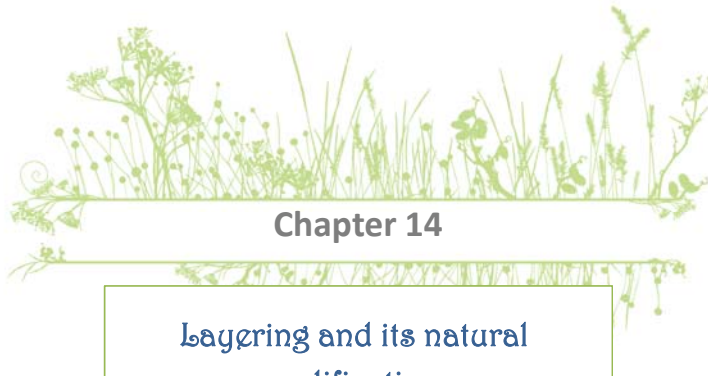





Plant Propagation

Dr. Sandra Wilson
Dr. Mack Thetford



Chapter 14

Layering and its natural modifications





Reasons for Layering success

- Attachment to the mother plant.
- Increased photosynthate and hormones in the rooting area.
 - A function of excluding light
- Invigoration and or rejuvenation
- Taking advantage of seasonal effects on rooting.

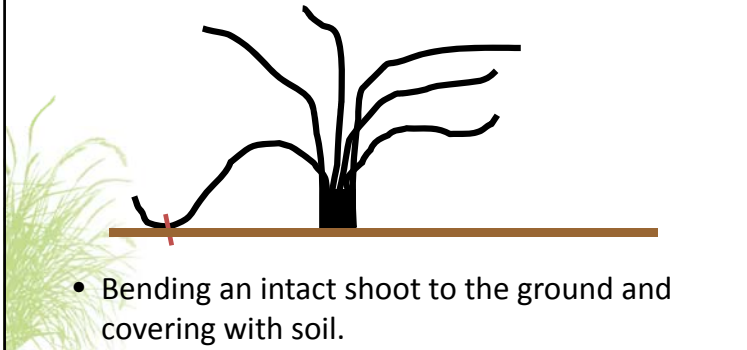


Procedures in Layering

- Simple
- Compound
- Serpentine
- Air
- Mound layering or stooling
- Trench
- Drop



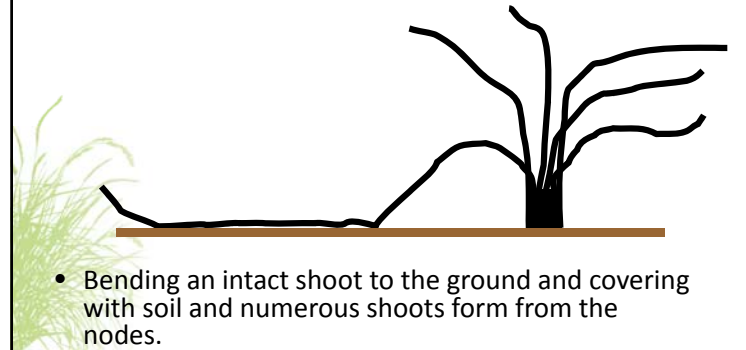
Simple Layering



- Bending an intact shoot to the ground and covering with soil.



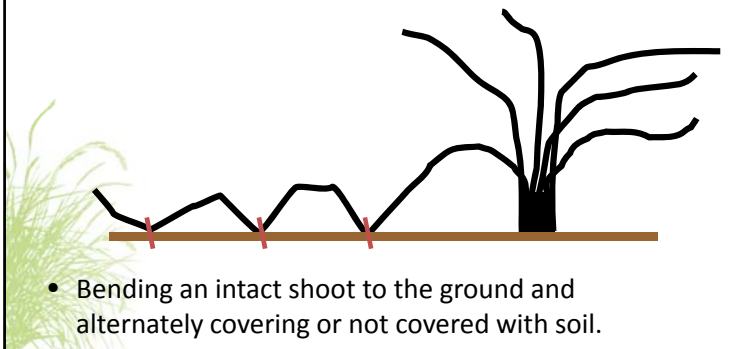
Compound Layering



- Bending an intact shoot to the ground and covering with soil and numerous shoots form from the nodes.



Serpentine Layering



- Bending an intact shoot to the ground and alternately covering or not covered with soil.



Air Layering

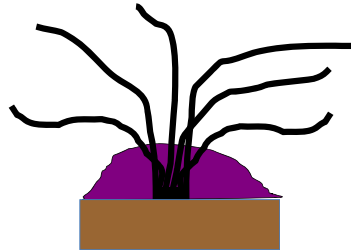


- Wrapping an aerial stem with rooting medium and causing adventitious roots to form.



Mound Layering or Stooling

- Shoots are cut back to the ground.
- As new shoots emerge rooting medium is mounded at the base of the new shoots.
- New roots form at the base of covered shoots.



Mound Layering or Stooling by trench layering



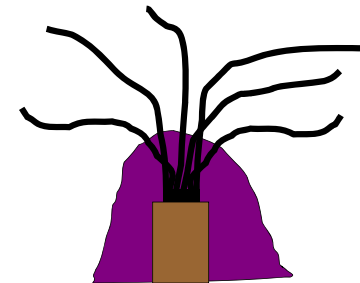
MANAGEMENT OF PLANTS DURING LAYERING



Figure 14-1 Apple rootstock production. (a) Apple stoolbeds of 8- to 10-year-old M9 EMLA rootstock, (b) stoolbeds of MM 111 planted at a 45 degree angle prior to layering, (c) layering with temporary electric cable clips to tie-down and train the layers flat in the planting trench, (d) sawdust applied on new growth in late May in England to etiolate the base of rootstock, (e) harvesting stoolbeds with a tractor-mounted rotary saw, (f) nursery-designed saw with replaceable teeth, (g) one-year-old, rooted apple layers with soil removed, and (h) brushing-off the winter covering of sawdust and soil in late March to begin the next stool crop cycle. Courtesy

Drop layering

- Mound layering of containerized plants.



PROCEDURES IN LAYERING

Table 14-1
COMPARISON OF DIFFERENT LAYERING TECHNIQUES

Layering technique	Description	Plants propagated by these methods
Simple	An intact shoot is bent to the ground and a single portion of the stem between the base and shoot tip is covered with soil or rooting medium so that adventitious roots form.	Numerous tropical and temperate shrubs and some trees. Examples include: hazelnut (<i>Cobalt</i>), viburnum, Forsythia.
Compound	A branch with numerous nodes is laid horizontally and covered with soil. Shoots develop from each node. Roots can form on the new shoots or the buried nodes.	Several woody shrubs as well as woody and herbaceous vines. Examples include: grape, wisteria, pathos.
Serpentine	Similar to compound layering except that each alternating node is covered with soil, leaving one node to root and the other node to develop a new shoot above ground.	Several woody shrubs as well as woody and herbaceous vines. Examples include: grape, wisteria, clematis, philodendron, pathos.
Air	A portion of the above ground stem is girdled and covered with a rooting substrate (sphagnum moss in a polyethylene covering). The girdled portion of the stem roots.	Several woody and herbaceous plants, especially tropical plants. Examples include: Citrus, Croton, Dracaena, Ficus.
Mound	Shoots are cut back to the ground and soil or rooting substrate (sawdust) is mounded around them to stimulate roots to develop at their bases.	Woody trees and shrubs, especially fruit tree rootstocks. Examples include: apple, cherry, hazelnut, oak, pecans.
Trench	The initial stem used to establish the layering system is laid horizontally in a trench. Shoots develop from nodes along the stem that are then covered with mounded rooting substrate (sawdust) similar to mound layering.	Woody trees and shrubs, that are difficult to establish from mound layers. Examples include: apple, cherry, quince, mulberry, walnut.
Drop	A modification of mound layering where the plants are grown in double-stacked containers rather than in the field.	Some woody shrubs. Examples include: barberry, boxwood, rhododendron.



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PLANT MODIFICATIONS RESULTING IN NATURAL LAYERING

Table 14-2
COMPARISONS AMONG STRUCTURES USED IN NATURAL LAYERING

Type of modified stem structure	Growth habit	Plants propagated by these structures
Stolons	A trailing or arched stem that grows horizontally above or below the soil to form new plants at the nodes.	Dogwood (<i>Cornus stolonifera</i>), bugleweed (<i>Ajuga</i>), mint (<i>Mentha</i>)
Runners	A specialized type of stolon (usually without leaves) that arises from the axil of a leaf at the crown and grows horizontally above ground. New plants arise at the tip as daughter plants.	Strawberry (<i>Fragaria</i>), spider plant (<i>Chlorophytum</i>), strawberry geranium (<i>Saxifraga</i>)
Rhizomes	A horizontal stem distinguished from a stolon because it is also modified as a storage organ. Usually found in ferns and monocots (see Chapter 15).	Iris, Solomon's seal (<i>Polygonatum</i>)
Crowns	The growing point of a plant at the soil surface where new shoots are formed.	Many herbaceous perennials and ornamental grasses
Offsets	Short horizontal shoot at the base of the main stem that forms an independent crown.	Many bulbs, daylily, Hosta, palms
Suckers	Shoots that develop from underground roots or shoots. In most cases, these arise from roots.	Raspberry (<i>Rubus</i>), pawpaw (<i>Asimina</i>)



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Stolons -



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- horizontal shoots (stems) growing laterally from the crown of a plant.

PLANT MODIFICATIONS RESULTING IN NATURAL LAYERING




Figure 14-18 Runners (arrow) arising from the crown of a strawberry (*Fragaria*) plant. New plants are produced at every second node. The daughter plants, in turn, produce additional runners and runner plants.



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- horizontal stem developing from the axil of a leaf which forms a new plant at one of the nodes.

Rhizomes –

- horizontal stem – typically the primary stem of the plant.



Crowns –



root-stem juncture of the plant.

PLANT MODIFICATIONS RESULTING IN NATURAL LAYERING

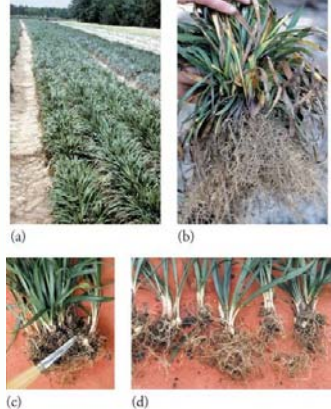


Figure 14–26 (a) Stock beds of field-grown Liriope. (b) Removing crowns, and (c and d) dividing into rooted liners or "bibs."

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Offsets –
(offshoot)



- a specialized leafy plant stem that develops from the base of some monocots.

Chapter 15

Propagation by
specialized stems and roots


Bulbs

Morphology

- Basal plates
- Scales
- Contractile roots

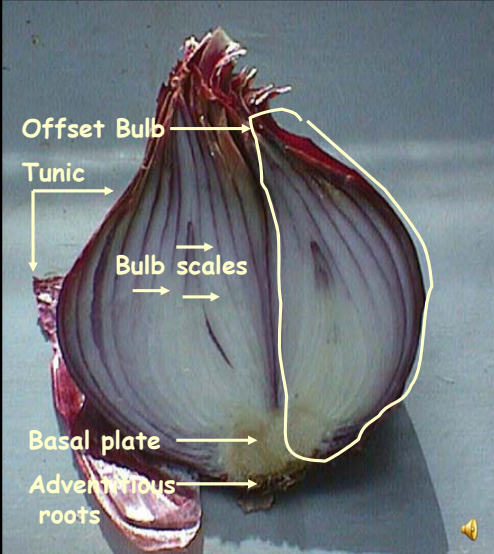
Types

- Tunicate (Laminate)
- Scaly



T
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C
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B
U
L
B



Offset Bulb

Tunic

Bulb scales

Basal plate

Adventitious roots

BULBS

- Definition and Structure
 - A **bulb** is a specialized underground organ consisting of a short, fleshy, stem axis (**basal plate**), bearing at its apex a growing point or a flower primordium enclosed by thick, fleshy scales.

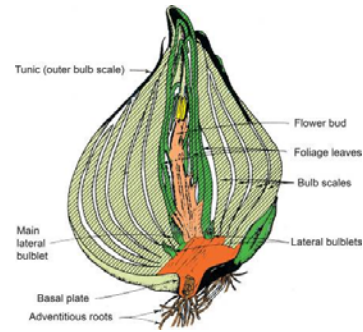


Figure 15-1 The structure of a tulip bulb—an example of a tunicate laminate bulb. Longitudinal section representing stage of development shortly after the bulb is planted in the fall.

BULBS

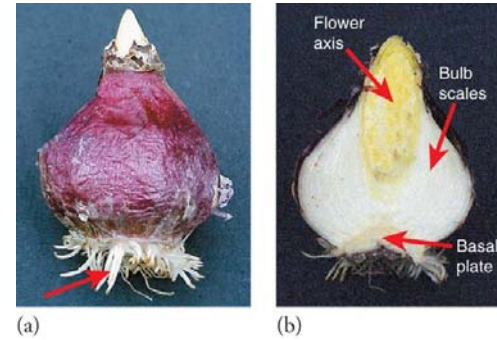


Figure 15-2 (a) Bulb with tunicate covering and adventitious roots (arrow). (b) Cross-section of bulb showing basal plate, bulb scales, and flower axis.



BULBS

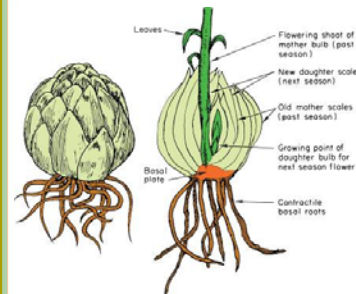



Figure 15-7 Left: Outer appearance of a scaly bulb of lily (*Lilium hollandicum*). Right: Longitudinal section of a bulb of *L. longiflorum* 'Ace,' after flowering stage, showing old mother bulb scales and new daughter bulb scales. Bulb obtained in fall near digging time (18).

Propagation

- **Bulblets** – underground miniature bulbs
- **Offsets** – bulblets grown to mature size
- **Bulbils** – aerial bulblets




Bulbils

- **Aerial bulblets**


Allium
(onion)

Lilium
(lily)



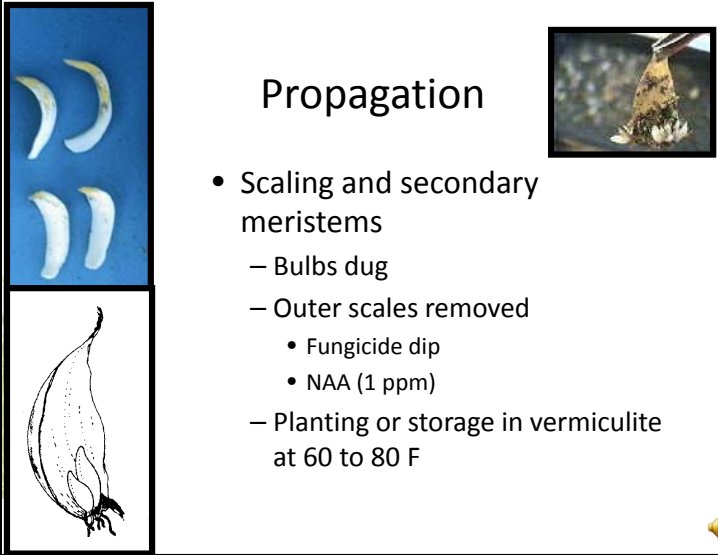
BULBS

- Propagation
 - Offsets
 - Tulip
 - Daffodil
 - Lilies
- Bulblet Formation on Stems
 - Stem Cuttings
- Bulblet Formation on Scales (Scaling)
- Basal Cuttage
- Leaf Cuttings
- Bulb Cuttings





Propagation

- **Scaling and secondary meristems**
 - Bulbs dug
 - Outer scales removed
 - Fungicide dip
 - NAA (1 ppm)
 - Planting or storage in vermiculite at 60 to 80 F






Cuttings

- Stem-tip
- Leaf node
- Leaf
- Tissue culture



Bulb Cuttings

- Amaryllis, Nerene
- Bulb sectioning
- Twin scaling

Basal Cuttage

- Hyacinths
- Offsets - too slow
- Scooping – removal of basal plate
- Scoring – destruction of apical meristem

BULBS

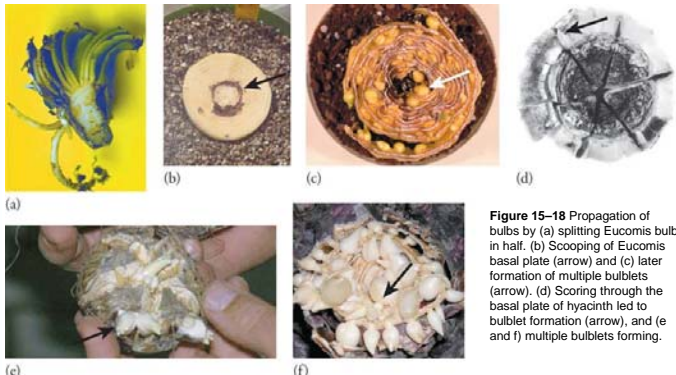
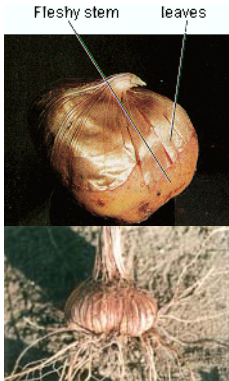


Figure 15-18 Propagation of bulbs by (a) splitting *Eucomis* bulb in half, (b) scooping of *Eucomis* basal plate (arrow) and (c) later formation of multiple bulblets (arrow), (d) scoring through the basal plate of hyacinth led to bulblet formation (arrow), and (e and f) multiple bulblets forming.

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Corm

- Structure-
 - solid stem structure with distinct nodes and internodes
 - dry leaf bases form a tunic
 - fibrous and contractile roots
- Propagation
 - Corm division
 - Cormels



CORMS

- Definition and Structure
 - A **corm** is a unique geophytic structure characteristic of certain important ornamentals, such as *Gladiolus* and *Crocus*.

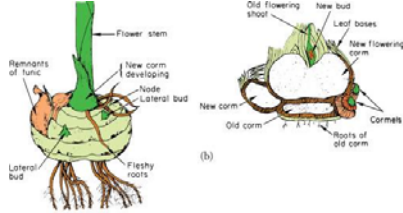


Figure 15-20 Gladiolus corm. (a) External appearance. (b) Longitudinal section showing solid stem structure.

CORMS

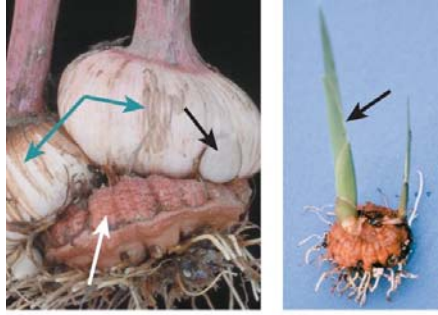


Figure 15-21 (a) Stage of gladiolus corm development during the latter part of the growing season. The remnants of the originally planted corm (white arrow) are evident just below the newly formed corms (blue arrow). A small white cormel has formed (black arrow). (b) Emerging flower stem of gladiolus (arrow).

TUBERS

- Definition and Structure
 - A **tuber** is a special kind of swollen, modified stem structure that functions as an underground storage organ

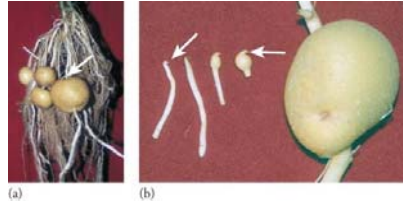


Figure 15-22 Tubers of potato (*Solanum tuberosum*) showing their development from (a) white stolons arising from stem tissue; roots are darker, thinner; the tuber is attached to the stolon the tuber's morphological basal (proximal) end (arrow). (b) Tubertization (tuber formation) is characterized by the hook "gancho" at the subapical portion of the stolon (arrows) and subsequent tuber enlargement.

TUBERS

- Growth Pattern
- Propagation
 - Division
 - Tubercles

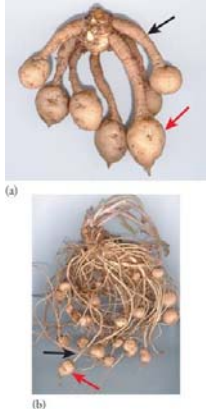
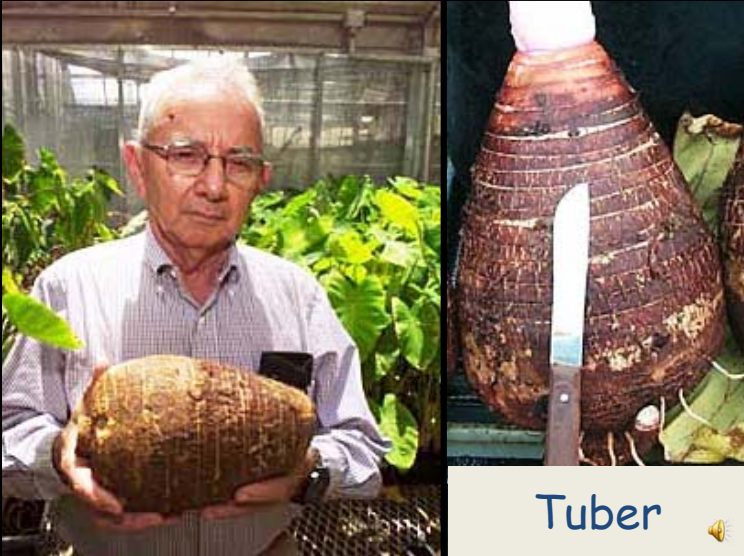


Figure 15-23 Stolon (black arrow) and tuber (red arrow) production in *Cucurma* (ginger, Thai tulip) and *Phlomis* (Jerusalem sage).

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Tuber

Amorphophallus (voodoo lily)

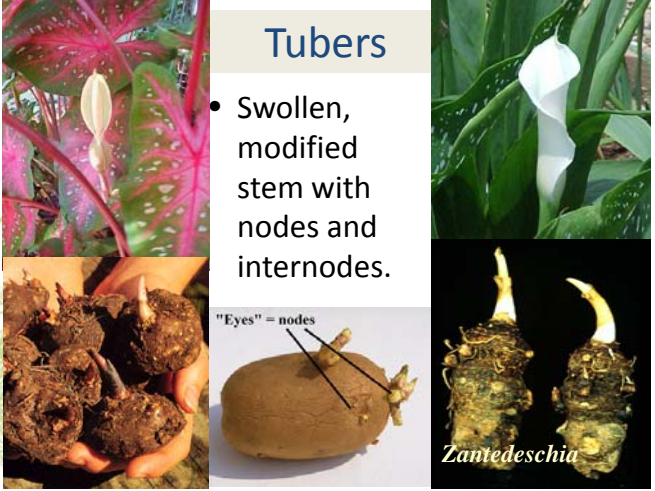
- Tubercle



Tubers

- Swollen, modified stem with nodes and internodes.

"Eyes" = nodes



Zantedeschia

TUBEROUS ROOTS AND STEMS

- Definition and Structure
 - The tuberous root and stem class includes several types of structures with thickened tuberous growth that function as storage organs.
 - Botanically, these differ from true tubers, although common horticultural usage sometimes utilizes the term *tuber* for all of them.



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TUBEROUS ROOTS AND STEMS

- Fleshy and Tuberous Roots
 - Tuberous Stems
- Growth Pattern
- Propagation
 - Division
 - Adventitious Shoots
 - Stem Cuttings



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TUBEROUS ROOTS AND STEMS

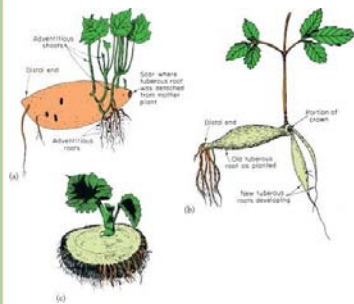


Figure 15-25 Types of fleshy and tuberous roots and shoots. (a) Sweet potato fleshy root showing adventitious shoots. (b) Dahlia during early stages of growth. The old tuberous root piece will disintegrate in the production of the new plant; the new roots can be used for propagation. (c) A tuberous begonia stem, showing its vertical orientation. This type continues to enlarge each year.



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TUBEROUS ROOTS AND STEMS

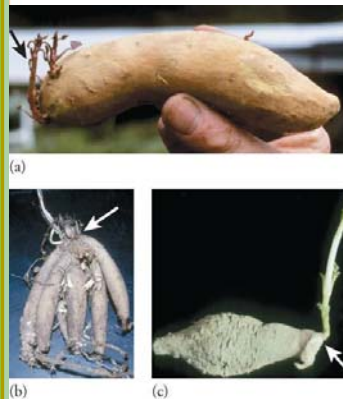


Figure 15-26 (a) Fleshy root of sweet potato with adventitious shoots or "slips" (arrow). (b) Tuberous roots of dahlia attached to crown (arrow). (c) Each separate tuberous dahlia root must have a section of the crown (arrow) bearing a bud that elongates into a shoot.




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Tuberous roots and stems

- Tuberous roots – (Dahlia)
 - Swollen root system attached to the crown.
- Tuberous stem – (Tuberous begonia)
 - Swollen stem produced by enlargement of the hypocotyl.




Tuberous roots

- Propagation
 - Division of tuberous roots with an intact shoot bud.
- Dahlia
 - Adventitious shoots (“Slips”) develop on the fleshy roots.




Rhizomes

- Specialized stem – the main structure of the plant grows horizontally.



RHIZOMES


- Definition and Structure
 - A **rhizome** is a specialized stem structure in which the main axis of the plant grows horizontally at, or just below, the ground surface.




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Rhizome





- Pachymorph – short, thick, fleshy, determinate rhizomes (Iris, Ginger)




Rhizomes


- Leptomorph – elongated, indeterminate rhizomes (Spreading bamboo)
- Propagation
 - Division of clumps and rhizomes
 - Culm cuttings



Rhizomes



Leptomorph



PSEUDOBULBS

- Definition and Structure
 - A **pseudobulb** (literally “false bulb”) is a specialized storage structure, produced by many orchid species, consisting of an enlarged, fleshy section of the stem made up of one to several nodes.



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ICONOGRAFIA DE ORCHIDACEAS DO BRASIL
Tab nº 279

Pseudobulbs

- Offshoots
- Division
- Back blub or green bulbs



PSEUDOBULBS

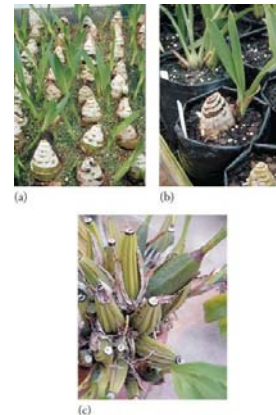


Figure 15-34 Commercial propagation of cymbidium orchids from pseudobulbs. (a and b) Back and (c) green pseudobulbs.



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