

Unit E: Fruit and Nut Production

Lesson 2: Citrus Production

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

1. Discuss the history and types of citrus fruits.
2. Describe citrus production throughout the world.
3. Determine the varieties of citrus.
4. Establish young citrus trees.
5. Care for established citrus trees.

Recommended Teaching Time: 4 hours

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

- A PowerPoint has been developed for use with this lesson plan
- <http://www.unctad.org/infocomm/anglais/orange/characteristics.htm>
- http://en.wikipedia.org/wiki/Key_lime
- <http://en.wikipedia.org/wiki/Pomelo>
- <http://aggie-horticulture.tamu.edu/extension/homefruit/citrus/citrus.html>

List of Equipment, Tools, Supplies, and Facilities

Writing surface
PowerPoint Projector
PowerPoint Slides
Copies of Transparency Masters
Various citrus fruits of Afghanistan
Young citrus tree for planting (optional)

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

endocarp
epicarp
mesocarp
semi-everbearing

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.

Try to provide the students with a variety of citrus fruits. If fresh fruit cannot be provided try to provide juices or other citrus products. Ask the students to name some products made using citrus fruits. Once they have done this, hold a discussion on the differences between citrus fruits and other fruits. Ask them, “Are citrus fruits grown the same way as other fruits?” “Can you grow citrus fruits anywhere in the world?” “Does anything special need to be done in the production of citrus?” Write their responses down on a chalkboard and refer to them throughout the lesson to determine what they already know.

Use this approach to move into Objective 1.

Summary of Content and Teaching Strategies

Objective 1: Discuss the history and types of citrus fruits.

(PowerPoint Slide #3)

- I. In order to better understand citrus, one must understand their origin and their growth characteristics.
 - A. Citrus species are believed to have originated somewhere in Southeast Asia around 4000 B.C.
 1. Slowly, citrus spread into Africa and the Roman Empire.
 2. During the Middle Ages, citrus spread to Europe and from there moved to North and South America.
 3. It is now widely produced throughout the world in areas of tropical and sub-tropical climates.

(PowerPoint Slide #4)

- B. Citrus belongs to the *Rutaceae* family
 1. They come from one genus, *Citrus*, and can interbreed with ease.
 - a. All citrus fruits are considered to be berries.
 2. The trees are evergreen with oblong leaves.

(PowerPoint Slide #5)

3. The fruit produced ranges in size and shape from 4 centimeters up to 14 centimeters.
 - a. All of the fruits consist of three layers.
 - i. The outer layer, commonly referred to as the rind, is called the **epicarp** and is where all of the glands are located that produce the essential oils.
 - ii. The epicarp ranges in color from bright orange to yellow.
 - b. The second layer is the **mesocarp**, which is white and spongy and is referred to as the pith.
 - c. The final inside layer is called the **endocarp**.
 - i. It is also referred to as the pulp and contains individual fruit sacs divided into segments surrounded by a film.

Use TM: E1-1 to review the parts of citrus fruit. Provide students with examples of citrus fruits and have them identify the three parts on a cross section of citrus.

Objective 2: Describe citrus production throughout the world.

(PowerPoint Slide #6)

- II. Citrus fruits are the highest valued fruit crop throughout the world and are produced in over 140 countries.
 - A. The top producing citrus countries are:
 1. Brazil is the top producer and exporter followed by countries around the Mediterranean and the United States.
 2. Brazil is first in grapefruit and orange production.
 3. India is first in lemon and lime production.
 4. China is first in tangerine production.
 5. Nigeria is a top producer of other citrus fruits.

(PowerPoint Slide #7)

- B. The most common citrus fruit is the orange which is processed into juice.
 1. About one third of citrus production is used for processing and of this about 80% is used for juice.
 2. Many other species of citrus are eaten fresh.

Hold a discussion about citrus production with the students. Ask them if they produce citrus at home or know anybody who does. Talk about the importance of citrus in Afghanistan.

Objective 3: Determine the varieties of citrus.

(PowerPoint Slide #8)

- III. There are many citrus fruits grown in Afghanistan, they are:
 - A. *Citrus limonia*
 1. *Citrus limonia* is a cross between a mandarin orange and a lemon.
 - a. It has an orange peel with a very acidic pulp.
 2. These fruits are also called rangpurs after the town in Bangladesh where it is believed to have originated.

(PowerPoint Slide #9) This is a picture of *Citrus limonia*. Try to provide fresh samples.

(PowerPoint Slide #10)

B. *Citrus aurantifolia*

1. This fruit is commonly referred to as Key Lime and is native to Southeast Asia.
2. It has a fruit 2.5-5 centimeters in diameter and is yellow when mature.
3. The fruit is borne on a tree generally about 5 meters tall with short ovate leaves.

(PowerPoint Slide #11) Picture of *Citrus aurantifolia*.

(PowerPoint Slide #12)

C. *Citrus sinensis*

1. This is the sweet orange that is widely produced throughout the world and is used for juice.
2. It is believed to be an ancient cross between *Citrus maxima* (pomelo) and *Citrus reticulata* (tangerine) with origins in Southeast Asia.
3. There are numerous varieties of oranges including Blood, Navel, Persian and Valencia.

(PowerPoint Slide #13) Picture of *Citrus sinensis*.

(PowerPoint Slide #14)

D. *Citrus reticulata* (sangtora)

1. This fruit is commonly referred to as Mandarin orange.
 - a. It is smaller than a regular orange.
2. The tree is somewhat drought tolerant but the fruit is still very delicate and is much more sensitive to cold than other types of citrus.

(PowerPoint Slide #15) Picture of *Citrus reticulata*

(PowerPoint Slide #16)

E. *Citrus paradisi*

1. This fruit was bred and created in Jamaica being called the “fruit of paradise” or the “forbidden fruit” and is commonly known as grapefruit.
2. Grapefruit is a large fruit, 10-15 centimeters in diameter.

(PowerPoint Slide #17) Picture of *Citrus paradisi*

(PowerPoint Slide #18)

F. *Citrus aurantium* (orange)

1. This orange is commonly called Bitter Orange.
 - a. It has many varieties including *amara*, Seville orange, Bergamot, Chinotto, and Daidai.
 - b. The varieties are cultivated from Vietnam to Italy.

(PowerPoint Slide #19) Picture of *Citrus aurantium*

(PowerPoint Slide #20)

G. *Citrus grandis* also *Citrus maxima*

1. Referred to as Pomelo, it is the largest citrus fruit ranging in size from 15-25 centimeters in diameter and weigh 1 to 2 kilograms.

2. Pomelos are native to Southeast Asia.
3. They are a light yellow to green color with a very thick mesocarp and sweet white endocarp.
4. When a pomelo is crossed with a tangerine it creates a tangelo.

(PowerPoint Slide #21) Picture of Citrus grandis

Try to provide fresh samples of all or some of these citrus fruits. If fresh samples can't be provided, show pictures. Discuss the unique characteristics of each of these fruits. Provide the students with a world map and have them indicate where each of these fruits originated.

Objective 4: Establish young citrus trees.

(PowerPoint Slide #22)

IV. Growing citrus can be easy and rewarding if careful attention is placed on the establishment of the tree and proper care in years after.

- A. The first task in establishing a citrus grove is to select a variety.
 1. The variety should be suitable for the region and should also match personal taste preferences.
 - a. Choose a tree with a suitable rootstock that will improve the tree's characteristics.
 - b. Depending upon the species, a second variety might be needed to cross-pollinate, though this is not common in many citrus species.

(PowerPoint Slide #23)

- B. Site selection is very important in the establishment of a citrus grove.
 1. Citrus trees need full sun but can tolerate a very small amount of shade.
 2. The soil should be well drained.
 - a. Sandy soils will require more frequent watering and fertilizing.
 - b. If a large grove is to be planted, consider space for trucks or any equipment that might be used.
 - i. If drainage of the area is uncertain, dig a post hole (a hole about 15 centimeters) and fill it with water.
 - ii. Soils that are suitable for tree establishment will drain in 24-36 hours. If it takes longer than 48 hours to drain, the site should be avoided.
 3. The soil should have a pH of 6 to 8.

(PowerPoint Slide #24)

- C. Planting the tree is the next important task.
 1. Best results come from planting during fall to late winter as the tree can become better established before the onset of hot, dry weather of late spring and summer.
 - a. Planting depth is critical to the survival of citrus trees.
 - b. The rootstock is somewhat resistant to root rot disease, but the top is quite susceptible. If the graft union is too low with respect to surrounding ground, the tree could contract root rot and die.

(PowerPoint Slide #25)

2. Remove any grass or other vegetation in a circle 0.9 to 1.5 meters in diameter, centered on the planting hole.
 - a. Dig the planting hole one and a half times wider than the root ball.

- b. In a bare ground situation, dig the hole exactly the same depth as the root ball, but in lawn grass, dig it 2.5 centimeters less than the root ball depth.
- c. The best way to determine proper depth is to lay a shovel handle or similar object across the hole, with both ends laying on undisturbed ground or the lawn grass.

(PowerPoint Slide #26)

- 3. Mixing topsoil, compost, peat or other materials with the backfill soil is unnecessary in good citrus soils.
 - a. Set the tree in the hole, backfill about halfway, then water sufficiently to wet the backfill and settle it around the roots.
 - b. Finish filling the hole and tamp the soil lightly into place.
 - c. Cover the root ball with 1 to 2 centimeters of soil to seal the growing medium from direct contact with the air and prevent rapid drying of the root ball.

(PowerPoint Slide #27)

- 4. Build a watering ring atop the ground around the tree, about 13 to 16 centimeters high and 16 to 20 centimeters thick.
 - a. The ring should be slightly wider than the planting hole.
 - b. Fill the water basin with water.
 - c. When the water soaks in, it may be necessary to add a little soil to the holes made as the soil settles around the root system.

(PowerPoint Slide #28) Illustration of a watering ring around a young citrus tree.

Refer to Unit B Lesson 4 for a reminder about planting trees

(PowerPoint Slide #29)

- D. Watering newly planted fruit trees is very important.
 - 1. Once the tree is planted it should be watered two to three times per week and then one to two times per week for the next few weeks.
 - 2. When watering, simply fill the water ring formed during planting.
 - a. Over time the watering ring will erode away which is an indicator that the tree should be partly established.
 - b. Once established, the tree can be watered by sprinklers or natural rainfall.
 - 3. Trees should be watered once the soil is dry an inch or more below the soil.
 - 4. Watering is very important before and during flowering and fruit set and a large citrus grove will benefit from an irrigation system.

(PowerPoint Slide #30)

- E. Fertilizing fruit trees is very important for the quality and yield of fruit.
 - 1. Beginning fertilizing as soon as the buds begin to expand or once the tree begins to produce new growth.
 - 2. Always test the soil first to see what nutrients are deficient.
 - 3. During the first year of growth, fertilize every six weeks during the growing season with a balanced fertilizer, generally 8-8-8.
 - 4. As the tree matures it will need more fertilizer per tree.

(PowerPoint Slide #31)

- F. Young trees need reduced competition from weeds and other vegetation.
 - 1. Create a vegetation free zone for a few feet around the tree.
 - 2. As the tree grows continue to create a vegetation free zone with a diameter as large as the drip line of the tree.

3. When the tree is small mechanical removal of weeds, such as hoeing, is recommended.
4. Mulch is not recommended as it can introduce root rot into the citrus tree.

(PowerPoint Slide #32) Picture of vegetation removed from around the base of a young citrus tree. Note that the vegetation is removed as far as the dripline diameter of the tree.

(PowerPoint Slide #33)

- G. If the tree planted was containerized, it should already be pruned for proper growth.
1. If the citrus tree was bareroot, extra attention will need to be paid to the pruning of the tree.
 - a. Create a strong system of scaffold branches and remove any watersprouts or shoots below the first scaffold branch.

(PowerPoint Slide #34)

- H. Temperature has a major impact on the success and survival of young citrus trees.
1. Citrus trees are tropical and sub-tropical plants and any freezing will result in poor fruiting or even death.
 2. The best cold protection for young citrus trees is a soil bank.
 - a. A soil bank is simply a mound of soil piled as high as possible on the young fruit tree, at least as high as the first scaffold branch.
 - b. If there is a freeze, the trunk and at least the first scaffold branches will be protected allowing the tree to regrow if the top dies.

(PowerPoint Slide #35)

3. Before banking, treat the trunk with an insecticide.
 - a. Be careful in the removal of the soil bank as the bark on the young tree will be tender and any damage is an invitation for disease.
4. Banking is time intensive and requires extra soil and is not suitable for large groves.
5. Cold protection may not even be needed if the temperature never reaches close to freezing.

(PowerPoint Slide #36) Picture of soil banked around a citrus tree for freeze protection.

If any young citrus trees are near the school, try to visit it as a class. If no young citrus trees are available, plant a citrus tree as a class and review these procedures as the tree is planted. If this is not possible, have the students determine where the best places to obtain young citrus trees are in their area.

Objective 5: Care for established citrus trees.

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- V. Once young trees have been planted, they need to be cared for to produce high quality fruit.
- A. Water is very important in the growth of any plant, especially citrus trees.
1. Citrus trees should receive at least 5 centimeters of water per week during the growing season.
 2. Towards the end of the season near harvest they only need about 2.5 centimeters.
 3. The amount of water will also depend on the soil type.
 - a. Sandy soils will need watered more often, whereas clay soils will hold water longer.

(PowerPoint Slide #38)

- B. Trees which have reached fruit bearing age need plenty of nitrogen but not too much because the tree will produce excess foliage instead of larger fruit.
1. If the percentage of nitrogen in the fertilizer is less than 15 percent, apply about 0.45 kilograms per 2.54 centimeters of trunk diameter per year.
 2. If the percentage is above 20, use 0.34 kilograms or less per 2.54 centimeters of trunk diameter per year.
 3. Fertilizer can be applied once a year, right before bud break.
 - a. Fertilizer application can be split up into multiple applications as well spreading it once before bud break, once at fruit set and another towards the end of the season around harvest.

(PowerPoint Slide #39)

- C. Citrus trees do not require a lot of pruning and are better left alone.
1. Remove damaged branches or diseased areas.

(PowerPoint Slide #40)

- D. Most citrus trees are very sensitive to freezing and need protection if a freeze is expected.
1. One method starts by removing all vegetation under the tree and thoroughly irrigating the ground a few days before the freeze is expected.
 - a. Bare, moist ground absorbs and conducts heat better than dry ground covered by weeds and grass.
 - b. This procedure helps radiate heat up and prevent some freezing of the tree.

(PowerPoint Slide #41)

2. Another method is done by simply covering the trees with a light blanket or some plastic.
 - a. If the blanket becomes wet be sure the weight does not break any branches.
 - b. If plastic is used, remove it during the day to avoid overheating and killing the tree.
 - c. Either of these treatments should be done the afternoon before the freeze is expected.

(PowerPoint Slide #42)

3. Portable heaters are another method.
 - a. Portable heaters placed underneath or between trees will radiate enough heat to prevent an extreme freeze on the tree.
 - b. This method requires extra inputs such as fuel and can be costly.

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4. The most common method used in large citrus groves involves an irrigation and sprayer system.
 - a. Sprayers are placed over the top of the trees and allowed to mist the trees covering them in water.
 - b. This method must be done before temperatures reach -2°Celsius when there is no breeze or -1°C if there is a breeze.
 - c. The sprayer must run constantly until temperatures are safely above freezing.
 - d. This method can cause ice build up on the branches and cause breakage of the limbs.

- i. It also causes excess saturation in the ground and can cause difficulties moving through the grove.

(PowerPoint Slide #44) This photo shows the difference between spraying trees for cold protection. The tree on the left was sprayed during a freeze and the tree on the right was not. The tree on the right is dead and cannot be saved.

(PowerPoint Slide #45)

- E. Productivity of the tree needs to be monitored closely.
 1. Citrus trees can produce fruit during their second year but generally do not produce until their third year.
 - a. Production generally increases as tree size increases.
 2. There usually are four or five flushes of new growth on a citrus tree each year and each flush is capable of producing flowers and setting fruit.
 3. The exceptions are lemons and limes which can flower and set almost year-round.

(PowerPoint Slide #46)

4. Typical citrus trees go through three distinct periods of fruit drop.
 - a. First is the drop of about 70 to 80 percent of the flowers during and immediately following bloom.
 - b. The second drop occurs a couple of weeks later, involving small fruit of pea-size to marble-size.
 - c. The third drop occurs in the early growing season, involving larger fruit, almost golf ball in size.
 - d. Navel oranges will drop again in mid-summer and in late summer.
 - e. A few fruit on all citrus will continue to drop through final harvest, but that is normal and cannot be prevented.

(PowerPoint Slide #47)

5. Excluding the **semi-everbearing** (producing nearly all year) citrus, most other types mature in the fall, including mandarins, tangelos, grapefruit and most oranges.
6. The juice quality of all citrus fruits improves during the season, so the longer it stays on the tree, the better it gets.
7. Citrus fruits generally store well on the tree; some fruit drop does occur but usually is compensated by increased size of the remaining fruit.
8. Eventually citrus fruits will begin to dry on the tree and should be harvested.

Depending on the time of the year, the freeze protection methods could be practiced as a class. Take the students to a grove (it it could be an orchard, just as long as it is arranged like a usual grove) and have them analyze which method they would use in this grove/orchard.

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 #48** can be used as review.

Application: Have the students visit a citrus grove or view a citrus tree. Discuss with the grower what was done to establish the tree and what is done to manage the tree or grove. If possible, plant a citrus tree as a class somewhere on the school grounds.

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. D
4. A

Short Answer

1. Any methods from Objective 5 letter D will work for this answer.
2. Southeast Asia
3. Orange (*Citrus sinensis*)
4. Removing vegetation from around the base of citrus trees decreases competition for nutrients and water. It also helps in freeze protection methods.

Sample Test

Name _____

Test

Unit E Lesson 2: Citrus Production

Part One: Matching

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

- a. **endocarp** b. **epicarp** c. **mesocarp** d. **semi-everbearing**

- _____ 1. The second layer of citrus fruit, often spongy and white.
_____ 2. The outer layer of citrus fruit, commonly referred to as the rind.
_____ 3. This is a type of fruit that produces nearly all year.
_____ 4. This inner layer of fruit is referred to as the pulp and contains individual fruit sacs divided into segments surrounded by a film.

Part Two: Short Answer

Instructions. Provide information to answer the following questions.

1. Describe two methods of freeze protection in citrus fruits.

2. Where is citrus believed to have originated?

3. The most commonly grown citrus fruit throughout the world is _____.

4. Why is it important to remove vegetation around the base of citrus trees?

Citrus Cross Section

