

Unit E: Fruit and Nut Production

Lesson 3: Growing Apples

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

1. Discuss the history of apples.
2. Discuss apple production throughout the world.
3. Understand the relationship between rootstocks and scions.
4. Demonstrate proper apple tree planting.
5. Demonstrate proper apple tree pruning.

Recommended Teaching Time: 3 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.hort.purdue.edu/newcrop/maia/history.html>
- <http://ohioline.osu.edu/hyg-fact/1000/1401.html>
- <http://www.weekendgardener.net/how-to/prune-apple-trees.htm>
- http://www.afghanistanhorticulture.org/Nursery_Survey.aspx

List of Equipment, Tools, Supplies, and Facilities

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Masters
Examples of apples from Afghanistan (optional)
A mature apple tree
An apple tree to plant (optional)

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

central leader
dwarf rootstocks
espaliers
open center
pomology
rootstock
scion
semi-dwarf rootstocks
standard rootstocks

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.

Provide students with examples of apples from Afghanistan. Ask them, “What makes an apple desirable to the consumer?” “What do you think is needed to grow an apple?” Write the students responses on the chalkboard or the computer so they can be shown on the PowerPoint Projector.

Use this approach to move into Objective 1.

Summary of Content and Teaching Strategies

Objective 1: Discuss the history of apples.

(PowerPoint Slide #3)

- I. Apples have a long and distinguished history and have an important part in the history of many cultures.
 - A. Apples originated in Kazakstan about 8000 years ago.
 1. This is where the largest number of wild types occur.
 - B. Nearly 7500 varieties of apple exist, contributing to the wide array of cultivated varieties.
 - C. Apples belong to the *Rosaceae* family which includes roses.
 - D. The science of growing apples is called **pomology**.

Visit <http://www.hort.purdue.edu/newcrop/maia/history.html> and have the students read about the history of apple. As a class, create a timeline of the important events in apple history on the chalkboard.

Objective 2: Discuss apple production throughout the world.

(PowerPoint Slide #4)

- II. Apples are produced throughout the world, wherever the climate is suitable, and account for 50 percent of the world's deciduous fruit tree production.
 - A. In Afghanistan, apple trees are located near water sources and is aimed at meeting the needs for the local markets.
 - B. The current apple production in Afghanistan largely depends on the few exotic varieties imported 20 years ago.
 - C. China produces the largest amount of apples followed by the United States. Turkey, France, Italy, and Iran are leading exporters.

Discuss apple production in Afghanistan. Ask the students if any of them grow apples at home or know somebody who does. Discuss where the students usually get their apples from. Try to provide some apples to the class for eating.

Objective 3: Understand the relationship between rootstocks and scions.

(PowerPoint Slide #5)

- III. Almost all apple trees purchased from suppliers are grafted.
 - A. The **scion** determines the type of apple and fruiting habit.
 - B. The **rootstock** determines the size of the tree, earliness to bear fruit, and longevity.
 - C. The scion and the rootstock will affect pest susceptibility and cold hardiness.

(PowerPoint Slide #6)

- D. Rootstock ordered locally will generally be most resistant to many of the diseases commonly affecting apples in that area.
- E. Choose a rootstock that will benefit both you and your orchard.
- F. There are three main types of rootstock.

(PowerPoint Slide #7)

- 1. **Standard rootstocks** will produce large, full-sized trees that may grow more than 7.6 meters tall.
 - a. They are very hardy and can be planted in a wide range of soils and climates.
 - b. They are sturdy, long-lived (50 years or even longer), and productive (producing about eight bushels of apples a year when fully grown).
 - c. Standard trees should be spaced at least 9 meters apart with rows no closer than nine meters.
 - d. If you choose standard rootstocks, you will be able to plant fewer trees in your orchard.

(PowerPoint Slide #8)

- e. Also, their large size makes pruning, spraying, and picking more difficult.
 - i. You will eventually need a ladder (or a long-handled fruit picker) to pick your apples.
- f. Full-size trees also take longer to bear fruit.
 - i. It will probably take five or six years (or maybe even longer) before the trees start to have a good crop.

(PowerPoint Slide #9)

2. **Semi-dwarf rootstocks** will reach a height of 4.5 to 6 meters.
 - a. They should be planted at least 6 meters apart with rows no closer than 7.6 meters apart.
 - b. They may not be as hardy as full-sized trees
 - c. They will produce about five bushels of full-size apples per year.
 - d. They are not as long-lived as full-sized trees and have a life expectancy of about 20 – 25 years.

(PowerPoint Slide #10)

- e. They do not require staking.
- f. Because they are smaller than full-sized trees, picking and care will be easier.
 - i. However, a ladder may eventually still be needed.

(PowerPoint Slide #11)

3. **Dwarf rootstocks** will grow 3 to 3.6 meters tall.
 - a. Place dwarf trees at least 4.5 meters apart and rows no closer than 6 meters apart.
 - b. They will be less hardy than full-sized or semi-dwarf trees.
 - c. Because their roots tend to be rather shallow and not very strong, dwarf trees will need to be tied to a sturdy stake.

(PowerPoint Slide #12)

- d. Dwarf trees will live for about 15 to 20 years and will begin bearing fruit in two or three years.
- e. They will produce one or two bushels of full-size fruit a year, and because of their smaller size, most of the fruit can be picked without a ladder.

(PowerPoint Slide #13) This is a picture comparing the various rootstocks and their height.

(PowerPoint Slide #14)

- G. Common rootstocks used in Afghanistan are East Malling 9 and Malling Morten 106
1. East Malling 9 or M.9 is most commonly used in Europe.
 - a. It creates a dwarf tree about 25% to 30% of a full size tree.
 - b. It is resistant to Phytophthora but not Woolly Apple Aphid.
 - c. The tree will need to be supported.
 2. Malling Morten 106 or MM.106.
 - a. MM.106 is typically free standing when mature
 - b. It is highly susceptible to crown and root rot
 - i. MM.106 is resistant to Woolly Apple Aphid.
 - c. Works well on poor, light soils.

Have the students research where the best places to get apple trees are located. Determine what varieties of apples these places sell and whether the trees would be suitable for an orchard in areas surrounding the school. Compile a list of apple tree suppliers so that the class can have a copy to use at home.

Objective 4: Demonstrating proper apple tree planting.

(PowerPoint Slide #15)

IV. Apples should be planted in late spring when the soil is thawed and air temperatures are cool.

A. Apple trees purchased in containers can be planted at the beginning of Autumn.

1. While fall is a good time to plant fruit trees, bare root trees are generally not available from nurseries at this time.

B. Apple trees should be planted where they receive full sun (at least six or more hours) and where the soil is reasonably deep and fertile with good water drainage.

(PowerPoint Slide #16)

C. Never expose tree roots to sun or drying winds so they do not become dry before planting.

1. After receiving trees, unwrap the package and make sure the roots are moist.

2. Keep roots packed in moist peat moss, sawdust, or strips of newspaper until ready to plant.

3. Keep the roots cool (but above freezing).

4. Try to plant trees soon after they are received.

5. Trees held for longer than a few days may bud out and can be susceptible to breakage.

6. About an hour before planting, soak tree roots in a bucket of water to ensure that they are hydrated.

(PowerPoint Slide #17)

D. Dig a hole about 0.6 meters wider than the spread of the tree roots and deep enough to prevent crowding.

1. The tree should be planted at the same depth as it was in the nursery.

2. Always keep the graft union 5 centimeters above the final soil line.

3. Before planting the tree, inspect the root system.

4. Prune broken roots and shorten long roots to 30 to 38 centimeters.

(PowerPoint Slide #18) This is a picture of a properly planted young fruit tree.

(PowerPoint Slide #19)

5. Use sharp pruning shears.

6. Place the tree in the hole and arrange the roots so they aren't overlapping.

7. If they appear cramped, make the hole larger!

8. Refill the hole with the same soil that was removed from the hole.

a. Refilling the hole with other materials will create an undesirable situation.

(PowerPoint Slide #20)

9. To avoid air pockets, tamp the soil with your foot as the hole is filled.

10. After the soil has been firmly tamped, slowly apply 3.75 to 7.5 liters of water to the tree.

11. This will hydrate the tree and help settle the soil around the roots.

(PowerPoint Slide #21)

12. Add additional soil if needed to maintain the soil at the same level as that surrounding the hole (unless planting on a berm).

13. If the graft union of the tree sinks into the soil, reposition it so it remains 5 centimeters above the soil level.

14. When the graft union becomes covered with soil, the scion cultivar will root and the dwarfing habit induced by the rootstock will be lost.

(PowerPoint Slide #22)

- E. After planting, a 38 to 45 centimeter piece of hardware cloth should be placed around the trunk of the tree to prevent rodent damage.
 - 1. It should be placed about four inches into the soil.
 - 2. As the tree becomes older, do not permit the hardware cloth to girdle the trunk.
 - 3. White plastic spiral tree guards should be avoided as they can provide a habitat for insect pests that may damage the tree.

(PowerPoint Slide #23)

- F. A stake should be placed beside an apple tree to provide support.
 - 1. A 5 x 5 centimeter stake is generally sufficient.
 - 2. For trees on dwarfing rootstocks, the stake should be 3 meters tall and will remain in the ground for the life of the tree.
 - 3. Small trees can be easily overloaded with apples and will lean or break because of their weaker root system.

(PowerPoint Slide #24) This picture illustrates the placement of a stake near a dwarfed tree.

(PowerPoint Slide #25)

- 4. Stakes for trees on semi dwarfing rootstocks should be 1.8 to 2.4 meters tall.
- 5. Stakes on these trees are needed only in the first five years after planting to support the main trunk.
- 6. After this time, the root system and the framework of the tree are generally strong enough to support the tree with fruit on it.
- 7. After selecting a stake, drive it 0.6 meters into the soil.
- 8. Secure the tree to the stake by a heavy no. 9 wire and section of an old garden hose or some other material to prevent scapping off the bark when the tree moves in the wind.

Refer to Unit B Lesson 2 “Selecting and Planting Fruit and Nut Trees”. TM: B2-1 has been included for a review. Stress the importance of pollinization in the apple orchard.

Objective 5: Demonstrate proper apple tree pruning.

(PowerPoint Slide #26)

- V. Pruning an apple tree will greatly improve yield, disease tolerance, fruit quality and aesthetics. Properly pruning an apple tree is not difficult but takes some practice that will benefit the orchard.
 - A. There are normally two goals when pruning an apple tree.
 - 1. Initially on young trees to encourage a strong, solid framework.
 - 2. On mature trees to maintain shape and encourage fruit production.
 - 3. The best time to prune apple trees is in late winter or very early spring before any new growth starts.

(PowerPoint Slide #27)

- 4. The only growth you ever want to prune or remove during the summer months, when the tree is actively growing, is a sucker.
 - a. On young and old trees, remove all suckers that grow up from the rootstock.

- b. The best time to do this is during the summer when suckers are least likely to resprout.

(PowerPoint Slide #28)

- B. When pruning just about anything, including apple trees, here is a list of situations you always want to prune out.
1. Suckers
 2. Stubs or broken branches
 3. Downward-growing branches
 4. Rubbing or criss-crossing branches

(PowerPoint Slide #29)

5. Upward growing interior branches
6. Competing leaders
7. Narrow crotches
8. Whorls

(PowerPoint Slide #30)

- C. The day apple trees are planted is the day to begin to train and prune them for future fruit production.
1. Neglect results in poor growth, delayed and under-sized fruiting.
 2. The following pruning styles are if you have recently purchased, or own a young tree, and need to determine its shape as a mature tree.
 3. A new apple tree will usually be either a .91-1.2 m whip (it has no branches), or a 1.2-1.8 m tall young tree with several branches. This is assuming you have not purchased a dwarf variety.

(PowerPoint Slide #31)

- D. Training to a **central leader** produces a tree that has a pyramid shape,
1. If your newly planted tree is a whip (it has no branches and looks like a long stick) cut the trunk at a height of about 81 cm.
 2. This will stimulate branches to grow along the trunk, and the topmost bud will become the central leader.
 3. For a new tree that already has side branches, cut back the trunk to 81 cm.

(PowerPoint Slide #32)

4. Cut off any branches along the trunk between the ground and 61 cm high.
5. Cut back any remaining side branches to 5-10 cm, leaving no more than 2 buds on each branch stub.
6. First Summer: Make sure the top shoot becomes the leader. Pinch back all other shoots.

(PowerPoint Slide #33)

7. First Winter: If there has been a lot of new growth, choose 3 to 5 branches for the first set of scaffold branches.
 - a. These branches should spiral around the trunk with about 10 cm vertical distance between each branch.
 - b. Cut off the other side branches and any vertical branches that may compete with the leader.
 - c. Prune back the main leader shoot, but keep it as the highest part of the tree to maintain your pyramid shape.

(PowerPoint Slide #34)

8. Second Summer: Make sure that the top shoot is growing vertically, cut off any competing shoots.
9. Second Winter: Select another set of scaffold branches .61-.91 m higher than the first set. If the tree didn't grow enough the second year, do this the third winter.
10. Thereafter: Keep doing the above until you have 3 or 4 sets of scaffold branches. Then simply keep that shape by pruning out watersprouts and any crossing, diseased, or unwanted branches. Try to keep the lower branches longer than the upper ones to maintain the shape.

Show TM: E3-1 to review central leader training. The pictures on top are the correct way to prune, and the bottom shows the incorrect way. Discuss the differences between the two sets of drawings with the class.

(PowerPoint Slide #35)

- E. Apples trained with an **open center** form a vase-shaped tree with no central leader; instead, several major branches angle outward and upward from the top of the trunk.
1. Cut back the newly planted tree to 61-81 cm, depending on how low you want the major branches to form.
 2. Choose strong, well-spaced branches that are 15-25 cm below the cut to become primary scaffold branches.
 3. If the young tree has some side branches, cut back the leader to 61-81 cm.

(PowerPoint Slide #36)

4. Select well-placed side branches that point out from the trunk in different directions 15-25 cm below the cut to become scaffold branches.
5. Cut back the selected branches to 5-10 cm stubs, and cut off all the other side branches.
6. By the end of the first growing season, the major scaffold branches should be formed.

(PowerPoint Slide #37)

- F. You can grow apples as **espaliers** as ornamentals against walls or fences, along wires, or on lattices.
1. Semi-dwarf varieties are the best choices because they grow slower and require less pruning than full-size varieties.
 2. Simply train the branches into the shape you want, or along a fence or wall.

(PowerPoint Slide #38)

3. Every year, prune to shape.
4. Direct its growth by pruning frequently during the growing season and during the dormant season to guide it into the shape you want.
5. It may take several years of training before the tree conforms to the shape you want it to take.

(PowerPoint Slide #39) This is a picture of an espaliered tree.

(PowerPoint Slide #40)

- G. Full-size trees can sometimes become neglected because of the care required to produce good fruit. The following guidelines will help determine if a full grown neglected tree can be saved by pruning.

(PowerPoint Slide #41)

1. Mature trees usually already have their shape determined, so the shape only needs to be maintained. Every year:
 - a. Remove broken or diseased branches
 - b. Crossing limbs
 - c. Weak stems
 - d. Any branches growing inward to the tree's center
 - e. Any growing vertically or straight down
 - f. Thin out enough new growth to allow light to filter into the canopy when the tree has leafed out so the fruit can ripen and color properly.

(PowerPoint Slide #42)

- g. Shorten any branches that are too long to avoid leggy growth
- h. Shape tree evenly and remember apples flower and fruit on old wood, so head back new growth to direct energy back into the flowers and fruit
- i. Also, if in the past years too many apples have formed and crowded each other out, you can thin the spurs to only a few per branch. This will allow enough light and air to circulate around to avoid diseases and small, puny fruit.

(PowerPoint Slide #43)

2. Neglected trees often become bushy and weak and will produce very poor quality apples. Such a tree requires extensive corrective pruning.
 - a. The main objective in pruning such a tree is to try to open up the interior to allow good light penetration.
 - b. The first step is to remove all the upright, vigorous growing shoots at their base that are shading the interior.

(PowerPoint Slide #44)

- c. As with the young apple trees, it is necessary to select 3 to 5 lower scaffold branches with good crotch angles and spaced around the tree.
- d. Limbs with poor angles, and excess scaffold limbs, should be removed at their base.
- e. In some cases it is advisable to spread the corrective pruning over two to three seasons.
- f. When severe pruning is done in the winter, the trees should not be fertilized that spring.

Have the students prune an apple tree. Also, review Unit C Lesson 3 “Pruning and Thinning Fruit and Nut Trees”. If apple trees aren’t available for pruning, have the students observe an apple tree that has already been pruned to view its growth.

Review/Summary: Use the student learning objectives to summarize the lesson. Student responses to the questions on **PowerPoint Slide #45** can be used to determine which objectives need to be reviewed.

Application: Have the students observe an apple tree and decide if it has been properly pruned. Observe the tree for any grafting that has been done. Also, if any trees were grafted in Unit C Lesson 2 “Demonstrating Plant Propagation Techniques Utilized in Fruit and Nut Production” observe those trees to see if the grafts were successful.

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

Answers to Sample Test:

Matching

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

Short Answer

1. Late fall or winter when the wood is dormant.
2. MM.106 and M.9

Test

Unit E Lesson 3: Growing Apples

Part One: Matching

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

- | | | | |
|------------------------|---------------------|--------------------------|-------------|
| a. central leader | b. dwarf rootstocks | c. open center | d. pomology |
| e. rootstock | f. scion | g. semi-dwarf rootstocks | |
| h. standard rootstocks | | | |

- _____ 1. The science of growing apples
- _____ 2. Determines the type of apple and fruiting habit
- _____ 3. Determines the size of the tree, earliness to bear fruit, and longevity.
- _____ 4. Produce large, full-sized trees that may grow more than 25 feet tall
- _____ 5. Reach a height of 15 to 20 feet
- _____ 6. Grow 10 or 12 feet tall
- _____ 7. Produces a tree that has a pyramid shape
- _____ 8. Produces a vase-shaped tree with no central leader

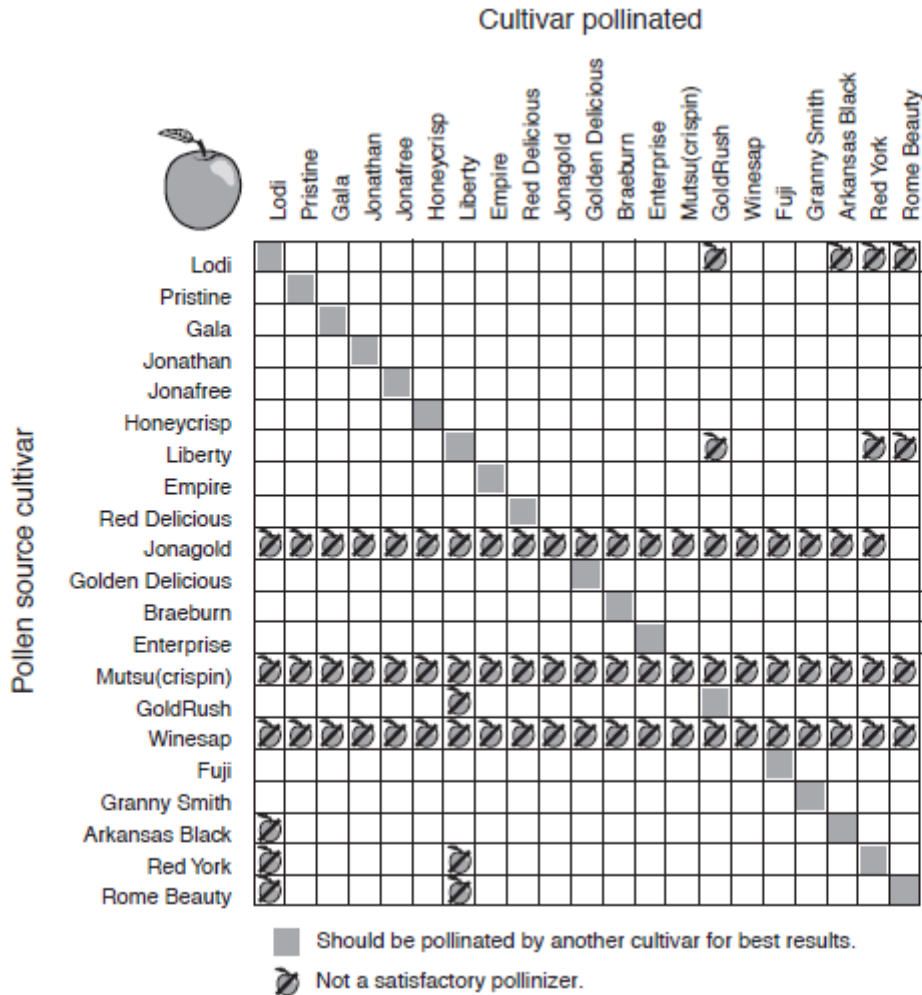
Part Two: Short Answer

Instructions. Provide information to answer the following questions.

1. What time of year is best to prune apple trees?

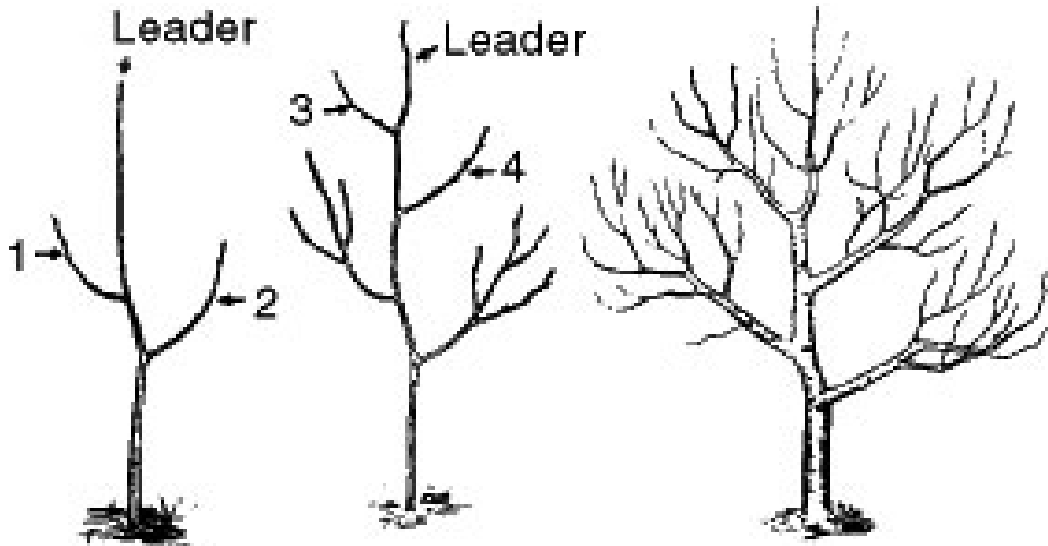
2. What are the two common rootstocks used in Afghanistan?

Apple Pollination



This chart represents 21 apple varieties that are commonly grown. It demonstrates which varieties easily cross-pollinate. For example, GoldRush will not cross-pollinate with Liberty but can cross-pollinate with all the other varieties (except itself). There are hundreds of apple varieties and in order to find a cross-pollinator ask the grower you obtain the root stock from.

Proper Central Leader Training

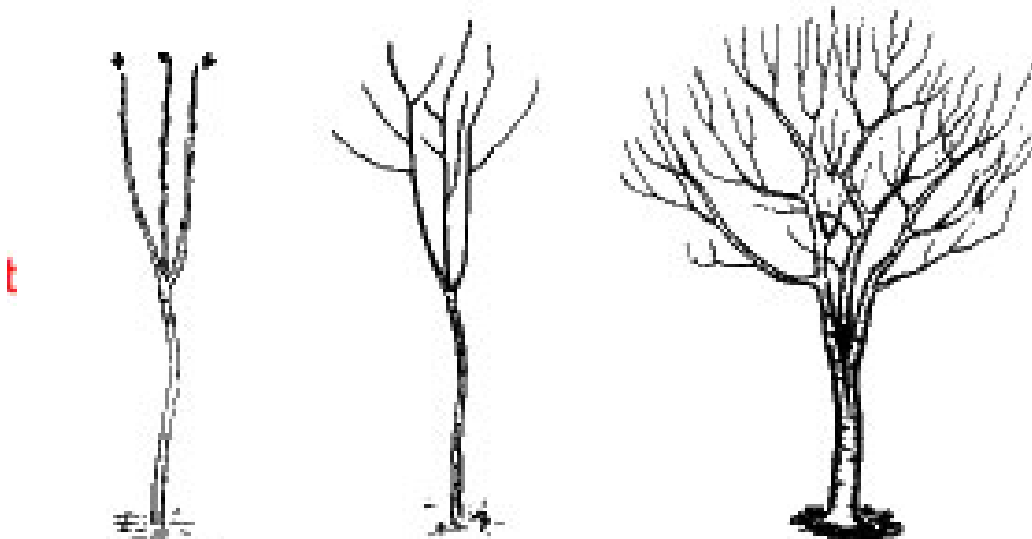


Correct

At planting

1 year later

After about 6 to 8 years



Incorrect