Propagation Made Easy
Take your propagation skills to the next level

30th Annual Florida Master Gardener Continued Training Conference

Dr. Mack Thetford
Associate Professor of Environmental Horticulture
Mack Thetford: Research Overview

Native plant species establishment for ecosystem restoration

Focus areas:
- reproductive biology of native and invasive plants
- application of propagation, production and landscape establishment techniques for coastal restoration on the Gulf coast
Mack Thetford: Teaching Overview

Plant Propagation
Plant Identification
Annual and Perennial Gardening
Landscape and Turfgrass Management
Ecosystems of North Florida
Dendrology
What We Ask of a Cutting

- Regenerate missing parts under conditions of:
  - Loss of water supply
  - Loss of nutrient supply
  - Excessive wounding
- Do not rot
## Types of cuttings

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<thead>
<tr>
<th><strong>Stem cuttings</strong></th>
<th><strong>Leaf-bud cuttings</strong></th>
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<td>□ Hardwood</td>
<td>▪ Single node stem cuttings</td>
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- Leaf blade
- Leaf blade & petiole
Adventitious root formation in cuttings

- Root initiation
- Root growth and development
Dedifferentiation-

- The capability of previously developed, differentiated cells to initiate cell divisions and form a new meristematic growing point.
Adventitious root formation

Preformed roots
(latent root initials)

Preformed root initials and root primordia develop naturally on stems while they are still attached to the parent plant.
Preformed root initials

Preformed root initials and root primordia develop naturally on stems while they are still attached to the parent plant.

Adventitious roots arising from preformed root initials

Campsis radicans
Adventitious root formation

Wound-induced roots

Wound-induced roots develop only after the cutting is made, in response to wounding in preparing the cuttings. These roots are formed *de novo* (anew).
Wound induced root formation

Day 0

Day 8

Day 12
# Types of cuttings

plant part or maturity of wood

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Stem Cuttings
Hardwood Cuttings
Deciduous or Narrow-leaved evergreen species

- Mature wood
- Dormant wood
- Firm wood
- Collected during dormant season
- May also need older wood for success
Hardwood Cuttings

- **Straight cutting**
  - Does not include older wood

- **Heel cutting**
  - Includes only a small piece of older wood

- **Mallet cutting**
  - Includes a short stem section of older wood
Softwood cuttings

- Cuttings collected from the soft, succulent, new spring growth of deciduous or evergreen species.
Semi-hardwood cuttings (greenwood cuttings)

- Woody, broad-leaved evergreen species
  - Partially mature wood from summer to early fall
  - Collected just after a flush of growth

- Deciduous plants
  - Leafy summer wood
  - Early fall wood
Herbaceous cuttings

- Succulent, nonwoody stems with leaves retained at the upper end.
- Auxins are generally not required but may be used to gain uniformity in rooting and development of heavier root systems.
- …to Strip or not to strip?
Leaf Cuttings – preformed, primary meristems

- Rudimentary leaves
- Stem (with intact bud)
- Root primordia
- Foot

New plants develop from a latent primary meristem – from cells that have not fully differentiated.
Leaf Cuttings –
Wound-induced, secondary meristems

- African violet
- Begonia
- Snake plant
Adventitious root formation

Preformed roots
(latent root initials)
Adventitious root formation

Wound-induced roots

Wound-induced roots develop only after the cutting is made, in response to wounding in preparing the cuttings.

Begonia sp.
4 STAGES OF ADVENTITIOUS ROOT FORMATION

ROOT INITIATION
1. Dedifferentiation of specific differentiated cells
2. Formation of root initials
3. Development of root primordia

ROOT GROWTH
4. Growth and emergence of root primordia
Wounding of stem cuttings to enhance rooting

Light

Heavy
Auxins

Auxin is required for initiation of adventitious roots on stems, and it has been shown that divisions of the first root initial cells are dependent upon either applied or endogenous auxin.
Auxins – natural and synthetic

Indole-3-acetic acid (natural)
- Considerable auxin activity but easily metabolized by the plant

Indole-3-butyric acid (natural)
- More effective than IAA for rooting and not easily metabolized by the plant.

α-naphththalene acetic acid (synthetic)
- More effective than IAA for rooting
Rooting Chemicals, formulations and carriers

- IBA is the best auxin for general use
  - nontoxic to plants over a wide concentration range
  - effective in promoting rooting of a large number of plant species
  - a relatively stable compound as a powder or liquid
- IBA may be toxic to softwood cuttings of some species
What are Rooting Cofactors?

Naturally occurring substances that appear to act synergistically with Auxin in promoting rooting.

Rooting cofactors
(Diphenols)
(IAA Oxidase /Peroxidase)
(Borate)

Induction of wound root initiation

Auxin
Classification of Plant Rooting Response to auxin

- **Easy to Root** – plants that have all the essential endogenous substances plus auxin.
  - When cuttings are made and placed under proper environmental conditions, rapid root formation occurs.
  - Auxin may enhance rooting, but is generally not required.
Classification of Plant Rooting Response to auxin

- Moderately Easy to Root - plants in which the essential endogenous substances are present, but auxin is limiting.

- Auxin is needed to enhance rooting.
Classification of Plant Rooting Response to auxin

- **Recalcitrant (difficult to root)** – plants in which an essential endogenous substance is limiting or the plant lacks the cell sensitivity to respond to these substances, even though natural auxin may or may not be present in abundance.

- Auxin application provides little or no enhancement of rooting.

- **What can be done to improve rooting?**
Environmental Manipulation
Water Relations – Humidity Control

1. Maintain an atmosphere with low evaporative demand.
2. Maintain acceptable temperatures for the regeneration process at the cutting base and avoid heat stress of leaves.
3. Maintain light levels suitable for photosynthesis and carbohydrate production.
Water Relations
– Humidity Control (vapor pressure)

$V_{\text{air}} > V_{\text{leaf}}$
no water loss from leaves

$V_{\text{air}} < V_{\text{leaf}}$
water loss from leaves
Mist Control systems

- **Static** – rely on clocks and timers to manage intermittent mist and fog systems.

- **Dynamic** – rely on environmental parameters to determine water status of cuttings.
Mist Controls - Static

24 hour clock and short interval clock

Diagram showing the connections between the 120 Volt Power Source, 24 Hour Clock, 24 volt Transformer, Short Interval Clock, Pressure Regulator, Solenoid Valve, In-line Screen, and Water Valve.
Basic mist system plumbing kit $55.00

P40-075 – DIG 24 3/4 inch VAC Preset Drip Zone Valve Assembly $33.00

R750 – DIG Adjustable Stake Sprayer Kit $20.00
Static Controller ($200)

- **Intermatic 24 Hour Outdoor Timer HB31R**
  - $30.00
  - Up to 2 ON / 2 OFF settings per day with a manual override ON/OFF switch

- **Intermatic Repeat Cycle Timer Model C8815 10 min Dial Cycle $140.00**
  - 5 second tripper actuating time.
  - Short Range Cycle Timers provide repeat cycling for “ON” times. Ten combination “ON/OFF” trippers supplied with each switch.

- **Honeywell 24V Step-Down Transformer**
  - $20.00
  - 120v/24v step down transformer, knockout mount, boxed.
Mist Controls - Static

Solid State Timer

120 Volt Power Source

Solid State Timer

Pressure Regulator

Solenoid Valve

In-line Screen

Water Valve
Static Controller ($160)

- Intermatic 24 Hour Outdoor Timer HB31R ($30)
- Up to 2 ON / 2 OFF settings per day with a manual override ON/OFF switch
- Sentinel DRT-1 Repeat Cycle Timer with Photosensor ($110)
  - designed to control devices that must be activated on a repeating cycle can be set in hours, minutes and seconds.
- Honeywell 24V Step-Down Transformer ($20)
  - 120v/24v step down transformer, knockout mount, boxed.
Static Controller ($330)

- **Intermatic 24 Hour Outdoor Timer HB31R**
  - $30.00
  - Up to 2 ON / 2 OFF settings per day with a manual override ON/OFF switch

- **Phytotronics 1A Single Zone Controller**
  - Model No: 1A  Catalog No: 1080 ($300)
  - The controller is provided with a 24 volt AC wall-mount transformer
  - The "seconds of on time" knob allows for 2, 4, 6, 8, 10, 12, 15, 20, 30, 40, 50, and 60 seconds of mist.
  - The "minutes between on time" knob allows for 2, 4, 6, 11, 15, 20, 30, 60, and 120 minutes between mist cycles.
Dynamic Control systems

- Electric leaf
  - Carbon electrodes (evaporation)

- Screen Balance (Mist-A-Matic)
  - Mercury switch (evaporation) weight of water on a screen.

- Photoelectric cell
  - Conducts current in proportion to irradiance.
Mist Controls - Dynamic

Mist-A-Matic

120 Volt Power Source
24 Volt Transformer

Screen Balance
Propagation Bench
Pressure Regulator
Solenoid Valve
In-line Screen
Water Valve
Dynamic Controller ($230)

- **Intermatic 24 Hour Outdoor Timer HB31R**  
  $30.00  
  Up to 2 ON / 2 OFF settings per day with a manual override ON/OFF switch

- **Electronic Leaf Mist Control**  
  $200  
  Includes 24 VAC transformer and 20' of 18-gauge two-strand bell wire for easy attachment to a 24V solenoid.
Enclosure Systems

- Low polyethylene tunnels
- Cold or hot frames
- Contact polyethylene systems
- Indoor polytents
Simple Enclosure Systems
Alternative systems

- **Subirrigation**
  - Water is supplied by capillary action through a coarse medium.
  - Can be used in combination with an enclosure system.