GROWERTALKS

Features

8/31/2017

Perfecting Propagation

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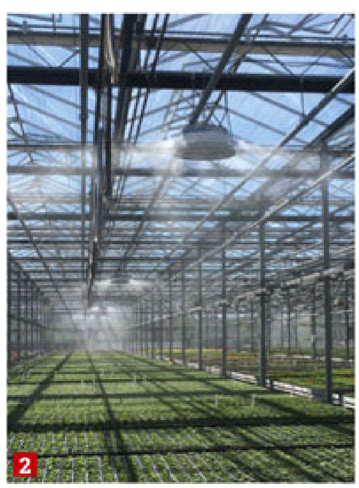
Propagation is the most demanding aspect of growing plants. At this stage, the plant's requirements are the most precise and the least forgiving. Mistakes made during the first weeks in propagation echo through the remainder of the crop, while a perfectly uniform tray of rooted cuttings makes life easy for the grower and profitable for the company.

In this article, we'll discuss the details of the ideal propagation environment, one that maximizes your chances of success. We'll assume the discussion focuses on propagating unrooted cuttings. (We won't address seed plugs, tissue culture or grafted transplants, since those crops require additional modification of your propagation strategy.)

Handling

From the time that the cuttings arrive until they're stuck on the propagation bench is equally important to everything that you do in the propagation greenhouse. This time should be viewed like the entrance of a patient at an emergency room: immediate attention and response is absolutely required. The unrooted cuttings have likely arrived in a box containing dangerous levels of ethylene gas and are at dangerously warm temperatures. You must respond rapidly to improve their environment without exposing them to dry air that will cause them to rapidly dry out and die.



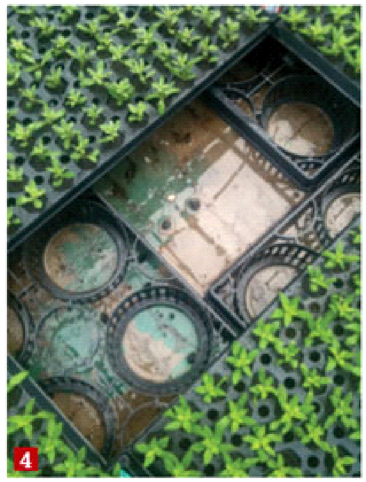


Figure 1. An example of cuttings that wilted on the carts prior to being placed under mist on the propagation bench. n

Figure 2. An example of a fog system in a propagation house that helps to reduce the frequency of the mist events by humidifying the greenhouse air. Also, note that dark shadows that occur in clear glass propagation greenhouses.

Figure 3. Small-stemmed cuttings inserted into large dibble holes result in poor contact between the stem and the growing media. This causes wilting, poor rooting and sometimes death.

Figure 4. An example of excess mist resulting in water accumulation under the propagation trays.

The standard operating procedures for receiving boxes of cuttings demand that someone with responsibility for the cuttings is immediately contacted when a delivery occurs. That individual is then responsible for immediately getting the boxes to a humidified cooler. The most common cooler temperature is 50F (10C) and the relative humidity should be over 80% to reduce water loss from the cuttings. The bags of cuttings should be removed from the boxes and placed onto shelves. This will reduce the cuttings' exposure to ethylene and will allow the cuttings to be cooled more rapidly than if they stayed packed in a tight box.

Sticking priority needs to be addressed. Species that are highly susceptible to ethylene need to be identified and stuck as soon as possible to minimize leaf yellowing, leaf drop and cutting death. Examples include lantana, portulaca, thunbergia, zonal geraniums, poinsettias, ipomea, euphorbia/chamaesyce and agastache.

Once cuttings are being stuck, it's important to maintain turgidity in the leaves between the sticking line and when they're placed under mist (Figure 1). A water tunnel is helpful for wetting the propagation medium and the foliage before the trays are placed on carts and transported to the greenhouse. The trays should stay out of direct sunlight and additional misting may be needed to prevent water stress while the cuttings are in transit to the propagation benches.

Mist, fog & humidity

Once the cuttings are on the propagation bench, water loss must be minimized by misting the foliage and/or humidifying the greenhouse air. If mist is used, the foliage should stay continually moist during the first two days and nights. Afterwards, the mist frequency should be reduced daily until misting ceases, typically between day 10 and 14 for most species. Mist during the night is very important during the winter months because the night length is long and heating systems tend to increase water demand. However, the cuttings begin to regulate their water loss better as they recover during the first week in propagation, so nighttime misting doesn't usually need to be applied after the first two nights.

Excess misting causes several challenges that we try to avoid, such as increased disease risk, leaching of nutrients and algae formation. One method to reduce mist is to increase the humidity. This can be accomplished with a fog generator or water can be applied to the floor underneath the propagation benches. Theoretically, fog is an ideal system to increase the relative humidity in a propagation area (Figure 2); however, maintenance on fog systems can be burdensome.

The mist control system should adapt to the changing environment, thus vapor pressure deficit (VPD) control systems are superior to time clock control. VPD control allows the mist frequency to adjust on a minute-by-minute basis as the climate changes, while time clock systems require growers to make adjustments, which is never as efficient. VPD control doesn't negate the need for a skilled grower, but will allow a grower to utilize their time more efficiently.

Light

Several aspects of light must be properly managed for propagation success. First, the evaporation of water is greatly affected by light intensity, so plants in bright spots will dry out much faster than those under shadows. Therefore, light should be uniformly distributed across the propagation area so that water use is uniform. Shadows can be minimized by providing diffused light in propagation greenhouses. Polyethylene is preferred over clear glass since it diffuses light much better; however, diffused glass is a recent innovation that shows much promise. Shadows are cast by greenhouse gutters, retractable shade curtains and thermal blankets (Figure 2). There are many ways to construct greenhouse and curtain systems, but the key is to avoid orienting the greenhouse or curtains in an east-west pattern, since this arrangement casts shadows that don't continually move throughout the day, especially during the winter months.

The second aspect of light to consider is the total amount of light delivered during the crop—otherwise known as the DLI or daily light integral. Cuttings don't have the same light requirement as mature plants; however, growers frequently provide insufficient DLI in propagation. Low DLI conditions arise when the greenhouse has a shade curtain with too high of a shading percentage and/or the curtain is engaged for too many hours each day. We recommend using a shade curtain with ≤50% light reduction. Often times, shade curtains of ≥60% light reduction are installed in propagation houses, but we find that the DLI can be insufficient in these greenhouses even during the summer months.

A DLI sensor is required to evaluate your greenhouse lighting situation and is certainly a worthwhile investment since the human eye is notoriously poor at estimating light levels. The target DLI is >4 moles/day. Lower DLIs result in slower and less uniform rooting. Cuttings perform well at DLIs in excess of 10 moles/day if water stress can be avoided; however, there's little room for misting error if cuttings run dry on a sunny day. Most propagators find that 5 to 10 moles/day will result in consistently good rooting and growth. During the winter months, supplemental lighting may be required to raise the ambient DLI levels up to 4 to 5 moles/day.

Temperature & ventilation

Bottom heat is essential for root initiation since the growing media temperature should be maintained at a minimum of 68 to 72F (20 to 22C), depending on species. Species preferring cooler temperatures, such as osteospermum, perform well at the lower end of that range, while poinsettias require warmer temperatures to root well.

When considering temperature management, the greenhouse cooling system must be taken into account. Wind or high velocity air movement can be a big problem in propagation houses; therefore, passive ventilation is preferred over the use of exhaust fans (active ventilation). Side vents, or roll-up curtain walls, and ridge vents allow for sufficient greenhouse cooling without causing excessive air movement that can rapidly dry out the cuttings. If one already has a propagation house with exhaust fans, baffles are often necessary to disrupt the laminar flow of air across the top of the cuttings. This can simply consist of a series of 2- to 3-ft. high, plastic walls constructed perpendicular with the air current.

Propagation media & water

Several good options exist for propagation media, but the first key is to have the stem of the cutting in good contact with the growing media. This seems simple, but poor contact resulting from excessively large dibble holes causes significant problems for growers each year (Figure 3). Small stemmed species, such as calibrachoa, are the most problematic. Growers must match the dibble size to the stem diameter.

The second key issue is to maintain the propagation media as “wet,” but not saturated. Technically, the media should be 85% to 95% saturated in order to provide enough water to keep the cutting hydrated and enough air space to supply the oxygen that’s required for respiration. Oxygen doesn’t diffuse rapidly through water, so air spaces are necessary in the pores of the media in order for oxygen to diffuse to the cutting.

The third key is to minimize leaching of water out the bottom of the propagation container. This wastes water and nutrients while promoting algae growth on the floors and benches. Propagators should be in the habit of continually checking under the propagation trays to observe if water is accumulating under the trays (Figure 4). If it’s accumulating, then the mist frequency should be decreased, or a lower volume mist nozzle should be used, or the boom speed should increase.

Water quality & nutrition

Unrooted cuttings arrive with a finite supply of nutrients in their tissues. These nutrients rapidly disappear in the first week of propagation as overhead mist is continually applied. Therefore, it’s expedient to apply nutrients prior to root initiation. There are different methods to deliver nutrients, but the use of water-soluble fertilizers in the mist solution has become popular over the past decade. The nitrogen concentration usually ranges from 50 to 100 ppm and the macronutrients are provided in proportion with the nitrogen. The minor nutrients are provided in proportion to the iron concentration, which is typically 1 ppm. Thus, the macros and minors should be mixed independently or a special propagation fertilizer can be purchased.

Finally, good water quality is critical for propagation success. Specifically, the water should have a low electrical conductivity and a low alkalinity (low concentration of bicarbonates). When mist is frequently applied to leaf surfaces and is constantly evaporating from those surfaces, salts contained in the water don’t evaporate and leave residues on the foliage. These residues cause serious damage to sensitive species, such as hairy, silver-leaved species and Mediterranean herbs, like rosemary and lavender. Alternative water sources need to be found or one must invest in filtration systems, such as reverse-osmosis to correct water quality problems.

Proper greenhouse design, environmental management and cultural practices are key to the successful propagation of unrooted cuttings. Thoughtful execution of these details is the difference between success and failure. **GT**

The author acknowledges the American Floral Endowment, the USDA-ARS Floriculture & Nursery Research Initiative and the Floriculture Research Alliance for their financial support of the research that went into the developing the information in this report.

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