

## **Unit C: Maintaining the Fruit and Nut Tree**

### **Lesson 1: Advantages and Disadvantages of Asexual and Sexual Propagation in Fruit and Nut Production**

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

1. Describe the differences between sexual and asexual growth cycles of plants.
2. Recognize the advantages and disadvantages of sexual or seed propagation.
3. Explain the advantages and disadvantages of asexual or vegetative propagation.

**Recommended Teaching Time:** 2 hours

**Recommended Resources:** The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed for use with this lesson plan.
- <http://pubs.cas.psu.edu/FreePubs/pdfs/UJ255.pdf>
- [http://aces.nmsu.edu/pubs/\\_h/h-322.html](http://aces.nmsu.edu/pubs/_h/h-322.html)
- <http://www.rootsofpeace.org/assets/Vegetative%20Propagation%20Techniques.pdf> This document discusses propagation in Afghanistan and can be used as a supplementary text to the lesson.

### **List of Equipment, Tools, Supplies, and Facilities**

Writing surface

PowerPoint Projector

PowerPoint Slides

Transparency Masters

Examples of fruit seeds (optional)

Examples of plants that have been asexually propagated (optional)

**Terms:** The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide #2):

Asexual propagation  
Budding  
Cross-pollination  
Cuttings  
Fertilization  
Gametes  
Grafting

Hybrids  
Layering  
Pollination  
Seed  
Self-pollination  
Sexual reproduction  
Tissue culture

**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.

**Get a piece of fruit like an apple and cut it open. Take one of the seeds and hold it up. Ask the students, “If we plant this seed, will the fruit from the tree look exactly like this apple?” Have the students answer and explain why. Tell the students that the fruit from this apple seed will not look like the apple it came from. Ask them, “Is there a way we can get exact copies of this apple?” Have students answer and explain why. Tell them that in this lesson they will be learning about how to make exact copies of fruit trees and also how to improve a fruit tree to be more beneficial to their orchard.**

**\*\* Use this activity to lead into Objective 1.**

## **Summary of Content and Teaching Strategies**

### **Objective 1: Describe the differences between sexual and asexual growth cycles of plants.**

(PowerPoint Slide #3)

- I. Plants reproduce in two ways sexual and asexual. Both forms are beneficial to fruit and nut production but asexual is more widely used.
  - A. **Sexual reproduction** occurs when the male sperm carried in the pollen unites with the female egg within a flower.

(PowerPoint Slide #4)

1. Most plants reproduce their own kind in nature by seeds that are the result of sexual reproduction.
  - a. The male sex cell (sperm) and the female sex cell (egg) are known as **gametes**.
  - b. The union of the gametes produces the **seed** that contains the embryo plant and stored food.

(PowerPoint Slide #5)

2. Both the male sperm and female egg contribute genetic information to the new embryo plant.
  - a. The union of sperm and egg results in new combinations of genetic information.
  - b. These combinations produce new traits that add to the vigor of the offspring.
3. The offspring that result from this new combination of genes are known as **hybrids**.

- a. People have greatly improved agricultural crops through hundreds of years of hybridization.

(PowerPoint Slide #6) This slide shows an example of hybridization in *Zea mays*. *The left and middle rows are parents and the row on the far right is the offspring. Notice the height difference.*

(PowerPoint Slide #7)

4. **Fertilization** unites the single chromosome in the sperm nucleus with the single chromosome in the egg nucleus.
5. **Pollination** is the transfer of the male sperm carried in the pollen to the female part of the flower, the stigma.
  - a. Plants rely on wind and water to transfer the pollen to the stigma.
  - b. In addition, plants depend on animals to help with pollination.
  - c. Birds, insects like bees, bats and other animals are attracted to brightly colored, scented flowers.
  - d. These animals transfer pollen from the anthers of the flowers they visit to the stigmas of other flowers.

(PowerPoint Slide #8)

6. When the pollen of a plant pollinates a flower on the same plant, it is called **self-pollination**.
7. Many plants have this ability to self pollinate, others like fruit trees do not.
  - a. When the pollen of a plant pollinates the flower on another plant of the same species, it is said to be **cross-pollination**.

(PowerPoint Slide #9) *This slide is an illustration of a flower being pollinated. Discuss the importance of pollination in fruit and nut crops and point out the important structures in the flowers that aid in pollination.*

(PowerPoint Slide #10)

- B. **Asexual propagation** in plants involves the reproduction of new plants using only the vegetative parts (stem, leaf and root) of the parent plant.
  1. This is possible because many plants have the ability to regenerate or grow not only the vegetative part of the plant, but also missing plant parts.

(PowerPoint Slide #11)

2. Asexual propagation consists of many methods.
  - a. **Cuttings**- a portion of a plant is removed and made to form roots. This is commonly used to propagate shrubs and house plants.

(PowerPoint Slide #12) *This slide illustrates different methods of cutting which will be covered in depth in the next lesson. Talk about the importance of cuttings and explain there are different methods that the students will get to try in the next lesson.*

(PowerPoint Slide #13)

- b. **Grafting**- a shoot or scion is removed from the desired plant and placed on another plant (the stock). This method is used with some fruit and nut trees.

(PowerPoint Slide #14)

- c. **Budding**- a bud is removed from the desired plant and placed on the stock. This method is used with some fruit trees and ornamentals such as roses.

(PowerPoint Slide #15)

- d. **Layering**- a portion of an attached shoot is partially buried underground where roots develop. The new plant may then be separated from the parent plant. Figs, raspberries, and many ornamentals can be propagated this way.

(PowerPoint Slide #16)

- e. **Division**- plants that grow in clumps are then dug and cut apart to form new plants.

(PowerPoint Slide #17)

- f. **Tissue culture** (micropropagation)- using very small pieces of plant tissue and growing it on a sterile nutrient media under aseptic conditions in a small glass container.

**Use TM: C1-1 to illustrate pollination. Discuss agents of pollination like honeybees. Ask what problems arise from the use of substances in our environment that destroy the honey bee populations? What would happen if all of the honeybees died? Discuss the importance of honeybees in fruit and nut production.**

## **Objective 2: Recognize the advantages and disadvantages of sexual or seed propagation.**

(PowerPoint Slide #18)

- II. Sexual, or seed propagation, is not commonly used in fruit and nut production but has advantages and disadvantages.

(PowerPoint Slide #19)

### **A. Advantages**

- 1. Diverse progeny possible.
  - a. Cross pollination between varieties can produce hybrids.
- 2. Many cultivated plants are from naturally occurring varieties that are cultivated for specific traits.
  - a. These traits are the result of seed diversity.
- 3. Usually less labor and materials involved than in vegetative propagation.

(PowerPoint Slide #20)

B. Disadvantages

1. Diseases and Insects
  - a. Seeds are not immune to insect and diseases which can cause germination problems.
2. Storage
  - a. To keep a seed's viability it must be kept in low temperature and low humidity.
3. Diverse progeny
  - a. The resulting plant will probably not be true-to-type.

(PowerPoint Slide #21)

4. Length of production time needed.
  - a. Because trees are growing from seed it will increase the amount of time until mature fruit can be harvested.
5. Seed provenance
  - a. Seed should be collected from the area it is to be grown in, at least within the same hardiness zone. Although not trouble free, this practice will help insure plant hardiness.
6. Uncertain germination.
  - a. When a seed is planted, its germination is never guaranteed.
7. Cross pollination with other species
  - a. This is required for some fruits like apples.
  - b. Planting the seeds from these apples will not result in an apple similar to that which the seed came from.

**Have each of the students stand up. Ask each one to name one advantage or disadvantage of sexual propagation. They should all try to name something different or elaborate on one already stated. Once a student has stated an advantage or disadvantage they may sit down and the next student will state their advantage or disadvantage of sexual propagation.**

### **Objective 3: Explain the advantages and disadvantages of asexual or vegetative propagation.**

(PowerPoint Slide #22)

III. Asexual or vegetative propagation is very useful to the fruit and nut industry for many reasons.

A. Advantages

1. The offspring are genetically identical and therefore advantageous traits can be preserved.
2. Only one parent is required which eliminates the need for special mechanisms such as pollination, etc.
3. It is faster.

(PowerPoint Slide #23)

4. Vegetative propagation is especially beneficial to the agriculturists and horticulturists. They can raise crops like bananas, sugarcane, potato, etc that do not produce viable seeds. The seedless varieties of fruits are also a result of vegetative propagation.

(PowerPoint Slide #24)

5. The modern technique of tissue culture can be used to grow virus-free plants.
  - a. Asexual propagation enables the production of plants that would otherwise be difficult or impossible because the plant does not produce viable seed or the seed is difficult to germinate.

(PowerPoint Slide #25)

- b. Asexual reproduction is also used when plants will not breed true and when it is necessary to maintain certain genetic forms of the plant.
  - i. This important benefit of asexual reproduction produces plants that are genetically identical to the parent plant; therefore, they have the same traits of the parent plant.
  - ii. The existence of many valuable crop plants depends upon our ability to reproduce them asexually.

(PowerPoint Slide #26)

- c. Asexual propagation may be faster than propagation by seed.
  - i. Germination and growth of seedlings is often slow compared to propagation by cuttings.
  - ii. It may also be more economical to produce plants asexually and in many cases it is easier.

(PowerPoint Slide #27)

#### B. Disadvantages

1. Asexual propagation may increase disease and insect susceptibility
  - a. Clones lack the genetic diversity found in seed produced plants.
2. Can be expensive and time-consuming
  - a. Requires proper tools and knowledge to achieve a successful graft.

**Have each of the students stand up. Ask each one to name one advantage or disadvantage of asexual propagation. They should all try to name something different or elaborate on one already stated. Once a student has stated an**

**advantage or disadvantage they may sit down and the next student will state their advantage or disadvantage of asexual propagation.**

**Review/Summary:** Use the student learning objectives to summarize the lesson. Have the students explain the response to the anticipated problem of each objective. Student responses can be used to determine which objectives need to be reviewed. Questions on PowerPoint Slide #28 can be used as review.

**Application:** Have students obtain seeds from fruit and nut trees. Students can work in groups or individually. Have the students obtain as many different fruit and nut seeds as possible. The seeds should be mounted on a poster or in a display case. Have them label each seed with the fruit it came from.

**Evaluation:** Evaluation should focus on student achievement of this lesson's objectives. A sample written test is attached.

## **Answers to Sample Test:**

### *Matching*

1. C
2. B
3. E
4. F
5. H
6. G
7. A
8. D

### *Short Answer*

1. Possible answers include:

#### **Advantages**

- Diverse progeny possible.
- Many cultivated plants are from naturally occurring varieties that are cultivated for specific traits.
- Usually less labor and materials involved than in vegetative propagation.

#### **Disadvantages**

- Diseases and Insects
- Storage
- Diverse progeny
- Length of production time needed.
- Seed provenance
- Uncertain germination.
- Cross pollination with other species

2. Possible answers include:

**Advantages**

- The offspring are genetically identical and therefore advantageous traits can be preserved.
- Only one parent is required which eliminates the need for special mechanisms such as pollination, etc.
- It is faster.
- Vegetative propagation is especially beneficial to the agriculturists and horticulturists. They can raise crops like bananas, sugarcane, potato, etc that do not produce viable seeds. The seedless varieties of fruits are also a result of vegetative propagation.
- The modern technique of tissue culture can be used to grow virus-free plants.
- Asexual propagation may be faster than propagation by seed.

**Disadvantages**

- Asexual propagation may increase disease and insect susceptibility
- Can be expensive and time-consuming

3. Sexual reproduction requires the union of sperm and egg through the process of fertilization to create a seed which will carry traits from both parents.

Asexual reproduction does not utilize sperm and egg and the offspring from asexual reproduction will be genetically identical to the parent.

## Sample Test

Name \_\_\_\_\_

# Test

### Unit C Lesson1: Advantages and Disadvantages of Asexual and Sexual Propagation in Fruit and Nut Production

#### **Part One: Matching**

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

- |                        |                        |             |            |
|------------------------|------------------------|-------------|------------|
| A. Asexual propagation | C. Sexual reproduction | E. Cuttings | G. Seed    |
| B. Pollination         | D. Grafting            | F. Layering | H. Budding |
- \_\_\_\_\_ 1. Occurs when the male sperm carried in the pollen unites with the female egg within a flower.  
\_\_\_\_\_ 2. The transfer of the male sperm carried in the pollen to the female part of the flower, the stigma.  
\_\_\_\_\_ 3. When a portion of a plant is removed and made to form roots.  
\_\_\_\_\_ 4. A portion of an attached shoot is partially buried underground where roots develop  
\_\_\_\_\_ 5. A bud is removed from the desire plant and placed on another plant.  
\_\_\_\_\_ 6. The union of gametes produces this structure that contains the embryo plant and stored food.  
\_\_\_\_\_ 7. The reproduction of new plants using only vegetative parts of the parent plant.  
\_\_\_\_\_ 8. A shoot or scion is removed from the desired plant and placed on another plant.

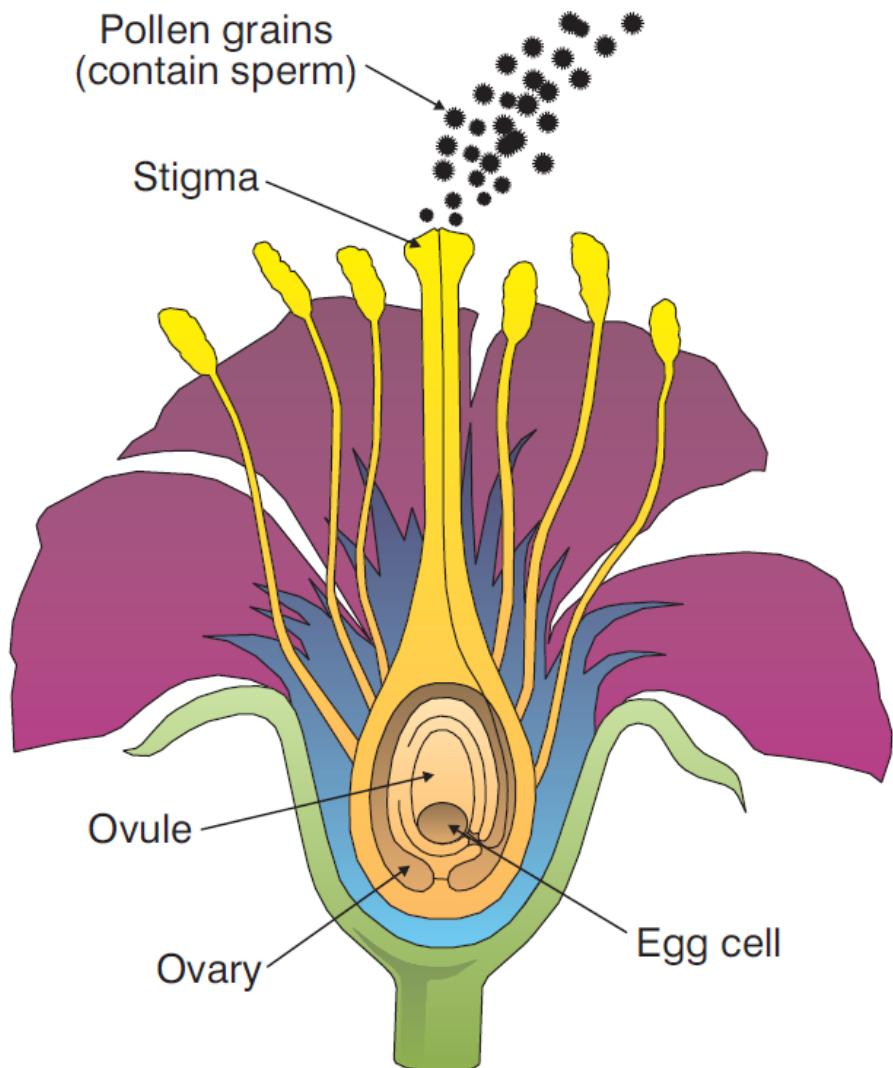
#### **Part II Short Answer**

*Provide information to answer the following questions.*

1. Explain 2 advantages and 2 disadvantages of sexual propagation as it relates to fruit and nut production.

2. Explain 2 advantages and 2 disadvantages of asexual propagation as it relates to fruit and nut production.
  
3. Describe the differences between asexual and sexual reproduction.

## Pollination



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