

Chapter 1. Introduction

Benefits of Growing Fruit at Home

Fresh fruit is an excellent source of fiber, vitamin C, and minerals. In recent years, consumption of fruits and vegetables has been consistently shown to reduce the risk of many cancers. Many chemical compounds found in fruits are being recognized for their potential in protection against heart disease and cancer.



Figure 1. Ripening red raspberries.

The American Cancer Society has developed guidelines for nutrition and cancer prevention. These guidelines are similar to the Dietary Guidelines for Americans (HHS and USDA) and include the following:

- Choose most of the foods you eat from plant sources.
- Limit your intake of high-fat foods, particularly from animal sources.
- Be physically active. Achieve and maintain a healthy weight.

- Limit consumption of alcoholic beverages if you drink at all.

The guideline stating to “choose most of the foods you eat from plant sources” has been recognized for years as being important for good health. More importantly, recent research has begun describing positive properties, specifically chemicals, contained in fruits, vegetables, grains, legumes, seeds, licorice root, soy, and green tea.



Figure 2. “An apple a day keeps the doctor away.”
Photo by Keith Weller, USDA/ARS.

A home fruit planting can provide fresh, tasty, and nutritious fruits for family use or sale. There are many excellent benefits to home fruit production:

- Growing fruit at home makes an excellent hobby for many gardeners. It can be a good source of fun and enjoyment. It is also a good way to exercise and release stress.
- You can be a proud producer of large amounts of delicious fruit in a relatively small area.
- Home fruit production can encourage children and adults to eat more fruit.
- Home fruit plantings can be incorporated into the landscape and can greatly enhance your home’s landscape.
- Home fruit gardeners can grow cultivars that are not available in local grocery stores or farm markets.
- Home fruit growers have direct control over pesticide inputs and can apply less chemicals in their fruit plantings.

- Growing fruit at home is an excellent educational experience for the young and the young at heart.

Potential Challenges

There is much more to growing fruit than planting and harvesting the crop. Fruit plantings require a great deal of continuous care and attention. Growing fruit requires considerable knowledge about planting site, planting techniques, soil and nutrition, cultivar selection, training and pruning, and pest management.

Fruit growing requires some investment in basic tools and equipment, including a sprayer for pesticide application. Some fruit crops (usually strawberries, brambles, and blueberries) can be grown without the use of pesticides. However, production of tree fruits without the use of pesticides will generally result in poor-quality fruit.

Some fruits are definitely easier to grow than others. For example, strawberries are very similar to herbaceous perennials or annuals. Some strawberry cultivars (day neutral and everbearing types)

produce berries during the first year of planting while others (June-bearing type) produce berries one year after planting. Raspberries and blackberries are like ornamental shrubs and are not difficult to grow. However, tree fruits require much more time for pruning and pest management and take three to four years to bear fruit.

Before you begin a fruit planting, it is a good idea to consider disease resistance, pollination needs, site requirements, susceptibility to frosts, and cold hardiness of fruit plants. You might also want to attend a few training programs on fruit production or consult with your State University Extension professionals.

Climate

Cold Hardiness

Cold hardiness, or the capacity of plants to tolerate low winter temperatures, varies greatly among different fruit crops and cultivars within fruit crops (Table 1). Cold damage that may occur can include the splitting of tree trunks, damage to strawberry crowns, or death of stems and buds.

Table 1. Approximate Low Temperatures That Damage Dormant Plants and/or Flower Buds.

Tree Fruit	Temperature
Apple	-30°F
Pear	-30°F
Peach and Nectarine	-15°F
Plum	-15°F
Cherry	-20°F
Apricot ¹	-25°F
Small Fruit	Temperature
Strawberry ²	-10°F
Blueberry	-20°F
Blackberry (erect)	-20°F
Blackberry (trailing thornless)	-5°F
Raspberry (red) ¹	-30°F
Raspberry (black)	-20°F
Grape ³	-15°F
Gooseberry	-30°F
Currant	-30°F

¹ Some cultivars are subject to flower bud damage with fluctuating temperatures and strong cold winds.

² Use of straw mulch will help protect against cold weather damage during winter, plant heaving in heavy soils, and frost damage to flowers and buds in the spring.

³ Some fruit cultivars are sensitive to strong cold winds.

USDA Plant Cold Hardiness Zones

Each state in the Midwest is divided into cold hardiness zones by the USDA. As an example, Ohio is divided into four hardiness zones based on the average annual minimum temperature. They are Zones 5a (-15°F to -20°F), 5b (-10°F to -15°F), 6a (-5°F to -10°F), and 6b (-0°F to -5°F). Refer to the USDA hardiness zone map (Figure 3). The majority of Ohio is in Zone 5b, while the southern end of Ohio is mainly in Zone 6a. The type of fruit crop and cultivar of fruit crop should be based on the average winter temperatures for your area. Check with your state's Cooperative Extension Service for information on cold hardiness zones.

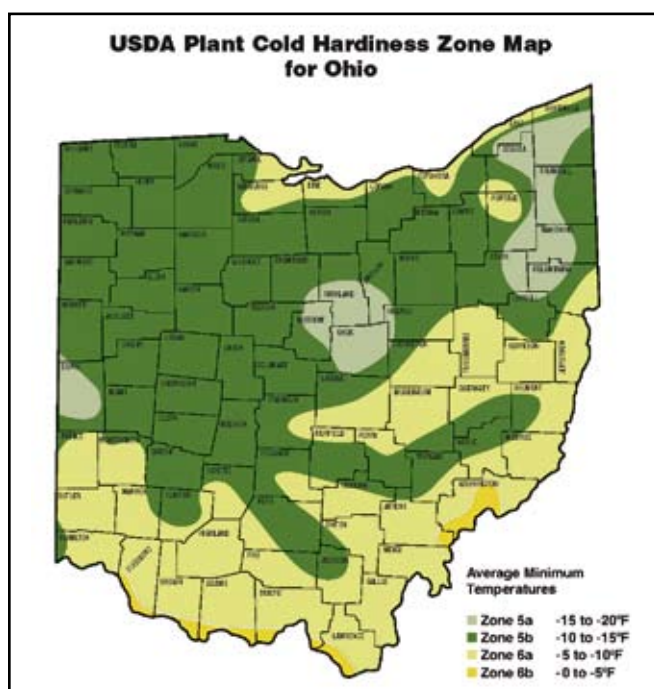


Figure 3. USDA Plant Cold Hardiness Zone Map for Ohio. Courtesy of the Ohio Nursery and Landscape Association. Used with permission.

Different fruit crops have varying degrees of susceptibilities to low temperatures (Table 1.) With each type of fruit crop, different plant parts and cultivars may have different thresholds for low temperature injuries. Plants that are healthy and properly acclimated for winter tend to withstand cold temperatures better than plants that are not acclimated and plants that are weakened.

Sudden changes or fluctuations in temperatures are common in the Midwest. Protecting plants from strong, cold winds can be beneficial. Planting on the east side of buildings or solid fences provides some protection from wind.

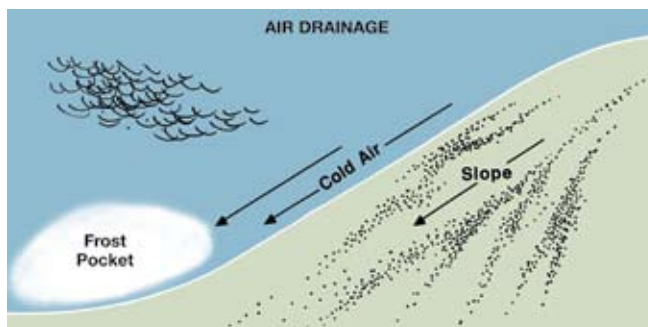


Figure 4. Air movement reduces moisture and humidity around plants in summer, prevents conditions that promote and spread diseases, and provides protection against late spring frosts.

Some fruits bloom early, such as apricot, sweet cherry, and peach, and are susceptible to frost damage to the blossom during early spring. In addition, frost damage will occur more frequently where cold air settles in low spots. It is best not to establish fruit plantings in such areas.



Figure 5. Strawberry flowers with symptoms of frost damage. Note the black (dead) centers.

Growing Season

The number of frost-free days during the growing season at any location can be an important factor in selecting adapted fruit crops. The growing season (number of frost-free days) in most of the Midwest is usually sufficient to grow most temperate-zone fruit crops. However, for certain fruit crops, the length of growing season is an important factor when selecting late-maturing cultivars for planting.

Soil

It is very important to select soil with proper characteristics since fruit crops are perennial and may occupy an area for many years. Fruit plants grow best in a fairly fertile, well-drained soil of loamy texture. A well-drained soil is essential to promote soil aeration and good root development. Never plant any fruit crop on a poorly drained (wet)

site. Although some trees might survive in poorly drained soil for a few years, they are destined to be short-lived and unproductive.



Figure 6. Gardeners should avoid planting fruit plants in soils that are consistently wet during the growing season.

Poorly drained soils are usually high in clay content and very sticky when wet. They tend to form a hard crust after a heavy rain, are easily compacted, and may hold water puddles for long periods after a rain. At the other extreme, very coarse sandy soils that drain rapidly dry out excessively during periods of prolonged drought.

A choice of soil types usually is not available to the homeowner. Where soil is unsuited to fruit crops, it should be improved prior to planting. Installing tile drainage and/or incorporating large amounts of organic matter, such as compost, will aid in improving soil structure, aeration, drainage, and fertility. Poorly drained soils should not be used for fruit production, unless fruit gardeners are willing to install raised beds or use other practices to improve soil drainage.

Soil Reaction (pH) and Fertility

Frequently, soils contain the proper amounts of most nutrients, but they may be in a chemical form that is unavailable to plants. This condition may result from an undesirable soil reaction, or pH. Soil reaction refers to whether a soil is acidic or alkaline (basic) or neutral. Soils with a pH 7 are neutral. Soils with a pH below 7 are acidic, and those with a pH above 7 are alkaline (Figure 7). Most fruit crops prefer slightly acidic soils where most mineral nutrients are readily available to the plants. Blueberries require highly acidic soils. Please refer to the chapters on individual fruit crops for more information on soil requirements for specific crops.

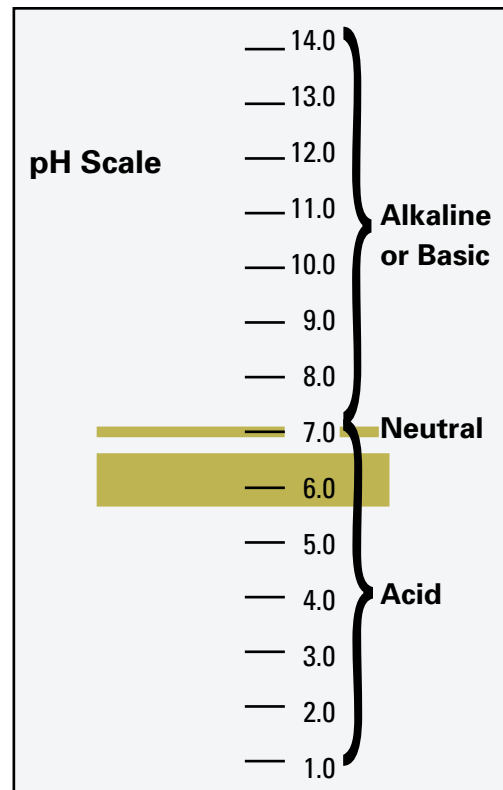


Figure 7. The pH scale shows whether soil reaction is acidic, neutral, or alkaline.

It is very important to take a soil test through a reliable laboratory to determine soil pH. The same report will also tell you what the lime index or buffer pH is. With both values, the soil testing lab can recommend soil amendments to lower or raise pH. Typically, sulfur is used to lower soil pH, while lime is used to raise soil pH. A soil test will also reveal specific nutrient levels. A typical soil test report will show you how much fertilizer to apply and whether you need to apply lime or sulfur.

The amount and type of fertilizer and lime or sulfur to apply for growing specific fruit crops is provided to the gardener along with the soil test reports. This is invaluable for successful fruit production. Applying fertilizer, lime, or sulfur without the benefit of soil test results and recommendations as a guide makes soil fertility maintenance and improvement haphazard. This can create more problems than it solves.

If your soil test report indicates a need for lime or sulfur to correct soil pH, fall is a good time to do that. Since the chemical reaction for pH adjustment takes three months to one year, an application of lime or sulfur can be applied in the fall prior to the year of planting since fruit crops are typically planted in spring. Soil pH requirements

are quite different for different fruit crops. Refer to the appropriate chapters and sections for specific recommendations for each fruit crop.



Figure 8. Do not guess; soil test! A soil probe (shown here) or a garden trowel can be used to take a soil sample.

Some garden centers carry soil test kits. However, these test kits do not provide an accurate reading of nutrient levels and soil pH. Gardeners are encouraged to work with their local county Extension office to determine how soil samples can be taken and where the soil samples can be sent for testing. State University Extension offices can provide gardeners with a list of suggested private soil testing labs.

Soil tests do carry a charge. However, such tests are an excellent investment. A soil test costs approximately \$15 to \$20. Check with your soil testing lab for latest rates. Gardeners should have their soil tested every three years.

Fertilization

Fertilization is an important practice in growing all fruit crops since a large amount of minerals are removed each year through fruit harvest, fallen leaves, and pruned stems. When properly used, fertilizers help improve plant health and increase yields and fruit quality. Improperly used, they may be wasted or result in plant damage, excessive growth, lack of fruit production, or poor quality fruit.

Even though fertilizers are very important, they cannot:

1. Correct or improve a soil structure that does not allow sufficient aeration or drainage for satisfactory root and plant growth.
2. Adjust an unsuitable soil reaction (pH).

3. Compensate for poor-quality plants or poorly adapted cultivars.

Gardeners may use either synthetic or organic fertilizer. A lot more research has been done on the use of synthetic fertilizers by universities and federal agencies. The recommendations for the rate and timing of synthetic fertilizers are very accurate because of the availability of research-based information from reputable sources. Synthetic fertilizers can also be available in both fast-release and controlled-release forms.

Generally speaking, it is more economical to use synthetic fertilizer. However, some gardeners prefer organic fertilizers. Organic fertilizers are products of living things and include manure, fish meal, and blood meal. Generally, organic fertilizers act more slowly than synthetic. Although poultry and rabbit manures are organic in nature, they must be used with caution on fruit crops because of the high concentration of nitrogen they contain.

Many different types and brands of fertilizers are available today. Fertilizers commonly used today in fruit production include the ones with an analysis of 10-10-10, 12-12-12, 15-15-15, 5-10-15, or 5-20-20. The types of fertilizers used for fruit plantings depend greatly on the nutrient levels in the soil and the type of the fruit crops grown. This is why soil tests are highly encouraged. Soil testing through a reputable lab is the best way to determine the nutrient levels, soil pH, lime index, or buffer pH. You will also receive recommendations on fertilizer and any materials needed to adjust soil pH.

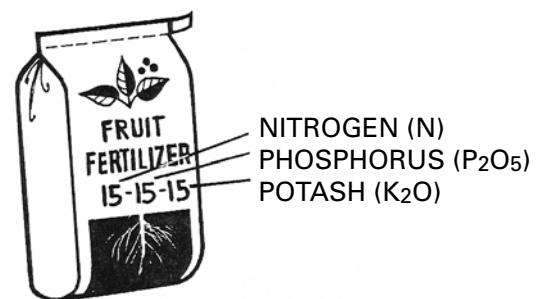


Figure 9. A complete fertilizer is typically recommended for home fruit plantings. Only a soil test can reveal the fertilizer needs of a given fruit crop.

Some more serious home gardeners may choose to conduct tissue analysis, *i.e.*, foliar (leaf) analysis. Tissue analysis is a great way to determine what is taken up by plants. It is a good supplemental test

to soil analysis and should probably be reserved for fairly large-scale fruit plantings.

Essential nutrients for fruit plants are best supplied from the soil. Complete fertilizers contain the three primary plant nutrients— nitrogen, phosphorus, and potassium. An example of a complete fertilizer is 12-12-12. The three number sequence used to describe fertilizers is known as fertilizer analysis. The first number in the analysis refers to the percentage of nitrogen by weight. The second number refers to phosphorus as the percentage of water-soluble phosphoric acid equivalent (P_2O_5), while the third number refers to potassium as potash (K_2O). Incomplete fertilizers lack one or more primary plant nutrients. Examples are 0-20-0 or 0-20-20. Soil test results and plant performance are valuable guides to the type and amounts of fertilizer to use.

Nitrogen generally needs to be applied each year since it is essential for all areas of plant growth. It is important in the development of chlorophyll, the pigment responsible for the dark green color in leaves, and photosynthesis, the conversion of carbon dioxide to carbohydrates. Hence, nitrogen is essential in promoting vegetative growth and in improving the quality of fruit. Nitrogen must be applied in proper amounts. Too much nitrogen causes excessive growth. This excessive growth can result in greatly decreased fruit production.

In apples and pears, the bacterial disease fire blight may develop and spread rapidly in plants with excessive, succulent growth. In addition, poorer fruit color and some physiological disorders in apples are also common when excessive nitrogen has been applied. Too much of any nutrient can cause damage or even kill plants.

Phosphorus promotes early root development and growth. It gives plants a rapid and vigorous start. It also stimulates flower bud formation and blooming, aids in shoot growth, and hastens maturity. Since phosphorus moves slowly in the soil profile, it is quite beneficial to add phosphorus in the planting hole prior to planting fruit plants, if soil test recommendations call for addition of phosphorus.

Potassium is essential to plant health and disease resistance and improves fruit quality. It is also important for the efficient use of water. Hence,

plants that are deficient in potassium may experience marginal scorching of leaves, which mimics drought stress.

Even though fertilizers that contain nitrogen, phosphorus, and potassium are often called complete fertilizers, fruit plants still need 11 other mineral nutrients called secondary elements and trace elements or micro nutrients. These elements are also essential to fruit crops. They will need to be added if the soil test report and/or plant tissue testing indicate an insufficient amount.

Common methods of applying fertilizers are broadcast application, sidedressing, topdressing, fertilizer solution application, and foliar spray. Broadcasting refers to uniformly applying the fertilizer over the entire area. Sidedressing refers to placing the fertilizer beside the row during the growing season. Topdressing is similar to sidedressing except that the fertilizer is applied around the plant. Caution: Fertilizer applied too close to the plant can cause fertilizer burn. Foliar applications are dilute fertilizer solutions applied directly to the leaves.

Timing of Fertilizer Application

The timing for fertilizing fruit crops differs greatly among fruit crops. Refer to the individual chapters and sections on specific fruit crops for recommended fertilizers and their timing. In order for fertilizers to promote growth, they must be soluble and present in the root zone in the correct concentrations. Fertilizers in very dry soil generally do not produce the desired results. Watering or rain may help improve fertility. Too much fertilizer may cause plant injury or plant death.



Figure 10. Fruit trees should be fertilized in early spring before growth starts. Shown here are dormant peach trees. Timing for fertilizing small fruits can be very different.

Soil Management

It is a good idea to prepare the soil a year before planting. Planting a cover crop and correcting soil pH imbalances will go a long way in soil improvement. Plant a cover crop to increase soil organic matter content and prevent soil erosion. You may also add organic matter at planting. Cover crops established in the fall should be turned over in the spring before plant growth is so tall that it is difficult to completely turn under. Cover crops may be seeded in September between rows of grapes and raspberries. Annual ryegrass and winter rye are good examples of cover crops. They need to be sowed before September 15 for best results.



Figure 11. Good planning is very critical for successful fruit plantings. It is a good idea to conduct a soil test and improve your soil the year before you plant your fruit crops.

When growing fruit crops, the planting should be mulched to a depth of two to three inches in the row for most fruit crops except blueberries. Blueberries require a thicker layer of mulch. Refer to the blueberry section for specific recommendations. Mulch helps conserve soil moisture, suppress weeds, and reduce fruit diseases. Areas between rows for most fruit crops except strawberries are usually seeded with perennial grass and mowed. The areas between the rows of strawberry plants are not usually seeded with grasses. Straw typically is used between and within the rows as mulch to control weeds, conserve soil moisture, and keep berries clean. In addition, straw can be used to cover plants for both winter and frost protection.

Pollination for Successful Fruit Production

Many home gardeners have experienced abundant blooms on various fruit crops without fruit production. There can be several causes for this problem. Unsuccessful pollination is at the top of the list. Pollination is the transfer of pollen from *anthers* (male part of the flower) to *stigmas* (female part of the flower) which may, or may not, be on the same flower or on the same plant. If the flower is not satisfactorily pollinated, fruit may drop, be poorly shaped, or malformed and unattractive.



Figure 12. Honeybees are required for pollination of many fruit crops.

Some fruits are *self-fruitful*, meaning that pollen from the same cultivar will result in successful pollination, fertilization, and fruit formation. For these, you do not need to plant two different cultivars that bloom at the same time. However, some fruits are *not self-fruitful*, (e.g., apple trees) and pollen from its own flower or pollen from a flower of another tree of the same cultivar is incapable of producing fertilization. This is because a biological antagonism exists between the pollen and the style of the flower. Therefore, *cross pollination*, or the transfer of pollen from the anthers of one cultivar to the stigma of another cultivar, is necessary when a cultivar is not self-fruitful. In addition, some cultivars have *sterile pollen* and cannot pollinate others. Gardeners are encouraged to consult with their local Extension office, garden centers, or mail-order nurseries when purchasing fruit plants to determine pollination requirements for a specific fruit crop or cultivar.

Many fruit crops also need honeybees or wild bees to carry pollen from one flower to the next since their pollens are heavy and sticky. These pollens are not carried to any extent by wind. Honeybees and wild bees are good carriers of pollen from the anthers of one cultivar to the stigma of another cultivar. The pollen adheres to the surface of the stigma and germinates and, if compatible, forms a pollen tube that grows down the style to the ovule. The sperm fuses with the egg cell, fertilization is completed, and seed development begins.

During recent years, honeybee populations have been drastically reduced by parasitic honey bee mites. Pesticide usage during bloom has also had a detrimental effect on honey bee populations. In addition, feral bee colonies (wild honey bees nesting in trees or other cavities) have been decreased dramatically. If you do not see any bees when your fruit trees are in bloom, your fruit size and yield can be greatly reduced. Misshapen fruit could result as well. Gardeners should refrain from applying insecticides when fruit trees are in bloom.

Other than the lack of viable pollen, other factors affecting pollination include cool, wet or humid weather, or strong wind that can limit or stop bee activity and lead to poor pollination. Frost damage frequently kills the *pistil*, the female part of the flower. Cold temperatures before or during bloom can cause poor seed count or poor seed formation, therefore causing malformed fruit and possibly fruit drop. Insects such as the tarnished plant bug feed on anthers and cause deformed strawberry fruit. Several other factors can adversely affect fruit set.

Apples, sweet cherry, plum, and nut crops, such as hickories, Persian (English) walnut, and filbert (hazelnut), require cross pollination and are generally considered self unfruitful. Therefore, two different cultivars need to be planted within 50 feet of each other for semi-dwarf fruit trees and 20 feet for dwarf fruit trees. Ideally, they should be planted side by side for much greater chance of successful pollination.



Figure 13. Apple, sweet cherry, plum, and nut crops, such as hickories, Persian (English) walnut, and filbert (hazelnut), require cross pollination and are generally considered self unfruitful.

Photo by Scott Bauer, USDA/ARS. Used with permission.



Figure 14. A bumper crop of blueberries.

Blueberries will yield more fruit if two different cultivars are planted near each other. Black walnut, chestnut, and butternut will also yield more if two trees of the same cultivar are planted together. Refer to Table 2 for best pollinizers, which are plant species or cultivars that produce the pollen for various fruit crops.

Table 2. The Best* Pollinizers (the Plant Species or the Cultivars That Produce the Pollen) for Various Fruit Crops.	
Apple Enterprise, Golden Delicious, Jonafree, Jonathan, Liberty, Lodi, Pristine, Rome Beauty	Sweet Cherry Hedelfingen, Black Tartarian, and Rainer
Pear Clapp's Favorite and Maxine	Japanese Plum Abundance, Methley (for Santa Rosa), and Shiro
European Plum Stanley and Shropshire Damson	Blueberry and Nut Crops Plant two different cultivars of the same crop for higher yields.
* Many other cultivars of each fruit crop can be good pollinizers. Refer to your nursery catalogs for more recommended cultivars.	

Peaches, nectarines, apricots, grapes, brambles, strawberries, currants, gooseberries, and sour cherries (pie cherry or tart cherry) do not require cross pollination but all except grapes require bee activity for maximum yield and desirable fruit shape.



Figure 15. Peach does not need cross pollination for a successful crop.

Pollen source does not influence fruit flavor. For example, McIntosh will be McIntosh in size, color, and flavor when pollinated by Golden Delicious. However, the seeds when planted would produce different seedling hybrids than their parents. Very few seedlings, if any, produce fruits of acceptable quality. This is why fruit plants are not propagated by seeds. They are propagated by cuttings, bud and stem grafts, or root suckers, depending on the fruit species.

