

GREENHOUSE OPERATION AND MANAGEMENT

Unit V: Plant Propagation

Lesson 1: Sexual Propagation

Competency/Objective:

Demonstrate the correct method for sexual propagation in the greenhouse environment.

Study Questions

1. What is sexual propagation?
2. What are some basic considerations for sexual propagation?
3. What are the environmental conditions to germinate seeds?
4. What is dormancy and how is it overcome?
5. What are the basic stages of the germination process?
6. What are the steps for planting seeds?
7. How do monocots and dicots differ in germination?
8. How should seedlings be cared for after germination?
9. When and how are seedlings transplanted?
10. How should seedlings be cared for after transplanting?

References/Supplies/Materials

1. *Greenhouse Operation and Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2002.
2. Transparency Masters
TM 5.1 Steps in Seed Germination of a Monocot
TM 5.2 Steps in Seed Germination of a Dicot

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3. Activity Sheet

AS 5.1 Transplanting a Seedling

4. Plug trays/seedling tray, growing media, 606 cell pack containers, plastic labels, small trowel, fork, or knife

TEACHING PROCEDURES

IMPORTANT NOTE: Each student needs to have a seedling for AS 5.1, as noted in Suggested Time Frame for Teaching (p. xxxv). Begin sowing fast-growing plants before teaching this lesson.

A. Introduction

A brief review of Lesson 1 from Unit III on plant parts, structures, and functions might be a helpful refresher for students. This unit addresses plant propagation: sexual propagation in Lesson 1 and asexual propagation in Lesson 2.

B. Motivation

Ask student if they observed any differences in their treatment of the seeds sown at the beginning of Unit I. How have various environmental factors - light, water, air, and temperature - affected the growth of the plants?

C. Assignment of Study Questions

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students work in a cooperative learning environment and have groups work on different study questions.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. What is sexual propagation?

Using seeds to start new plants is referred to as sexual propagation.

- A. It is a method by which new plants are produced from seeds.
- B. Environmental conditions must be ideal for germination to occur.

2. What are some basic considerations for sexual propagation?

The quality of seeds and proper storage of seeds are important factors. The other two elements students should know well are containers and growing media.

A. Seed selection

1. Select high-quality seeds that are free of the following:
 - a. Disease and insects
 - b. Broken seeds
 - c. Weed or other seeds
2. Hybrid seeds offer advantages but cost more.
 - a. More resistant to disease
 - b. Generally more vigorous; produce higher yield

B. Seed storage

1. Keep seeds dry and cool.
2. Store seeds in paper packets in sealed glass jars.

C. Containers

1. Should be clean and sturdy
2. Size and material according to type of seeding
 - a. Direct seeding
 - b. Indirect seeding

D. Growing media

1. Clean, free of debris and disease
2. Loose
3. Fine texture

E. Legal considerations

1. Federal law - the Plant Variety Protection (PVP) Act of 1970
 - a. Encourages scientists and breeders to continue biotechnological experiments
 - b. Provides plant breeders with exclusive marketing rights within the United States
 - c. Grants a certificate of protection for 18 years; is analogous to a patent
 - d. Contact information:
Commissioner, Plant Variety Protection Office
Agricultural Marketing Service
National Agricultural Library Bldg., Room 0, 10301
Baltimore Blvd., Beltsville, MD 20705-2351
2. PVP amendments in 1994
 - a. The amended PVP restricts how much seed a grower can save. The law states that the grower may save no more seed than the planting area can accommodate.
 - b. The grower cannot sell saved seed if plans change.
3. State law - Missouri Plant Law
 - a. This requires all who sell, give away, or transport nursery stock in the state of Missouri to submit to inspection.
 - b. The purpose of the inspection is for the state entomologist to examine the plants for insects and diseases.
 - c. Fees for greenhouse inspections are based on the facility's square foot area under glass.

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- d. Contact information:
 - State Entomologist
 - Missouri Department of Agriculture
 - P.O. Box 630
 - Jefferson City, MO 65102-0630
 - Phone: (573) 751-5507
 - Fax: (573) 751-0005

3. What are the environmental conditions to germinate seeds?

Ask the students to name four important environmental factors. As a hint, mention that they were covered in Unit IV. Why do they think these factors are vital to plant propagation?

A. Moisture

1. Water absorption - first step in germination
2. Growing medium
 - a. Should be moist
 - b. Misted with fine spray after seeds are sown
 - c. Covered to retain moisture

B. Temperature

1. Different seeds germinate at different temperatures.
 - a. Warm weather crops
 - b. Cool weather plant
2. General range is 68-86°F.
3. Soil temperature should remain constant.
4. Heating elements can be used to warm soil.

C. Light

1. Some seeds require light to germinate.
 - a. Should be sown shallowly
 - b. Should not be covered
 - c. Example: lettuce
2. Many seeds require no light to germinate. (In some cases, light may inhibit germination.)
 - a. Should be sown more deeply
 - b. May be placed in a dark area
 - c. Example: geraniums

D. Air

1. Germination is an aerobic process (requiring oxygen).
2. Medium must be well aerated.

4. What is dormancy and how is it overcome?

Seeds wait for the ideal environmental conditions before germinating. This resting state is called dormancy. The length of dormancy varies among plants. For example, some varieties of maple have seeds whose dormancy period lasts only a few weeks, whereas some lotus plant seeds germinate after 2,000 years of dormancy. Some hard seeds need some coaxing to germinate. The three methods for overcoming dormancy are described here.

- A. Dormancy
 - 1. Resting stage of seed
 - 2. Prevents seed from germinating until environmental conditions are ideal
- B. Methods of overcoming dormancy
 - 1. Scarification of hard seed coatings
 - a. Mechanical - rubbing with sandpaper or nicking a portion of seed coating
 - b. Chemical - carefully soaking in sulfuric acid to soften seed coating
 - 2. Exposure to cold (stratification) for several weeks
 - 3. Exposure to heat to weaken seed coating

5. What are the basic stages of the germination process?

Four stages signal the germination of plants. Ask students to recall the emergence of their plants from the previous unit and the structures of plants learned in Unit III. What is the first phase?

- A. Water absorption
- B. Enzymatic breakdown
- C. Production of new cells; formation of new tissue
- D. Emergence of seedling

6. What are the steps for planting seeds?

Ask students to recount how they planted the seeds used for Unit IV and what if anything they would do differently.

- A. Prepare growing medium
 - 1. Fill container up to 3/4 in. from the top with moistened germination mixture. Ensure that container has drainage holes.
 - 2. Level off and tap to settle.
 - 3. Make shallow holes or rows according to directions on seed packet.
- B. Set seeds
 - 1. Place seeds in the holes or rows.
 - 2. Label with plant type, variety, and date of planting.
 - 3. Cover with dry medium (generally, with an amount twice the seeds' diameter).
- C. Observe daily
 - 1. Watch for signs of too much or too little moisture.
 - 2. Watch for germination.

7. How do monocots and dicots differ in germination?

TMs 5.1 and 5.2 are good illustrations of the differences in monocot and dicot germination. Ask students what they notice while examining the images. What are the differences between the two types of plants?

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- A. Monocot (See TM 5.1.)
 - 1. Hypogeous germination (Cotyledon remains underground.)
 - 2. Stages
 - a. Seed swells as moisture is absorbed.
 - b. Seed coat ruptures.
 - c. Radicle grows down.
 - d. First internode and epicotyl grow up.
 - e. After epicotyl emerges, new leaves form and food production starts.
 - f. New root system grows just beneath the soil above the first internode.
- B. Dicot (See TM 5.2.)
 - 1. Epigeous germination (Cotyledon emerges aboveground.)
 - 2. Stages
 - a. Seed swells as moisture is absorbed.
 - b. Seed coat splits.
 - c. The radicle emerges and grows down.
 - d. The hypocotyl elongates, forms an arch, and pulls the cotyledon upward.
 - e. When the hypocotyl reaches light, elongation ceases, and the hypocotyl straightens up and pulls the cotyledons out of the soil.
 - f. The cotyledons open, turn green, and provide food until the true leaves develop.
 - g. The first true leaves unfold from the epicotyl, exposing the growth bud.
 - h. The cotyledons die, dry up, and fall off.

8. How should seedlings be cared for after germination?

This question addresses fundamental concerns for the greenhouse operator: environment, irrigation, fertilization, and disease prevention.

- A. Environment
 - 1. Remove cover once seeds have germinated.
 - 2. Move to area that receives bright light.
 - 3. Growing temperature is 10°F cooler than temperature for germination period.
- B. Watering
 - 1. Keep moist but not soggy.
 - 2. Allow drying between watering but do not allow seedlings to wilt at any time.
- C. Fertilizing
 - 1. Fertilize promptly and regularly with a complete fertilizer.
 - a. 20-20-20 is usually appropriate.
 - b. Apply 1/4 of the recommended strength a few days after germination.
 - 2. Too much fertilizer can damage seedlings.
- D. Disease prevention and treatment
 - 1. Prevent disease.
 - a. Use soilless mix or pasteurized medium and sterilized containers.
 - b. Provide sufficient air circulation.
 - c. Allow medium to dry out slightly between waterings.
 - 2. Treat diseases such as damping-off (a fungal disease that attacks at ground line).
 - a. Limited infection - Dig out and discard infected plants and soil.

- b. Widespread infection - Drench entire soil area with fungicide.

9. When and how are seedlings transplanted?

Seedlings are fragile. When transplanting the seedlings, timing, methods, and handling are vital to their survival. Have students complete AS 5.1.

A. Timing

1. Seedlings can be transplanted after they develop the first set of true leaves.
2. Do not delay transplanting.
 - a. Health of the plant suffers.
 - b. Seedlings become overcrowded and spindly.

B. Method

1. Water seedlings.
2. Carefully lift the small plants with a small trowel, fork, or knife.
 - a. Leave some growing medium around roots.
 - b. Do not allow roots to dry out.
3. Fill container with moist growing medium.
4. Make a hole in the medium.
5. Insert seedlings slightly deeper than they were in the previous pot.
6. Gently pat growing medium around base of seedling.
7. Water the plant.

C. Handling

1. Seedlings are fragile and must be handled gently.
2. Handle by leaves, not stems.

10. How should seedlings be cared for after transplanting?

Ask students to consider what kinds of precautions a greenhouse owner should take to ensure successful transplanting of seedlings.

- A. Keep in indoor environment.
- B. Keep in shade or under fluorescent lighting for a few days.
- C. Keep away from intense heat.

F. Other Activity and Strategy

Show the class a video available from CATER (Career & Technical Education Resources), 2 London Hall, University of Missouri-Columbia: *Plant Propagation*, Volume I (AG V46),

G. Conclusion

There are proper procedures and methods involved in sexual propagation. Germinating seeds is affected by several factors and the process varies with monocots and dicots. Caring for seedlings is crucial after germination and transplanting.

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H. Answers to Activity Sheet

Instructor's discretion

I. Answers to Assessment

1. D
2. A
3. D
4. A. Resistant to disease
B. Produce higher yield.
5. Germination in dicot plants wherein the cotyledon grows aboveground.
6. Plants produced from seeds
7. A. Environment
B. Water
C. Fertilizer
D. Disease prevention and treatment
8. After developing the first set of true leaves
9. A. Keep indoors
B. Keep in shade or under fluorescent lighting
C. Keep away from intense heat
10. A. Prepare the growing medium
B. Set the seeds
C. Watch daily
11. To ensure nursery stock is without insect and disease infestations.

UNIT V: PLANT PROPAGATION

Name _____

Lesson 1: Sexual Propagation

Date _____

ASSESSMENT

Multiple Choice: Circle the letter of the best answer.

1. What is the second stage in germination?
 - A. Emergence of seedling
 - B. Absorption of water
 - C. Production of new cells
 - D. Enzymatic breakdown

2. What are temperature, water, air, and light?
 - A. Environmental factors in germination
 - B. Consideration for sexual propagation
 - C. Factors in timing of transplantation
 - D. Methods to overcome dormancy

3. What are three methods to overcome dormancy?
 - A. Chemical, mechanical, and aerobic process
 - B. Mechanical, heat, and enzymatic breakdown
 - C. Stratification, scarification, and water absorption
 - D. Heat, stratification, and scarification

Short-Answer Questions: Write the answers in the space provided.

4. What are two advantages of using hybrid seeds?
 - A.
 - B.

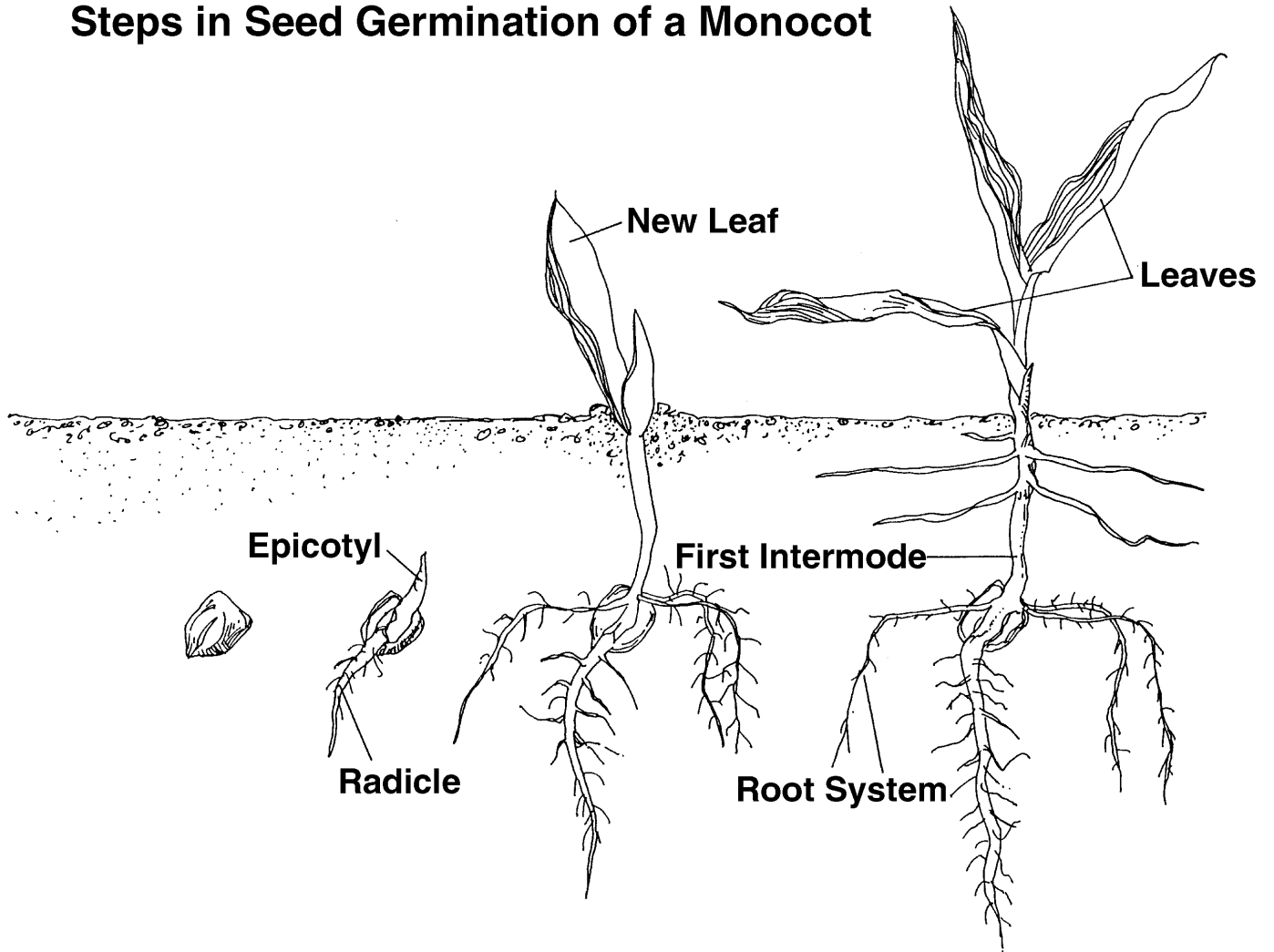
5. What is epigeous germination?

6. What is sexual propagation?

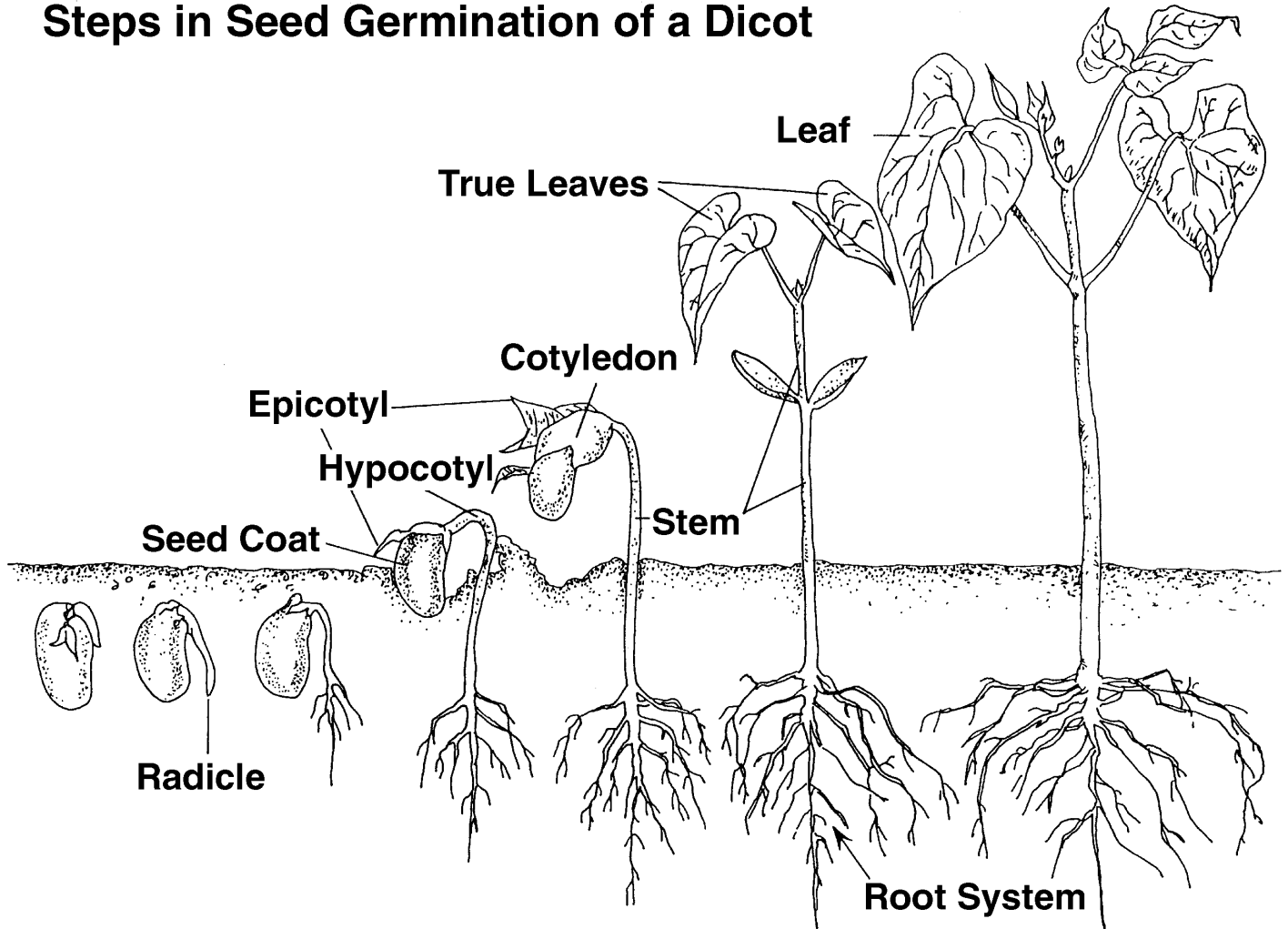
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7. What are four factors to observe in caring for seedlings after germination?
 - A.
 - B.
 - C.
 - D.
8. When can seedlings be transplanted?
9. What are three ways to care for seedlings after transplanting?
 - A.
 - B.
 - C.
10. What are three steps in planting seeds?
 - A.
 - B.
 - C.
11. What is the purpose of the Missouri Plant Law?

Steps in Seed Germination of a Monocot



Steps in Seed Germination of a Dicot



UNIT V: PLANT PROPAGATION

AS 5.1

Lesson 1: Sexual Propagation

Name _____

Transplanting a Seedling

Objective: Demonstrate proper procedures in transplanting a seedling.

Directions: Transplant a seedling. Record all the steps involved. Identify the type of seedling by recording its binomial nomenclature and common name. Record the date the plants were transplanted and note the seedling's progress.

Materials

Growing medium
Pen and paper
Plastic labels
Plug trays/seedling tray
606 cell pack
Small trowel, fork, or knife
Water

Procedures

1. Water seedling.
2. Carefully lift seedling with small trowel, fork, or knife.
3. Fill plant container with moist growing medium.
4. Insert a hole in the growing medium.
5. Insert seedling slightly deeper than it was in previous pot.
6. Pat growing medium around base of seedling.
7. Water seedling.

