

Lesson C4–10

Propagating Plants Asexually

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area 4. Identifying Basic Principles of Plant Science

Lesson 10. Propagating Plants Asexually

New Mexico Content Standard:

Pathway Strand: Plant Systems

Standard: I: Apply principles of anatomy and physiology to produce and manage plants in both a domesticated and natural environment.

Benchmark: I-C: Explain and use basic methods for reproducing and propagating plants.

Performance Standard: 1. Determine the role of genetics in plants. 2. Describe the components and functions of plant reproductive parts. 3. Identify and practice methods of asexual/sexual propagation. 4. Describe the principles of plant micro-propagation. 5. Apply principles and practices of biotechnology to plant propagation.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain asexual propagation.
2. Discuss and identify the various methods of stem cutting propagation.
3. Discuss the methods of leaf and leaf-bud cuttings.
4. Describe the various types of growing media used for cuttings.
5. Describe grafting and identify three common methods.
6. Explain layering and the difference between separation and division in plant propagation.
7. Explain tissue culture.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Schroeder, Charles B., et al. *Introduction to Horticulture*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2002. (Textbook and Activity Manual, Chapter 5)

Reiley, H. Edward and Shry, Carroll L. Jr. *Introductory Horticulture*. Albany, New York: Delmar Publishers, 1997. (Textbook and Lab Manual, Unit 6)

Other Resources. The following resources will be useful to students and teachers:

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 4)

Lee, Jasper S. and Diana L. Turner. *AgriScience*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 8)

List of Equipment, Tools, Supplies, and Facilities

Writing surface

Overhead projector

Transparencies from attached masters

Copies of student lab sheet

Transparency set for *Introduction to Horticulture* textbook

Copy of video from University of Illinois, Horticulture Department, titled *Tree Grafting*. This includes Cleft Graft, Repair Graft, T-Bud Graft, and Whip & Tongue Graft. OACE #029 (217)333-2666

Copy of video from University of Florida, titled *Laboratory Procedures For Tissue Culture Plants, A Beginner's Guide* VT234. (Institute of Food & Ag Science Publishing, Building #64, University of Florida, Gainesville, FL 32611).

Samples of peat moss, perlite, vermiculite, and sand

Terms. The following terms are presented in this lesson (shown in bold italics):

Air layering

Asexual propagation

Bark graft

Budding

Callus

Cleft graft

Clone

Division
Explants
Grafting
Hardwood cuttings
Layering
Leaf cutting
Leaf-bud cutting
Micropropagation
Patch budding
Plantlet
Scion
Semi-hardwood cuttings
Separation
Simple layering
Softwood cuttings
Stem cuttings
T-Budding
Tissue culture
Understock (rootstock)
Whip-and-tongue graft

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Bring a variety of houseplants to class, such as African violet, jade, aloe vera, etc. Ask students if they have ever seen seeds from these types of plants for sale in a garden center or seed catalog? The response should be no. Ask students where garden centers are able to get plants such as these to sell if they cannot buy seeds to raise new plants. Discuss that these plants are propagated asexually, without seeds. Ask if there are any students who have parents or grandparents that may have propagated any of these plants at home. If so, discuss how their parents or grandparents did the propagation.

Summary of Content and Teaching Strategies

Objective 1: Explain asexual propagation.

Anticipated Problem: What is asexual propagation?

- I. Plants may be reproduced sexually (with seeds) or asexually (without seeds). In traditional agriculture, sexual reproduction is the dominant method of producing new plants. In horticulture, both sexual and asexual reproduction are common methods of producing new plants.
 - A. **Asexual propagation** is the reproduction of new plants from stems, leaves, or roots of a parent plant. Portions of parent plants are used to make new plants.
 - B. Asexual propagation allows one to produce more plants faster, propagate plants that do not produce viable seeds, and to produce plants that are identical to the parent plant. A plant that is identical to the parent plant is known as a **clone**.

Ask students to define the term asexual. Once they determine that it means “without union of sperm or pollen and egg”, ask them how plants might be able to reproduce asexually. Use the notes above to guide the discussion. Ask students to explain the difference between parents and offspring from sexual versus asexual propagation.

Objective 2: Discuss and identify the various methods of stem cutting propagation.

Anticipated Problem: What are the different methods of stem cutting propagation?

- II. A **stem cutting** is when a portion of the stem that contains a terminal bud or lateral buds is cut and placed in growing media to produce roots. There are three basic types of stem cuttings:
 - A. **Softwood cuttings**—from soft, succulent growth.
 - B. **Hardwood cuttings**—from one-year-old growth, deciduous, or evergreen plants.
 - C. **Semi-hardwood cuttings**—from woody broad-leaved plants with new shoots.

Use TM: C4–10A and the notes above to discuss the different types of stem cuttings. Ask students to identify plants that they think would be good candidates for each type of cutting. You may have students use available reference material to identify various plants that are typically propagated by one of these three methods.

Objective 3: Discuss the methods of leaf and leaf-bud cuttings.

Anticipated Problem: What are leaf and leaf-bud cuttings and how are they made?

- III. Numerous plants can be propagated using leaf and leaf-bud cuttings.
- A. A **leaf cutting** consists of only a leaf blade or leaf blade with petiole attached. In the case of the leaf blade, the primary veins are cut and the blade is laid flat on top of the growing media. The leaf is pinned down. New plants will form at the point where the veins were cut. In the case of the leaf blade with petiole, the petiole is inserted into the growing media. Eventually, roots will form at the end of the petiole and new shoots will emerge from the base of the petiole.
 - B. A **leaf-bud cutting** consists of a leaf, petiole, and a short piece of stem with a lateral bud. These are made from plant material having well developed buds and healthy, actively growing leaves. The stem is treated with a rooting hormone and inserted into the growing medium with the lateral bud just below the medium surface. The new plant will develop from the lateral bud.

Use the notes above and transparency IH-10 from the transparency set for the Introduction to Horticulture text to discuss leaf and leaf-bud cuttings. Complete LS: C4–10A to give students experience in propagating plants by stem cuttings and leaf cuttings.

Objective 4: Describe the various types of growing media used for cuttings.

Anticipated Problem: What are the various types of growing media used for cuttings?

- IV. The type of growing medium used for rooting cuttings varies depending on the type of cutting and the cultural practices used. The media needs to hold moisture, provide good aeration and drainage, and be free from diseases and weed seeds. Common growing media used are:
- A. Peat moss and perlite mixture—good moisture retention, yet provides good aeration.
 - B. Vermiculite—good moisture retention.
 - C. Sand—provides good aeration.
 - D. Sand and peat moss mixture—good mix of moisture retention and aeration.

Show students samples of peat moss, perlite, vermiculite, and sand. Students should note characteristics of each and be able to identify them. If you have a greenhouse and you buy potting soil, bring a sample into the classroom and have students identify each of the various soil components. Use TM: C4–10B and the notes above to discuss the advantages of each type.

Objective 5: Describe grafting and identify three common methods.

Anticipated Problem: What is grafting? What are three grafting methods?

- V. **Grafting** is the process of connecting two plants or plant parts together so they will unite and grow as one. A plant that has been grafted consists of:
- A. The **scion**, which is a short piece of stem with two or more buds.
 - B. The **understock** (rootstock), which is the lower portion of the graft containing the root system.

There are three common grafting methods:

1. **Whip-and-tongue graft**—joins small scion and rootstock together (usually under 1 inch in diameter).
 2. **Cleft graft**—joins small scion to larger rootstock; usually done in winter.
 3. **Bark Graft**—similar to cleft graft except done in early spring when bark easily separates from wood.
- C. **Budding** is similar to grafting except that the scion is reduced to a single bud. There are two common methods of budding:
1. **T-Budding**—taking buds from one plant and inserting them under bark or rootstock.
 2. **Patch budding**—bud is “patched” onto stem when the bark is thick.

Use transparencies IH-11, IH-12, and IH-13 from the transparency set for the Introduction to Horticulture text and the notes above to discuss the various methods of grafting. If you have the videos mentioned in the resources section, show the video “Tree Grafting” from the University of Illinois so students can see the actual procedures for grafting. There is a website at: <http://classes.aces.uiuc.edu/Hort100/> that does a nice job of explaining how to complete a T-Bud Graft.

Objective 6: Explain layering and the difference between separation and division in plant propagation.

Anticipated Problem: What is layering and what is the difference between separation and division in plant propagation?

- VI. Layering, separation, and division are common methods of propagating certain plants.
- A. **Layering** is a method of asexual propagation where roots are formed on a stem while it is still attached to the parent plant. There are two basic types of layering:
1. **Simple layering**—branches are bent to the ground and portions of branches are covered with soil. The terminal ends are left exposed. The covered portion must have a bud or buds and must be injured—roots should form in this area.
 2. **Air layering**—This type removes a portion of the bark on the stem and covers it with moistened sphagnum moss. It is then covered with plastic to prevent it from drying out; roots should form in this area.

- B. Some plants produce vegetative structures which can be separated or divided from the parent plant as a natural means of reproducing.
1. **Separation**—method in which natural structures are removed from the parent plant and planted to grow.
 2. **Division**—method in which parts of plants are cut into sections that will grow naturally into new plants.
 3. Plant structures that can be separated or divided include:
 - a. bulbs
 - b. corms
 - c. rhizomes and tubers
 - d. plant crowns

Use transparency IH-14 from the transparency set for the *Introduction to Horticulture* text and the notes above to discuss air layering. Use strawberries as an example to explain how simple layering is done in nature or in gardens at home. Use the notes above to discuss the difference between separation and division. If you have access to an aloe vera plant, it is good to use in demonstrating how to divide a plant for asexual propagation.

Objective 7: Explain tissue culture.

Anticipated Problem: What is tissue culture?

- VII. Tissue culture, also known as **micropropagation**, is the most recent method of asexual propagation.
- A. **Tissue culture** is a method of growing pieces of plants, called **explants**, on an artificial medium under sterile conditions. The explant forms a **callus**, an undifferentiated mass of cells. Using certain media, the callus produces roots, shoots, and other differentiated cells. This new plant has tiny leaves, stems, and roots that have not yet developed into normal-sized parts, and is called a **plantlet**.
 - B. Tissue culture is common in research and commercial production. It requires special equipment and facilities and highly trained technicians. Tissue culture must be performed in sterile conditions.
 - C. Tissue culture allows production of a large number of plants from a small amount of parent plants, in a short period of time.

Use TM: C4–10C and the notes above to discuss the various terms associated with tissue culture. If you have the video “Laboratory Procedures For Tissue Culture Plants: A Beginner’s Guide”, show it to students to demonstrate how tissue culture is performed.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different perspective. Questions

at the end of chapters of textbooks covering this material may also be used in the review/summary.

Application. Application may involve the following student activities using attached lab sheet:

Stem and Leaf Cutting Propagation Exercise—LS: C4–10A

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample test is attached.

Answers to Sample Test:

Part One: Matching

1=c, 2=e, 3=a, 4=f, 5=b, and 6=d

Part Two: Completion

1=asexual

2=leaf

3=hardwood

4=moisture, drainage, diseases

5=single bud

6=explants

Part Three: Short Answer

1=any two, any order=bulbs, corms, rhizomes, tubers, plant crowns

2=a=good moisture retention, b=good aeration

Test

Lesson C4–10: Propagating Plants Asexually

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|---------------------|-----------------|
| a. micropropagation | d. air layering |
| b. callus | e. division |
| c. scion | f. clone |

- _____ 1. A short piece of stem with two or more buds.
- _____ 2. A method of reproduction in which parts of a plant are cut into sections that will grow into new plants naturally.
- _____ 3. Another term for tissue culture.
- _____ 4. Genetically identical to the parent.
- _____ 5. An undifferentiated mass of cells.
- _____ 6. Involves removing a portion of the bark on the stem of plant and placing moist sphagnum moss over the exposed area.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. _____ propagation is the reproduction of new plants from the stems, leaves, or roots of a parent plant.
2. _____ cuttings are made by taking a leaf blade or leaf blade with petiole attached. They are placed in a growing medium where they are rooted.
3. _____ cuttings are made from one-year-old growth from deciduous or evergreen plants.
4. A good soil media needs to hold _____ and provide good aeration and _____. It should also be free from _____ and weed seeds.
5. Budding is similar to grafting except that the scion is reduced to a _____.
6. In tissue culture, the pieces of plants grown on an artificial medium in sterile conditions are called _____.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. What are two different plant structures that can be separated or divided?
 - a.
 - b.

2. Describe the characteristic or effect of the following types of growing media:
 - a. Vermiculite—

 - b. Sand—

Types of Stem Cuttings

1. **Softwood cuttings**
2. **Hardwood cuttings**
3. **Semi-hardwood cuttings**

Characteristics of Various Soil Media

- 1. Peat moss and Perlite mixture—good moisture retention and good aeration**
- 2. Vermiculite—good moisture retention**
- 3. Sand—provides good aeration**
- 4. Sand and peat moss mixture—good mix of moisture retention and aeration**

Tissue Culture Terms

Explants—small pieces of plants grown in artificial medium under sterile conditions

Callus—undifferentiated mass of cells

Plantlet—small, under-developed plant

Lab Sheet

A Stem and Leaf Cutting Propagation Exercise

Purpose:

To learn how to propagate softwood cuttings and leaf cuttings by asexual propagation.

Materials

Selected plants (softwood cutting = geranium, leaf cutting = African violet)

Knife

Rooting hormone

Flat and soil media

Transparent dome for flat

Procedure

1. Fill flat with soil media.
2. Remove from the top, a 2–3 inch section of geranium stem. Instructor should determine how many cuttings each student will make. Remove leaves from the bottom inch of the stem.
3. Dip the cut end of the stem into rooting hormone and place it into soil media at a depth of approximately 1 inch.
4. Remove the leaf with petiole from the African violet. The petiole should be 1–2 inches long. Dip the cut end of petiole into rooting hormone and place it into the soil media at a depth of approximately 1 inch.
5. Take several cuttings.
6. Water the cuttings in the flat cover and with the dome.
7. The flat should be placed in greenhouse or in a well-lighted area that is moderately warm.
8. Keep the soil moist.

Observations

1. Depending on the plants used and the temperature, roots should be observed on the stems and the leaf petioles in approximately 3–4 weeks.
2. Rooted stem cuttings may be transplanted into pots after an abundance of roots are about 1 inch long. Rooted leaf cuttings may be transplanted into pots after new shoots emerge from the base of petiole.