

HORT 201
Plant Propagation
Laboratory Exercise 6

Propagation by Specialized Stems and Roots

Reference: Text Chapter 15, pp. 560 - 588

Key words and terms from CD:

Basal plate, bulb, bulb offset propagation, bulbil, bulblet, corm, cormels, crown, division, eyes, geophytes, mini tubers, nontunicate bulb, offsets, pseudobulbs, runners, scaling, scooping, tuber, tubercle, tuberous root, tuberous stem, tunicate bulb,

Objectives:

1. Become familiar with several kinds of bulbs, corms, rhizomes, and tubers.
2. Learn several methods for propagating bulbous plants from bulb scales and bulb sections.
3. Learn how to propagate plants from corms and cormels.
4. Learn how to propagate plants from rhizomes.
5. Learn how to propagate plants from tubers.
6. Learn how to propagate plants from tuberous roots.

Introduction:

A number of plants produce specialized vegetative structures that store water, nutrients and food that allow them to survive adverse environmental conditions by going dormant, dying to ground level and waiting for more favorable growing conditions. For some plants this is a means of surviving dry seasons and for others a means of surviving the cold of winter. These are generally herbaceous perennials with specialized structures such as bulbs, tubers, tuberous roots, corms and rhizomes.

These specialized structures also function in natural vegetative reproduction of the species and are manipulated by horticulturists as tools of plant propagation. In this weeks laboratory we will look at a number of techniques used to multiply these plants. Chapter 16 (p. 560-588) of your text does an excellent job of discussing this topic in plant propagation. Make sure to read it and go over illustrations of organ morphology and propagation techniques.

Methods of Propagation:

A. Bulb propagation

Bulbs are specialized underground organs produced mainly by monocots. There is a short, fleshy stem attached to a basal plate and a growing point or a flower primordium at its apex. The stem is enclosed by thick fleshy leaves called bulb scales which are also attached to the basal plate. These scales are modified leaves that store carbohydrates which the bulb will require for the next season's growth. Most bulbous plants are monocots which display the typical monocot stem morphology.

Meristems develop at the basal plate in the axils of scales and produce miniature bulbs called bulblets, which when grown to full size are called offsets that grow as new independent plants the following season.

There are two basic types of bulbs. 1.) Tunicate bulbs have an outer bulb scale, called a tunic, which is dry, brown, and membranous (Fig. 1). Species with this type of bulb include tulip (*Tulipa* spp.), daffodil (*narcissus* spp.), grape hyacinth (*Muscari* spp.) amaryllis (*Hippeastrum* spp.) and onion (*Allium*). 2.) Nontunicate (scaly) bulbs do not have this dry, membranous tunic and are more delicate in nature with exposed storage scales (Fig. 2). Lily (*Lilium hollandicum*) is a species with this type of bulb. There are a number of methods to propagate bulbs.

1. Bulblet formation on individual bulb scales (scaling) – Easter lily

Individual bulb scales are separated from the mother bulb and placed under growing conditions so that individual bulblets form at the base of each scale. This technique is used primarily for lilies and large numbers of new plants can be propagated from a single bulb. One scale can give rise to 3-5 bulblets. Easter lilies sold in the U.S. are propagated by this technique primarily in the state of Oregon. It takes 2-3 growing seasons to produce a finished bulb from a scale. Outer scales give rise to larger bulbs than those from inner scales.

Scales are handled by three methods. First, they may be planted 2½" deep outdoors in beds or frames and grown for 2-3 years, to produce a finished bulb. Second, scales may be inserted vertically in flats of moist vermiculite to about half their length. Small bulblets form in 3-6 weeks. The scales are then transplanted to flats to develop further at which time they are transplanted to the field. Two to three years of subsequent growth are required to produce a finished bulb. Finally, scales may be packed in moist vermiculite in closed polyethylene bags and held at 70°F for 6-8 weeks. Once bulblets form, the bag is moved to refrigerated storage at 40°F for an additional 8 weeks to satisfy the cold requirement and break dormancy. At that point they can be planted in the field to develop into finished bulbs in 2-3 years.

2. Offsets – garlic, daffodil, grape hyacinth, tulip

Offsets are mature bulblets still attached to the mother bulb. This method of bulb propagation occurs naturally in many bulbous species and is sufficiently rapid for commercial production for the species listed above. The offsets will remain attached to the mother bulb for many years if left undisturbed, but usually are separated when bulbs are dug and replanted.

3. Basal Cuttage – hyacinth, daffodil, grape hyacinth

Hyacinth is the primary plant propagated by this method. Daffodil and grape hyacinth can also be propagated this way. Methods include scooping or scoring to remove apical dominance and encourage bulblet formation. Many more bulblets can be produced this way versus offset propagation.

In scooping, the entire basal plate is removed (scooped out) deep enough to destroy the main shoot, and adventitious bulblets develop at the base of the exposed bulb scales.

In scoring, three knife cuts are made across the base of the bulb deep enough to go through the basal plate and growing point. Growing points in the axils of the bud scales grow into bulblets.

For both of the above methods it is important to callus the bulbs for several days in open trays at 70°F, cut side down. Callused bulbs are then held in trays in the dark with the temperature increased to 85°F after 2 weeks. They are held under these conditions in a humid environment for an additional 10 weeks to allow bulblets to begin to develop. The mother bulbs are then planted to field conditions in the fall. Numerous shoots appear from the bulblets the following spring. It takes 4-5 years to obtain salable bulbs by this method.

4. Bulb cuttings – daffodil

In bulb chipping, the top third of the bulbs are cut off. The bulbs are then cut into 6-10 vertical sections. Each section is further divided by sliding a knife down between each 3rd or 4th pair of scales cutting through the basal plate. Each of the resulting sections consists of a piece of basal plate and 3-4 scales. The cuttings are planted vertically in vermiculite with their tips just showing above the surface. Bulblets develop from the basal plate between the scales in a few weeks. Resulting bulblets are transplanted to flats of media to continue development.

In twin scaling bulbs are divided as in bulb chipping, but scales are further divided until each section has only a pair of bud scales connected by a small piece of basal plate (Fig. 4). They are placed in plastic bags with moist vermiculite and held at 70°F for 3-4 weeks. Bulblets develop at the edge of the basal plate. Most *Narcissus* are propagated by this method.

B. Corm propagation

Corms and cormels – crocus and gladiolus

A corm is the swollen base of a stem enclosed by dry scale-like leaves (Fig 5). It is a solid stem structure with nodes and internodes. Crocus and gladiolus are propagated by natural increase of new corms and cormels (miniature corms) in the field. It takes 2 growing seasons for a cormel to mature to a salable corm.

C. Rhizome propagation

Rhizomes - Canna lily, ginger (*Zingiber officinale*)

Rhizomes are horizontal stems running either at or just below the ground surface. These specialized stems have been modified to be storage organs. Unlike roots, rhizomes have nodes and internodes. After a summer's growth the Canna lily can be separated into typically four or five separate smaller rhizomes, each with a growing nodal point ('growing eye'). Without the growing point, which is composed of meristem material, the rhizome will not grow. As with many rhizomatous plants, not all rhizomes will grow. Propagators are usually satisfied with an 80% success rate.

D. Tuber Propagation

Tubers – potato (*Solanum tuberosum*)

The potato is an underground stem known as a tuber. It is a stem because it has many nodes called eyes with the spaces between eyes known as internodes. Tubers are a special kind of swollen, modified and compressed stem structure that functions as an underground storage organ. Propagation is by planting the tubers whole or by cutting them into sections, each containing one or more "eyes". The so-called eyes of potatoes are really axillary buds which contain several small buds at each site. These buds can expand to form shoots which grow to make whole plants. Cut surfaces need to heal and become suberized to protect them from decay before planting. This is achieved by storing the cut "seed" potatoes under humid warm conditions for 2-3 days before planting.

D. Tuberous root propagation

Propagation of tuberous roots – dahlia, sweet potato (*Ipomoea batatas*)

Roots do not have nodes and internodes. Tuberous roots are swollen secondary roots modified for storage purposes. To propagate a plant from a tuberous root, the root must be capable of producing adventitious shoots (sweet potato) or must also be accompanied by a section of crown that bears a shoot bud (dahlia). Sweet potato tuberous roots will produce shoots at the proximal end and new roots at the distal end of the root. Dahlia tuberous roots without a shoot bud are called "blind" roots and they are not capable of giving rise to new plants. The usual method of propagating dahlia is by crown division. Dahlias are not winter hardy so crowns with tuberous roots are harvested in the fall and stored in a cool place in vermiculite to prevent drying out. They are divided in spring shortly before planting making sure to include sections with at least one "eye" (bud).

Dahlias can also be propagated by seed but pure breeding hybrids or inbreds are not available. Because of this, all cultivars are vegetatively propagated by crown divisions. Seedlings develop tuberous roots early in their life cycle and can be vegetatively propagated to introduce a new cultivar. Tuberous root development is influenced by photoperiod and is triggered by short days of late summer.

Procedure for Today's Lab:

Part A: Bulblet formation on scales (scaling) – Easter lily

1. Obtain one Easter lily bulb. Be able to identify the bulb scales, basal plate, and flowering shoot and absence of a tunic. Please note the container and media the Easter lily bulbs were shipped and stored in.
2. a. Remove 10 outer mature scales and 10 inner immature scales. Mark the immature scales with a black dot from your marking pen so you can tell them from the mature scales later in this experiment.
b. Let the cut surfaces dry 5 minutes. While wearing latex gloves, treat the scales with bulb dust (fungicide) by placing the scales in a plastic bag that has bulb dust and close and shake the bag to cover the scales.
3. Stick 5 mature and 5 immature scales (5 scales per row for a total of 2 rows) into a 601 market pack filled with moist vermiculite. Insert the scales half their length in the media. Label each row with species, mature or immature, date, lab section and your lab group number.
4. Place the remaining 5 mature and 5 immature scales in a plastic bag containing about a cup of moist sphagnum moss. Label the bag as in step 3.
5. The market pack will be placed in Zone 16 under mist and the plastic bag will be stored in a warm dark storage drawer below your lab bench. We will observe these later in the semester.
6. Optional - You may use any remaining lily scales from the bulbs to make a plastic bag to take home (store in a warm, dark place). Check in 4-6 weeks for bulblet formation.

Part B: Mature plant formation from offsets – garlic

1. Obtain one garlic bulb. Garlic bulb offsets are called cloves. Separate three cloves from the garlic bulb.
2. Plant the bulblets in a 6 inch pot containing Premier ProMix PGX media. Plant three cloves in a pot about 1 inch deep. Use a tag to label your pot with the species, number of bulblets planted, date, lab section and name identifying your lab group. Place the pots in the flats provided which will be placed in Zone 21.

Part C: Basal Cuttage – hyacinth, daffodil, grape hyacinth

1. Obtain 1 hyacinth bulbs, 3 daffodils and 3 grape hyacinth reserved for basal cuttage.
2. Score 2 daffodil bulbs and two grape hyacinth bulbs. Scoop 1 hyacinth, 1 daffodil bulb and 1 grape hyacinth bulbs. Follow the procedures as described on page 3 of this lab handout. Cut the daffodil bulbs first before you do the smaller and harder grape hyacinth bulbs.
3. Place the bulbs buried half way cut side down in the 601 market pack filled with dry vermiculite. Label to identify your group. Place your market pack in the flat provided. They will be moved to Zone 21 and stored without watering. We will take a look at them later in the semester to see what happens.

Part D: Bulb cuttings – daffodil

1. Obtain 2 daffodil bulbs reserved for bulb cuttings.
2. Use 1 bulb to prepare bulb cuttings using the "bulb chipping" technique and use the other bulb to prepare cuttings using the "twin scaling" technique. Both techniques are described on page 3.
3. Let the cut surfaces dry 5 minutes, then while wearing latex gloves, place the cuttings in the plastic bag with bulb dust. Close and shake to cover cuttings with dust.
4. Plant the cuttings in a 601 market pack filled with dry vermiculite and mark for 2 rows. Plant twin-scaling cuttings in one row and bulb chips in one row. Just the tip of the bulb cutting should be sticking out of the media. Label appropriately and place the finished pack in the flat provided. These will be placed in zone 21 but not watered.

Part E: Corms and cormels – crocus

1. Obtain 4 crocus corms. Cut one in half lengthwise and observe how the internal structure is different from bulbs. You should be able to identify lateral buds, the flowering shoot, and any cormels if present.
2. Plant the other 3 corms in a 5 inch pot filled with Premier ProMix PGX and place them in the flat provided. Label the pot with species, date, lab section and name of your lab group. They will be moved to zone 21. We will look at these later in the semester to determine how new corms form.

Part F: Division of rhizomes – ginger

1. Please examine the ginger rhizome at the front of the lab and be able to identify the growing points (nodes) on the rhizome.
2. Each group should obtain a clump of ginger rhizomes and divide them as demonstrated by the instructor. Each rhizome must have a growing “eye” or the rhizome will not grow.
3. Take your divisions to the potting room and pot up 3 divisions (one per student) in individual 5inch pots and take them to Zone 21. Place your pots on the bench reserved for your lab section and water in the pots. Save other divisions by placing them in the box provided.

Part G: Propagation of tubers – potato

1. Obtain 1 potato tuber and observe its structure and morphology so that you can identify nodes and internodes. These ‘organic’ potatoes have not been treated with a growth inhibitor as most supermarket potatoes have been.
2. Cut the tuber into sections that contain at least 1 eye. Make at least 4 seed pieces and place them in an empty 601 market pack to be placed in the drawer below your lab bench. Label your pack with your group name. The potatoes will be allowed to suberize and we will pot them up later this week.

Part H: Propagation of tuberous roots – sweet potato

1. Obtain one sweet potato. Compare it’s morphology to the potato used in Part G so you understand why a potato is a stem and a sweet potato is a root.
2. Take your sweet potato to the potting room and pot it up in the large pots provided. Orient the sweet potato horizontally covered with 1 inch of media. Take your pot to Zone 21 and water it in.

Part I: Plant Chrysanthemums stem cuttings from Lab. 4 and place in Zone 16.

Cuttings will be moved to Zone 21 for scoring. Use the data sheet provided to record your data and turn in your data at end of lab. You may pot up any cuttings you wish to keep.

Part J: Deciduous Hardwood Cuttings – score your deciduous hardwood cuttings you placed in Zone 16 and the cooler as instructed in the handout for Lab #2.

Results

Use this page to record observations and results of experiments in Lab # 6.

Part A: Bulblet formation on scales (scaling) – Easter lily

Part B: Mature plant formation from offsets – garlic

Part C: Basal cuttage of bulbs – hyacinth, daffodil and grape hyacinth

Part D: Bulb cuttings – daffodil

Part E: Corms and cormels – crocus

Part F: Rhizomes - ginger

Part G: Tubers – potato

Part H: Crown division of tuberous roots – sweet potato