II. Vegetative Propagation

- Use of Apomictic Seeds
- Use of Specialized Vegetative Structures
- Adventitious Root Induction (Cuttings)
- Layering
- Grafting
a. Use of Apomictic Seeds

- **Apomixis** = Development of seeds from maternal tissue inside ovule
- Some apomictic seeds are formed from megaspore mother cells
- Apomictic seeds produce plants that are genetically identical as maternal plants
- Examples: Mango, Kentucky bluegrass, Citrus
How is Apomictic Seed Formed?

- Asexual seed formation from maternal tissues around zygotic embryo inside an ovule
- Apomictic seeds can be formed from nucellar tissues, egg mother cell, flower heads (bulbils)
- Found in Kentucky bluegrass, dandelion, citrus, Alliums

Nucellar embryos in Citrus
b. Specialized Vegetative Structures

- Runners (Stolons)
- Bulbs
- Corms
- Rhizomes
- Off-Shoots
- Stem Tubers
- Tuberous Roots
- Root Suckers
Runners (Stolons)

- Above-ground running stems
- New plants are formed on each node
- Examples: Strawberry, Spider Plant, Buffalograss
Bulbs

- A specialized underground organ consisting of a basal plate, growing points, flower primordia, and fleshy scales
- Found in monocots
- Tunicate bulbs - Onion, tulip, garlic, hyacinth
- Non-tunicate bulbs – Easter lily, Oriental lily
- Bulblets, bulbils, stem bulblets
Scaly Bulbs: Easter Lily
Anther Removal on Easter Lily Flowers

- Pollen germination on stigma triggers ethylene release
- Yellow color stain makes the flowers unsightly

Anthers intact  Anthers removed
Rhizomes

- Laterally grown underground stems
- Iris, ginger, lily of the valley, orchid
Offshoots

- Lateral shoots, often with roots at the base, produced on main stems which can be separated and grown as independent plants
- Examples: Pineapple (slip), dendrobium, cymbidium
Stem Tuber

- Tuber is a swollen, modified stem structure that functions as an underground storage organ
- Examples: potato, caladium, Jerusalem artichoke

Use of eyes in potato propagation
Tuberous Roots

Sweet Potato
- Adventitious shoots
- Adventitious roots
- Distal end
- Scar where tuberous root was detached from mother plant

Dahlia
- Portion of crown

Begonia
- Tuberous stem base
- Distal end
- Old tuberous root as planted
- New tuberous roots developing
b. Cutting Propagation

- Detached stems and roots are used to induce adventitious roots or shoots

- Woody Plants
  - Hardwood cuttings
  - Softwood cuttings
  - Semi-hardwood cuttings
  - Single-node cuttings

- Root Cuttings
  - Problem with phenotype conversion in chimeric plants
Hardwood and Semi-hardwood Cuttings

1-Stock plant nursery, 2-making cuttings, 3-bundles of cuttings, 4-IBA treatment, 5-rooting in artificial mix, 6-outdoor misting system for rooting
Influence of IBA on Rooting- *Cordia parvifolia*

1-Control, 2-50% ethanol, 3-100 ppm, 4-1000 ppm, 5-2000 ppm, 6-4000 ppm, 7-6000 ppm, 8-8000 ppm, 9-10000 ppm IBA
Cutting Propagation in Jojoba

• Regular Stem Cuttings
  – Use 4-5 nodes
  – Semi-hardwood cuttings

• Single Node Cuttings
  – Double-eye single node cuttings
  – Single-eye single node cuttings
Single Node Cuttings of Jojoba
Cutting Propagation in Jojoba
Clonally Propagated Jojoba Field
Bakersfield, CA
Shoftwood Cuttings - Hydrangea

Use of Butterfly and Single Node Cuttings
Softwood Cuttings-Peach
Herbaceous Cuttings - Carnation
Pauk Ecke’s Poinsettia Greenhouse
Leaf Cuttings-African Violet, Piggyback Plant
Chimeras

- A plant that is composed of tissues of more than one genotype
- Chimera (Greek Word)

A mythological monster, having a lion’s head, a goat’s body and a serpent’s tail
Three Types of Chimeras

- **Periclinal (hand-in-glove)**: Plant
- **Mericlinal (irregular sectoring)**
- **Stable mutant type. Not a chimera**
- **Original type (stable)**
- **Sectoral (piece-of-a-pie)**
Examples of Chimeric Plants

Chrysanthemum

Rose
Propagation by Grafting

• **Requirements for Success**
  – Compatibility between stock and scion
  – Alignment of cambium layers
  – Prompt handling

• **Grafting Methods**
  – Cleft grafts
  – Whip-and-Tongue
  – Side grafts
  – Budding
  – Inarching
  – Bridge Grafts
  – Topworking
Cleft Graft

- Scions are bevelled in two directions
- Scion placement in stock
- Correct cambial contact
- Scions in place
- Right
- Wrong
- Incorrect, due to lack of cambial contact
- Incorrect, no cambial contact
- Wounds are covered with grafting compound. If both scions grow, one is subsequently removed.
Whip Graft, Whip-and-Tongue Graft

Whip Graft

Whip-and-Tongue Graft
Side Grafts

Scion

Position of cut on understock

Completed graft
Budding
Grafted Plants
Bridge Graft and Inarching

- Rejuvenating old fruit trees
- Repair damage on the tree trunk
Topworking

- Scions are grafted on branches of mature trees
- Used to change cultivars on old fruit trees
Use of Herbaceous Grafting

1. Virus Indexing
2. Synthetic Plants
3. Construction of Genetic Chimeras
4. Improved Crop Performance
5. Research in Plant Physiology
6. Enhancement of Esthetic Value
Various grafting methods in vegetables with or without rootstock root systems

Cucurbit (watermelons, melons, cucumbers, squashes, etc.)

Solanaceous crops (tomatoes, peppers, eggplants, paprika, etc.)
Grafted Cactus Production
Tomatoes, grafted onto tomato rootstock (left) or on potato (right)
Eggplant/potato

Cabbage/Radish

Chinese cabbage/Radish

Eggplant/potato

Tomato/eggplant
Herbaceous Grafts
### Cultivation of Grafted Vegetables in Korea and Japan.

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<th>Crop</th>
<th>Japan</th>
<th>Korea</th>
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<tr>
<td></td>
<td>Field+Tunnel</td>
<td>Greenhouse</td>
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<tr>
<td></td>
<td>Total Grafted</td>
<td>Total Grafted</td>
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<tr>
<td>Pepper*</td>
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Robotic Grafting Machine
Seedling Grafting on Vegetable Plugs
Herbaceous Grafts
After placing the scion on the top of rootstock to match the vascular bundle, thread or clips are used to hold the position.

*Diameter of scion: 10 mm.*

* After placing the scion on the top of rootstock to match the vascular bundle, thread or clips are used to hold the position.

*Standard rootstock length: 9 cm long*

* Diameter of rootstock: 30~35 mm*

__**Hylocereus trigonus**, the most popular rootstock for cactus grafting__
Care of grafted watermelon seedlings in a commercial greenhouse
Commercial Cactus Greenhouse in Korea