuttings if the greenhouse is shaded.

The early models of the Agritech humidifier produced larger droplets that were difficult to maintain airborne. Turbulence in the airflow caused a coalescence of the droplets and saturation near the humidifier. Improved fan blades and a pressurized hub in the humidifier have greatly improved the quality of fog. An oscillator on the humidifier continuously changes the direction of outflow to cover approximately 1000 sq ft per humidifier. Cuttings must be within approximately 35 ft of the humidifier for satisfactory removal of heated microclimates among the cuttings. The best results have been observed in the typical 30 x 100 ft quonset type greenhouse when 3 units were located 33 ft apart, two on one side alternated with one on the other side to completely cover the cuttings with 90 degree quadrant oscillations directed toward the exhaust fan. These units are easily installed and provide an economical means of converting greenhouses for propagation.

A new unit has been used for experimental propagation. The quality of fog is good and the equipment is light and simple to operate. It has no nozzles to plug and is mounted on only one motor. It would be used similarly to Agritech humidifiers and should be available by spring.

As with anything new, acceptance is not always easy, yet some propagators are already convinced that ventilated high humidity propagation is a concept which will remain as a choice for propagators. They are finding that cuttings root better and remain stronger than those from their previous systems. As equipment improves, more propagators should find this to be true.

DALE MARONEK: Don, are you supporting the concept that you should not use any hormones in this system?

DAN MILBOCKER: This has been our experience. The absorbed heat into the medium appears to take the place of the hormone. In most cases you can eliminate the hormone completely.

DALE MARONEK: That seems to go along with what we have found in our nursery where bottom heat plus a hormone causes basal burning. But if we do one or the other we do not get burn.

DAN MILBOCKER: We have seen that high temperature (above 90°F) favors root initiation but lower temperatures are better for root growth.

PETER VERMEULEN: Do you need to use a fungicide and what about water quality?

DAN MILBOCKER: No, we did not use fungicides on the experiment I showed you. Water quality was important on the old units but the newer units do not have a true nozzle and water quality is not important.

PROPAGATION: FOG NOT MIST

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(See Western Region, page 100)