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Propagating Vegetative Cuttings

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Stage 1
Cutting Harvest, Arrival and Sticking


- Shoot tip cuttings have been severed from stock plants for propagation
- Goal is to minimize time and stress between cutting harvest and sticking
 - Initiate misting
 - Moderate temperatures
 - Reduce light levels

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Stage 1
URC Handling Procedures/Priority


- Cutting quality begins to decline from the time the cutting is harvested until ~day 3 to 4 in propagation

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Stage 1
URC Handling Procedures/Priority

- **Three Options:**
 - **PLAN A.** Stick immediately
 - **PLAN B.** Hold cuttings in a cooler (<24 h)
 - **PLAN C.** Hold cuttings on a propagation bench (<24 h)

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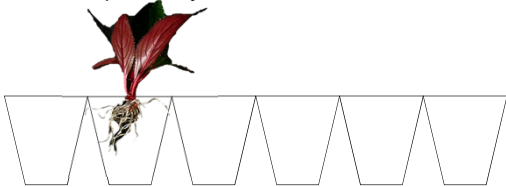
Stage 1 **Sticking**

- Typically, cuttings should be stuck $\frac{1}{2}$ to $\frac{3}{4}$ inch (1.3 to 1.9 cm) deep into a rooting substrate
- Cuttings that are stuck too shallow are prone to lodging
- Cuttings stuck too deep may have root initiation and development hampered by lack of oxygen in space that is constantly filled with water

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Stage 1 **Sticking**

- Most rooting containers have a perched water table that remains $\frac{1}{4}$ to $\frac{1}{2}$ of the depth of the cell, so the base of a cutting is ideally stuck just above this water level





Stage 1 Sticking

- The rooting substrate should be on the propagation bench and thoroughly moistened in preparation for sticking cuttings
- Turn the mist on once you begin sticking cuttings to reduce water stress and start to reestablish turgor in the cuttings



Stage 1 Sticking

- The frequency of mist application will vary widely depending on the crop, weather conditions, and greenhouse environment
- Excessive misting can contribute to future disease problems and excess leaching
- A typical mist routine would be misting every 5 to 10 minutes for 3 to 8 seconds for 24 hours, reduced to every 10 minutes after 3 to 4 days



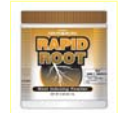
Stage 1 Hormones in Propagation

- IBA (auxins)
 - Promotes uniform rooting
 - Speed of rooting
 - Greater root mass
 - Can increase leaf yellowing by increasing the export of sugars from the source leaves
- Florel (ethylene)
 - Aborts flower buds
- Fascination or Fresco (BA and GA)
 - Reduces leaf yellowing of geraniums



Stage 1 Rooting Hormones

- Dips
 - 1000 to 5000 ppm IBA
 - Powders, liquids, gels
 - Labor-intensive
- Foliar sprays
 - 50 to 400 ppm IBA (@ day 1 or 2)
 - Water-soluble formulations preferred



Stage 1 Rooting Hormones

- | | |
|---|---|
| <ul style="list-style-type: none">• Essential<ul style="list-style-type: none">– Calibrachoa– Crossandra– Dahlia– Mandevilla/Dipladenia– Osteospermum– Scaevola– Sedum 'Autumn Joy'– Hard-to-root cultivars of many species (Lantana, etc.) | <ul style="list-style-type: none">• Beneficial
(under non-optimal conditions)<ul style="list-style-type: none">– Poinsettia– Zonal geranium |
|---|---|





Stage 2 & 3 Callusing and Root Development

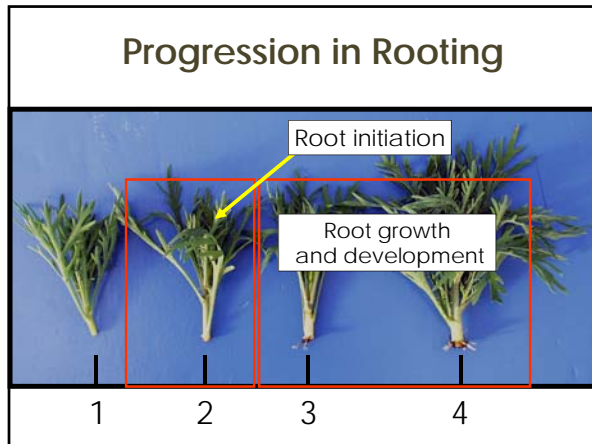
Environmental parameters to control

- Light intensity - Daily light integral (DLI)
- Photoperiod
- Temperature
- Humidity and Air movement
- Misting

Stage 2 Callusing

- The basal (cut) end of the cutting develops a necrotic plate, becomes suberized
- Root initials start to form in the stem
- Try to minimize stress
- Key factors during callusing include:
 - Air and substrate temperature
 - Mist and humidity





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Stage 3 Root Development

- Roots have initiated and must “fill in” the plug
- Maximize root growth
- Key factors during root development include:
 - Substrate temperature
 - Light
 - Mineral nutrition



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Light Intensity

Stage 1: stick to callus formation:

- Initially, provide cuttings with low light levels >500 and <1000 footcandles (>100 and <200 μmol)

Stage 2: after root initiation:

- After roots have initiated, more moderate light intensities >1300 and <2000 footcandles (>260 and <400 μmol) are generally preferred

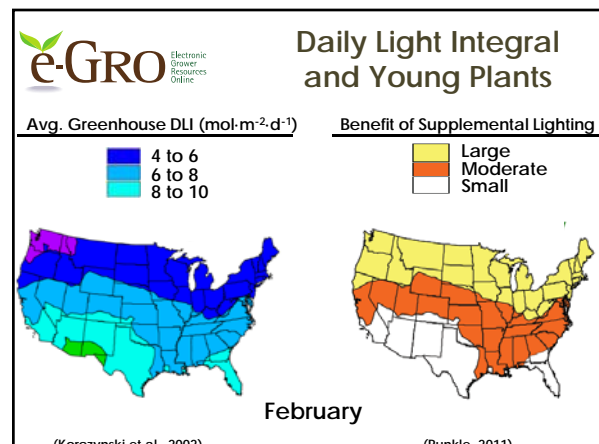
Stage 3: after roots fill half the plug:

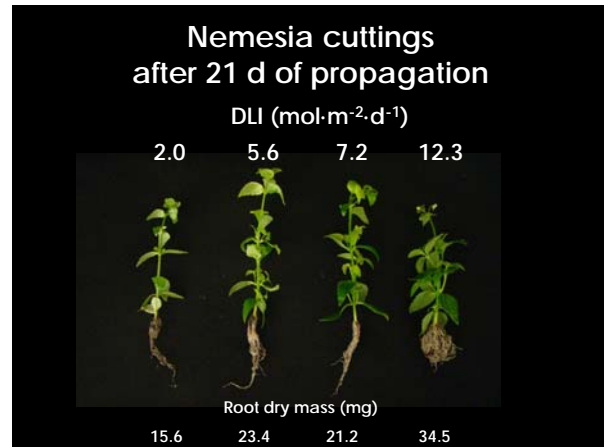
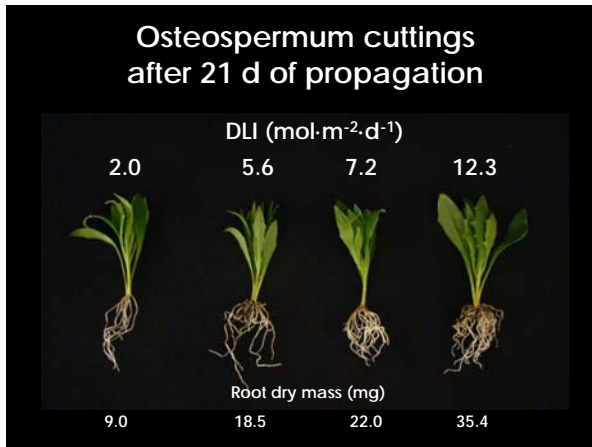
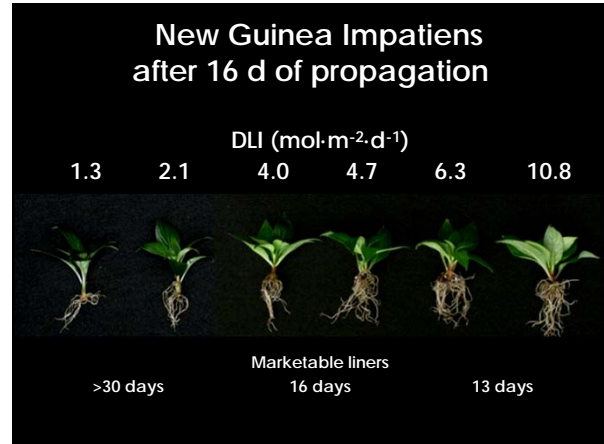
- Once roots fill about half of the plug cell maximum light levels can be increased 2,500 to 4,000 footcandles (500 to 800 μmol)

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Light Intensity

- Diffuse, indirect light is best
- White wash or exterior shade in combination with retractable shade curtains can provide a good system for light modulation, especially in the spring and summer
- Retractable shade curtains alone can be the most effective way to modulate light transmission
- Avoid excessive shading during winter months or during cloudy weather





Temperature

- Bottom heat is recommended for callusing and rooting
- With bottom heat, maintain media at 73 to 77 °F (23 to 26 °C) and air temperature at 68 to 73 °F (20 to 23 °C)
- Without bottom heat, maintain air temperature at 77 to 80 °F (25 to 27 °C)

Under bench bottom heating is efficient, especially with fins

Bench top heating with hot water circulating through tubing is another way to efficiently warm the growing substrate

Temperature

- Greenhouse floor heating can be used to efficiently warm the growing substrate
- Air temperature is generally lower (5 to 15 °F) so energy savings can be achieved

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Humidity and Air Movement


- >70% relative humidity at 68 °F (20 °C)
- >75% relative humidity at 73 °F (23 °C)
- >80% relative humidity at 78 °F (26 °C)



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Misting

- Should be applied to prevent cuttings from drying out, and should be on long enough to just barely coat leaf surface
- Misting frequency should be adjusted based on temperature, humidity, and especially light levels
- Non-misted enclosed tents of plastic can be erected on a bench covering the cuttings



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Fertilizer


Factors influencing root development

- Source: low in P and low in NH_4
 - To reduce unwanted stretch and growth (ie. 14-0-14, 15-0-15)
 - Avoid addition of P unless you are certain the crop is not adversely affected (ie. poinsettia)
- Frequency: constant fertility of around 50 to 100 ppm N delivered through mist
- Once cuttings have rooted, fertilize at 100 to 150 ppm N every watering with a clear water applied once per week

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Fertilizer

Beware of phosphorus during propagation



RO water (no fertilizer) 50 ppm nitrogen and 8 ppm phosphorus from a plug fertilizer

Erik Runkle, Michigan State Univ.

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Stage 4

Toning the Rooted Cutting

- Cuttings are fully rooted in the cell
- Plants are prepared for shipping and/or transplanting
- Key factors during toning include:
 - Light
 - Moisture
 - Mineral nutrition
 - Height control

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Stage 4

Toning the Rooted Cutting

Plant Growth Regulators

- Application(s) can be made at end of stage 2, stage 3, or start of stage 4
- Low rates, early
- Other environmental factors may be enough to control crop until transplanting/shipping
- Crop, season, local conditions, chemical availability plus other factors will influence choice of PGR

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Stage 4 Toning the Rooted Cutting

Temperature and Light

- Reduce substrate temperatures to 64 to 66 °F (18 to 19 °C)
- This will allow root development to continue but not create unwanted stem growth or stretch
- Reduce air temperature to 58 to 65 °F (14 to 18 °C) to further reduce stretch and begin to tone cutting
- Increase light intensity from 4,000 to 4,700 fc(800 to 940 μmol)

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Take Home Message

General Changes in Environmental Conditions and Cultural Factors During Stages of Young Plant Production

<u>Condition</u>	<u>Stage 1</u>	→	<u>Stage 4</u>
Temperature	High	→	Low
Light	Low	→	High
Moisture	High	→	Low
Nutrition	Low	→	High

	Stage 1	Stage 2	Stage 3	Stage 4	
Light	500 to 1,000 fc	1,300 to 1,800 fc	2,500 to 4,000 fc	4,000 to 4,700 fc	↑
Temperature					
Bottom heat	68 to 80 °F	68 to 73 °F	65 to 68 °F	64 to 66 °F	↓
Air Temp.	70 to 80 °F	68 to 73 °F	65 to 68 °F	58 to 65 °F	↓
Moisture					
Mist	5 to 10 min/ 3 to 8 sec	10 to 20 min/ 3 to 5 sec	Discontinue, syringe	Begin overhead, subirrigation	↓
Substrate	Moist, not saturated	Moderately moist	Reduce moisture	Allow substrate to dry	↓
Fertility	< 0.75 mS/cm	50 to 100 ppm N, low P/ NH ₄ -N	50 to 100 ppm N, low P/ NH ₄ -N	125 to 250 ppm N, toning MgSO ₄ , iron chelate	↑