Introduction to Plant Propagation
What are the Basics?

**ART** – knowledge of mechanical manipulation and technical skills which take practice to master.

**Science** – knowledge of plant growth and structure that enable one to understand *WHY* and to explain problems.

**Experience** – knowledge gained over time about different kinds of plants and various methods by which they can be propagated.
This Is Propagation

1. Seed, showing embryo inside.
2. Seed, outside.
3. Seed Capsule.
4. Diagram of a flower.
5. H-budding.
6. Shield Budding.
8. Pot Layer.
11. Cleft Graft.
15. Half-ripe wood cutting.
16. Leaf-bud Cutting.
17. Tip Layer.
19. Mound Layer.
20. Bridge Graft.
22. Tuber.
23. Tuberous Root.
25. Bulb.
Why cuttings?

Clone – plants that are identical to one parent

Sports – chimera – mutations

Quantities

Relatively fast

Relatively easy, but…
Variables in successful cutting propagation

- **Timing**
  - **Magnolia grandiflora**
  - July-August

- **Juvenility**
  - Mature

- **Stage of growth**
  - Semihardwood,
  - terminal bud set
  - mature leaves, 2-3 left on end

- **Size**
  - 4 – 6 inches

- **Wounding**
  - None

- **Hormones**
  - 5 sec dip,
  - 1% NAA in 50% EtOH

- **Media**
  - Coarse perlite, 4” deep flats

- **Bottom heat**
  - None

- **Water management:**
  - **Humidity**
  - 2 ½ sec/ 5 min

- **Mist**

- **Other**
  - Polytent, 53% saran shade
Types of cuttings

- Leaf
  - Leaf bud cuttings = single node
- Stem
  - Herbaceous
  - Succulent
  - Softwood
  - Semi-hardwood = Greenwood
  - Intermediate wood = Ripewood
    - Needle evergreen
  - Hardwood
    - Deciduous
    - Broadleaf evergreen
    - Needle evergreens
- Specialized structures
- Root
Cutting types

Herbaceous

Leaf removal

Plastic bag around pot maintains humidity

Cuttings stuck
Cutting types

- Softwood
- Leaf removal

Plastic bag to maintain humidity

Cuttings stuck
Longitudinal axis of woody dicot stem
Herbaceous dicot stem anatomy
Woody Dicot Stem Anatomy
Events leading to adventitious root initiation
Root development

Emerging root

Root initial

Cambial zone
Transverse section of stem with developing roots

before planting

beginning of rooting

root emergence
Vascular cylinder
Vascular system of dicot (L) and monocot (R) stems

Dicot vascular system is connected by cambium

Monocot vascular system is disperse
Basal cuts

Basal cut just below node  Basal cut in mid-internode
CUTTING TAKEN

DIRECT ROOT FORMATION

INDIRECT ROOT FORMATION

Nondirected (undifferentiated) cell division
Callus formation
Cell differentiation
Vascular strand formation

Competent Root Forming Cells:
Potential Root Initiation Site

Induced Competent Root Forming Cells:
Potential Root Initiation Site

induction stimulus

induction stimulus

Cytological Changes
Directed Polar Cell Division
(i.e. anticinal divisions, etc.)

ROOT INITIALS
Organization at Apex

ROOT PRIMORDIUM
Differentiation
Vascular connections

ROOT EMERGENCE

NO ROOTS

NO ROOTS
Callus formation

1. Bark
   a. Parenchyma
   b. Sclerenchyma Fibers
2. Cambium
3. Wood
4. Pith
Callus to root development
Callus formation
Collecting & Handling

- Know source (true to type, disease-free, insect free)
- Position on the plant
- Leaves turgid, cool
- Prevent desiccation
- Fungicidal dip
- Trim to size
- Remove basal leaves
- Adjust leaf area
- Treat (if necessary) with auxin
Phases of Growth
Leaf removal

1. To make it easier to stick cutting in the medium
2. Prevent rotting of leaves in medium
3. Reduce leaf mass – improve air circulation
4. Prevent umbrella effect over neighboring cuttings
5. Reduce water loss
Leaf area reduction

Reduction of photosynthetic area can hamper rooting except in easy to root species.

Smaller leaf area allows more cuttings per unit area.
Effect of leaf area on rooting
Leaf area remaining

8 leaves 6 4 2
Effect of leaf area on rooting
Special pre-treatments

Girdling, ringing

Etiolation, blanching
Cutting treatment

Wounding admits water, air, auxin; stimulates cell division; opens stem to root emergence
Rooting Hormones

Indoleacetic acid (IAA)
Indolebutyric acid (IBA)
Naphthaleneacetic acid (NAA)
Potassium, sodium salts (KIBA, KNAA, NaNAA)
Naphthaleneacetamide
2,4-dichlorophenoxyacetic acid (2,4-D)
Auxin formulations

- Liquid (carrier is alcohol – ethyl or isopropyl, dimethylformamide, DMSO, water)
- Talc dust (sometimes with fungicide)
- Gel (DipGel)
- Antifreeze (polyethylene glycol)
- Lanolin
## Concentration ranges (parts per million, percent a.i.)

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<th>Range</th>
<th>Rooting Difficulty</th>
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<td>50-100 ppm</td>
<td>overnight soak</td>
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<tr>
<td>500-1500 ppm</td>
<td>fairly easy to root</td>
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<tr>
<td>2000 – 3000 ppm</td>
<td>intermediate wood</td>
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<tr>
<td>4000 – 7500 ppm</td>
<td>hardwood</td>
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<td>10,000 ppm &amp; higher</td>
<td>difficult to root</td>
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Duration of exposure

- Quick dip (5 seconds)
- Soak (1 to 5 minutes, overnight)
- Formulation matters
- Spray on – to wetness
- Dusts and gels adhere to stem and remain
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<th>Dilution (%)</th>
<th>ppm</th>
<th>mg/ml</th>
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Dilution on volume basis (liquids, assuming 100% stock solution)

- 1:1 = 50% = 500,000 ppm
- 1:2 = 33.3% = 333,333 ppm
- 1:3 = 25% = 250,000 ppm
- 1:4 = 20% = 200,000 ppm
- 1:5 = 16.7% = 167,000 ppm
- 1:9 = 10% = 100,000 ppm
- 1:19 = 5% = 50,000 ppm
- 1:99 = 1% = 10,000 ppm
Example:

Dip N Grow auxin formulation is 1.5% active ingredient
(auxins are IBA and NAA in 2:1 ratio)

100% stock solution contains 15,000 ppm
1:1 dilution with water contains 7,500 ppm
1:2 dilution 5,000 ppm
1:4 dilution 3,000 ppm
1:5 dilution 2,500 ppm
1:9 dilution 1,500 ppm
1:14 dilution 1,000 ppm
2:13 dilution 2,000 ppm
Leaves stripped, ready to stick

Dashed line represents depth of sticking of cuttings:

Herbaceous (L), Softwood (C), Ripewood (R)
Other cutting types

Heel cutting

Mallet cutting

Heel  Mallet  Straight
Position of basal cut

Basal cut just above node, mid-internode, below node
Leaf-bud or Single Node

Each piece of stem has a leaf and the associated bud in its axil.
Rooted Single Node Cuttings
Single node, split node cutting
Double node cuttings
Polarity

Normal, upright orientation

Inverted cutting with roots at physiological base and shoots at physiological top.

When laid horizontally, roots develop at physiological base

while shoots develop at the physiological top end of cutting.
Stem (Cane) cuttings

Orientation is hard to determine. Use slanted basal cut for vertical stick. Or, lay horizontal and let the plant figure it out.

New roots develop from base of new shoots
Leaf cutting

African violet leaf cutting

Plastic soda bottle
Leaf Cuttings

Echeveria leaf
Leaf Section cutting

Epiphyllum cactus  Sansevieria
Propagating underground structures
Pre-rooted
(like a natural layer)

Just cut rooted segments apart and pot them.
Dividing a crown

Separate stems with their roots
Division of Rhizomes

Rhizomes are horizontal underground stems, often with roots. Propagate by severing a tip with some stem and roots if present.
Division of Dahlia
Dividing a Tunicate Bulb

Dust segments with a fungicide
Scale Propagation
Separation of Mother and Daughter bulbs
Scooping a bulb to Propagate it

Remove the basal plate and invert the bulb. Daughter bulblets form on the base of the scales.
Root cuttings

Plants that throw suckers from the root system are good candidates for propagation by root cuttings. Simply sever a piece of root and bury it shallowly in the medium.