LEAF Network Mission

Link people with the benefits of edible trees and support edible trees with people's stewardship.

CONTENTS

For each section of this Guide, go to the corresponding section of the *LEAF Network website* (**leafnetworkaz.org**) for more explanations, photos, graphics and links to related resources. The website also provides the detailed *Arizona Edible Tree Directory*, the narrative *Profiles of Arizona's Edible Trees*, the *Arizona Edible Tree Photo Gallery* and a calendar of tree-related activities and events around Arizona.

LEAF Network

Linking Edible Arizona Forests

PHOTO CREDITS

The people listed below generously provided photos in ***Growing Edible Forests, An Illustrated Guide***. Permission to use photos should be obtained from execdirector@aztrees.org through **leafnetworkaz.org**.

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GENERAL GUIDANCE

The information provided in ***Growing Edible Arizona Forests, An Illustrated Guide***, along with supplemental information at the *LEAF Network website*, is intended as general guidance.

CONSULT LOCAL EXPERTS

Consult experts in local government, Cooperative Extension and plant nurseries to discuss which tree species, planting locations and strategies will work best for your Arizona location.

COMPLY WITH REGULATIONS AND RESTRICTIONS

Understand and comply with all regulatory requirements and restrictions that might apply to planting and managing trees, especially trees in the vicinity of overhead power lines and buried utilities. Before implementing any actions described herein, readers should review all regulations that might pertain to their location and/or adjacent properties and adhere to all requirements. If in doubt, consult with local regulatory experts.

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Linking Edible Arizona Forests

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All trees enrich our lives, our communities and our world. Edible trees add beauty and provide other benefits.

CHAPTER ONE

LEARN Values, Benefits & Characteristics

Shade and Cool

Purify Air

Build Soil

Purify Stormwater

Screen Wind

Create Wildlife Habitat

Add Beauty

Provide Economic Benefits

Build Community

Improve Food Security

LEARN Values, Benefits and Characteristics

We use the term *edible trees* to describe trees that produce fruits, nuts, seeds and pods that suit human tastes. Trees in people's yards, communities, orchards and open spaces create Arizona's Edible Forests. By planting edible trees, you provide tasty, nutritious, fresh foods for you, your family and your community. In ***Growing Edible Arizona Forests, An Illustrated Guide***, we describe and illustrate five basic steps to bring edible trees into your life. Whether you are putting a single tree in your backyard or a food forest at a public site, follow these steps to *LEARN, CHOOSE, PLANT, CARE AND HARVEST*.

Following the FIVE CORE VALUES described below can help you sustain edible trees now and for generations to come:

Carefully select appropriate edible trees. Base your selection on personal and community needs, tree characteristics, current climate and site conditions and potential future climate conditions.

Create resilient sites for trees. Apply design strategies to sustainably build soil, harvest water and plant and care for trees to ensure healthy, productive growth.

Share the bounty. To increase local health and food security, first meet your needs and then share surplus with family, neighbors and the community to increase access to nutritious, local food.

Learn about, grow, harvest and celebrate trees as a community. Bring children, elders and your community together to learn about edible trees and share in their planting, care and harvest. Celebrate the good food, history, culture and stories of your community's trees.

Prepare for the long life of trees. Trees can live decades and even centuries. To benefit generations to come, write down information that future stewards will need to care for trees.

Benefits of Edible Trees

All trees provide benefits, with edible trees adding even more value:

Provide shade and cooling. Tree canopies provide shade, cool the air, reduce damaging sun exposure and reduce cooling costs.

Purify air. Leaves absorb carbon dioxide (a heat-trapping gas), release oxygen and intercept air pollutants.

Build soil and reduce erosion. Leaf fall builds soil and supports the growth of soil life. Tree canopies cushion the impact of raindrops. Tree roots hold soil in place, reducing erosion.

Moderate floods and purify stormwater. Tree roots improve water infiltration, so falling rain can nourish plants instead of flooding streets, and filter and cleanse stormwater.

Improve conditions. Trees screen wind, views, dust and noise, enhance aesthetics and provide wildlife habitat.

Yield economic benefits. Trees produce structural wood, fuel, food, medicinal products and fiber. Trees increase property values, support tree-related businesses and provide commercial food crops.

Build community. Celebrating local edible trees encourages communities to gather together to care for, harvest, and learn about trees from one another.

Improve food security. Edible trees increase sustainable local food supplies, enhance dietary variety and improve nutrition.

Save resources. Local foods reduce fuels used to transport food long distances. Native trees can grow on rainfall alone.

Characteristics of Edible Trees

Key characteristics of edible tree are described below, including suitable elevations, water needs and chill requirements. These characteristics are noted for fruits, nuts, seeds and pods of selected edible trees, shown on pages 11 and 12. Additional characteristics of edible trees are described on page 10. The *LEAF Network website* **leafnetworkaz.org** provides a summary table of trees and their characteristics along with additional tree detail in the *Arizona Edible Tree Directory*.

Due to potential climate changes, tree characteristics could change over time. Potential climate change effects on trees are described throughout this Guide, along with strategies to select trees and design sites for long-term tree health.

Arizona Elevations for Trees

Different trees thrive in different climates. Arizona climates vary with changes in elevation from low deserts to high mountains. General elevations where edible trees can grow are shown under the photographs on pages 11 and 12. Based on the elevations, a list of trees recommended for Arizona cities and towns is provided at the *LEAF Network website*. Keep in mind that different varieties of the same tree species can tolerate additional heat and cold. The U.S. Department of Agriculture (USDA) and Sunset Magazine have mapped and described planting zones for the U.S. Nursery tags often indicate which of these zones are best for a specific tree. Observe trees in your area, ask neighbors which edible trees grow well in their yards and consult local plant nursery and Cooperative Extension professionals for advice.

Low Desert	Mid Desert	High Desert	High Plateau, Mountain	High Mountain
Lake Havasu City, Phoenix, Yuma	Ajo, Casa Grande, Tucson	Globe, Kingman, Sierra Vista, Willcox	Page, Prescott, Winslow, Tuba City	Flagstaff

Water Needs of Trees

The amount of water a tree needs to grow, produce and stay cool depends on weather, location, tree size, species, and additional factors. Trees can generally be grouped into *low*, *medium* or *high water-use* categories to estimate their water needs. On pages 11 and 12, the number of water drops shown below photos indicates these general water needs. Check the trees at your site for health and soil moisture to determine specific water needs.

- **Low water-use plants.** Water needs range from around 12 to 20 inches per year for native desert trees and for nonnative trees from other dryland environments.
- **Medium water-use plants.** Water needs range from around 20 to 40 inches per year for moderate water-use native trees, such as those found along washes, and for many nonnative trees. Medium water-use trees may need more water in low deserts.
- **High water-use plants.** Water needs range from about 30 to 50 inches per year for high water-use native trees—typically found along flowing streams or in areas with shallow groundwater, and nonnative trees from cooler/wetter climates.

Chill Requirements of Trees

In general, temperate fruit crops need winter chill hours. *Chill hour requirements* are the number of hours wintering trees must spend between the temperatures of **32°F and 45°F** to stimulate proper bud growth, fruit set and fruit development. Different varieties of trees such as apple, peach, fig and pomegranate have different chill hour requirements. Many types of temperate fruit and nut trees have varieties that require less chill hours and can be planted in warmer areas. Ask experts at local nurseries and Cooperative Extension offices for their advice and experiment to see what grows best at your site.

Native and Nonnative Trees

Both *native edible trees* and *nonnative edible trees* provide food with nutritious proteins, vitamins and minerals. Native trees are those that grow naturally in the wildlands of Arizona without the need for human care. They are adapted to the rainfall patterns, temperatures, local climates and microclimates around Arizona, and many have supported indigenous peoples for thousands of years.

Nonnative edible trees have been introduced to Arizona from regions around the world. With sufficient water, many nonnative edible trees can adapt well to local Arizona conditions.

Dwarf Semi-Dwarf Standard

Average Tree Sizes

Tree size varies with a tree's genetics, age, planting environment, water supply and pruning. Smaller trees use less water than larger trees of the same type. Dwarf trees—created through breeding or grafting—are much smaller than standard-sized trees. Semi-dwarf trees are intermediate between the two. Standard-sized trees can typically be pruned to keep them smaller than their potential mature size. Knowing a tree's full potential size will help you choose the spacing and number of trees appropriate for your site.

Tree Life Span

Tree life spans vary depending on the species and conditions. Some trees live longer than those who plant them, so plan ahead for long-term watering and maintenance of your trees. Keep records of useful information about your trees such as variety (subdivisions of tree species with differing characteristics), water needs, fertilizing frequency, pruning instructions and harvest times to help future tree stewards sustain healthy, productive trees.

Pollination Requirements of Trees

Flowers of all edible trees require *pollination*, which is the transfer of pollen from the male part of a flower (stamen) to the female part of a flower (pistil). Pollination fertilizes flowers so the tree can produce fruits, nuts, seeds or pods. When selecting trees, find out how they are pollinated and use this information in planting design. Types of pollination include:

Self-pollination. Tree blossoms pollinated by their own pollen or pollen from another flower on the same tree.

Cross-pollination. Tree blossoms pollinated by another tree of the same variety, or another variety of the same species; many need bees to transfer the pollen. Different varieties may flower in early, mid- or late season. Be sure to plant varieties that bloom at the same time.

Animal and insect pollination. Tree blossoms that need bats, birds, bees, moths or other insects for pollination. These trees should not have insecticides or other chemicals applied that could hurt pollinators.

Wind pollination. Tree blossoms that rely on wind to carry the pollen among trees. Wind-pollinated trees need several trees of the same species planted within 50 feet of each other to ensure that sufficient pollen reaches flowers.

Male and female trees. Trees that have male and female flowers on different trees (called *dioecious plants*), where only the female trees produce fruit. A male tree is needed in the vicinity to pollenate the female tree to ensure production. Get professional advice on design in these cases.

Selected Edible Trees that Grow in Arizona

Much more information about these trees and other edible species is provided at the *LEAF Network website* and the *Arizona Edible Tree Directory*. Characteristics are shown using the symbols placed under the photographs.

General Elevation Areas Where This Tree Could Grow in Arizona

Low Desert	Mid Desert	High Desert	High Plateau, Mountain	High Mountain
Lake Havasu City, Phoenix, Yuma	Ajo, Casa Grande, Tucson	Globe, Kingman, Sierra Vista, Willcox	Page, Prescott, Winslow, Tuba City	Flagstaff

Tree Water Use is Generally

- Low Water Use (12–20 inches/yr)
- Medium Water Use (20–40 inches/yr)
- High Water Use (30–50 inches/yr)

Chill Hours between 32°F and 45°F will be needed to stimulate proper bud growth, fruit set and fruit development

Almond

Apple

Apricot

Carob

Cherry

Citrus

Date Palm

Elderberry

Fig

Hawthorn

Ironwood

Jujube

Juniper

Loquat

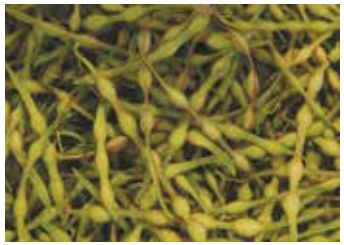
Medlar

Mesquite

Mulberry

Oak

Olive



Palo Verde

Peach

Pear, Asian

Pecan

Persimmon

Pinyon Pine

Pistachio

Plum

Pomegranate

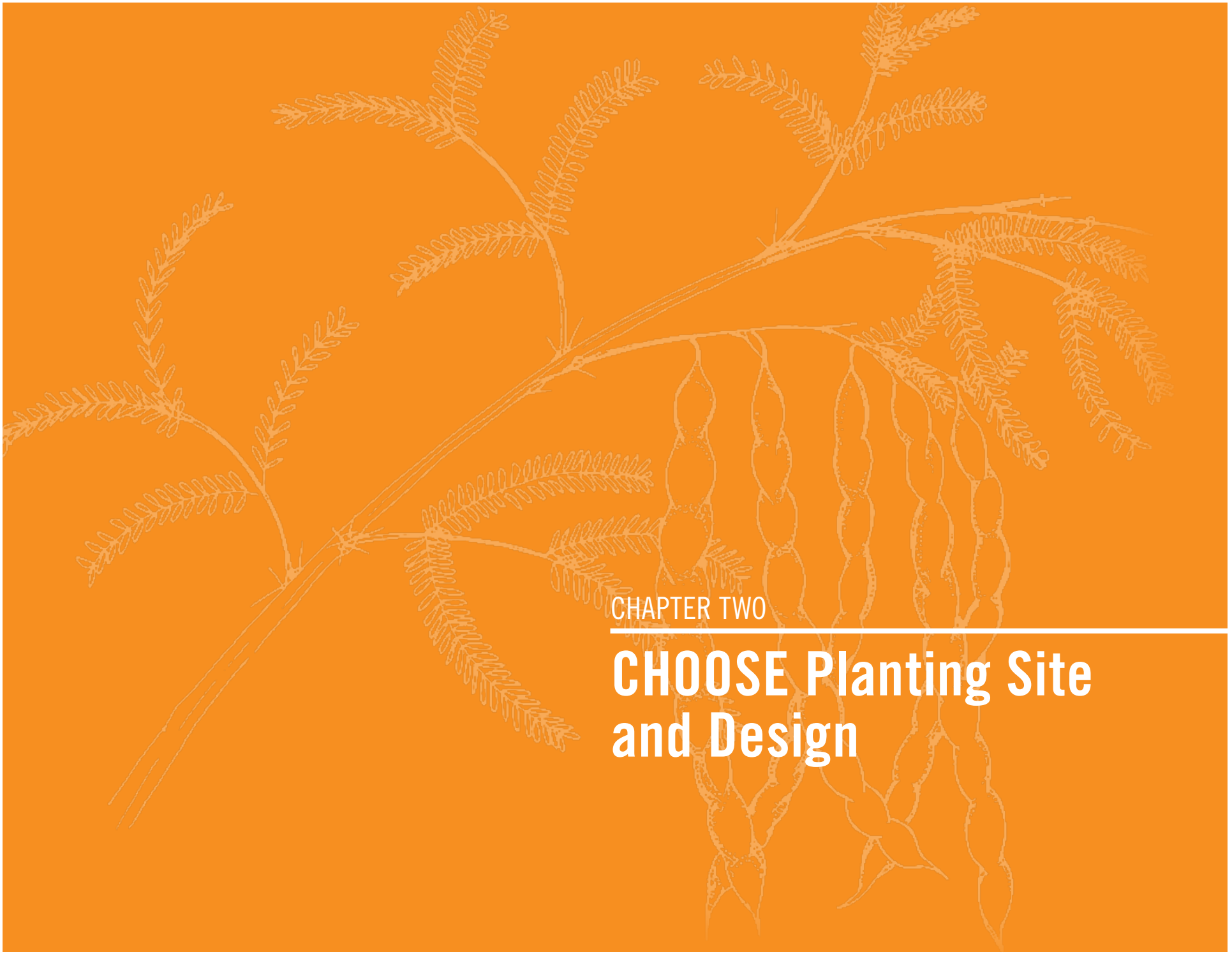
Quince

Saguaro

Sapote

Walnut

Right tree. Right place.
Right time. Bright future.



CHAPTER TWO

CHOOSE Planting Site and Design

CHOOSE Planting Site and Design

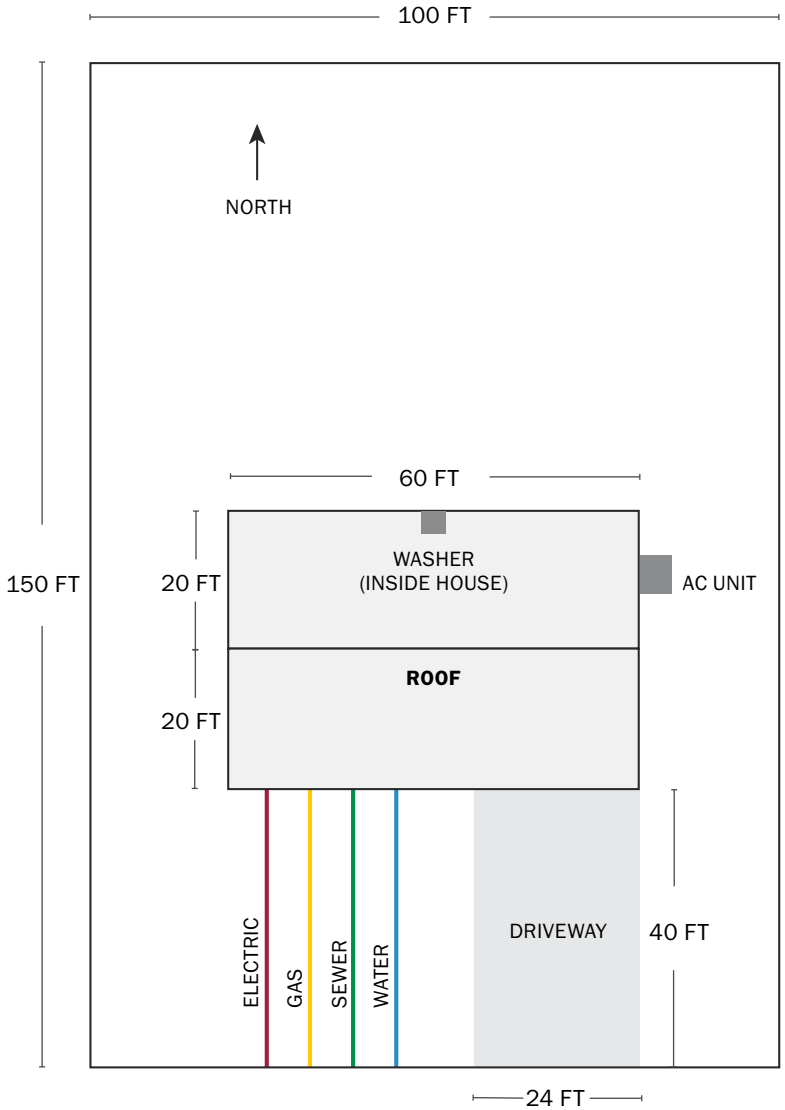
Identify your goals, planting sites and water sources to create your planting design.

Personal and Community Goals

- Describe your personal and cultural connections to edible trees.
- What fruits, nuts, seeds and pods do you like to eat?
- Are you interested in native trees? Nonnative trees? Both? Which edible trees grow in your region of Arizona?
- How much produce do you want for yourself? To share?
- Do you have enough time to plant, maintain and harvest trees? Who else can help?
- Do you want to plant trees at a private site or a public site? Who owns and maintains the site?
- What water resources are available to support your trees? Can these supplies be sustained over time?
- How can edible trees help increase food security and nutritional value for your community?
- Are there edible trees that have cultural and/or historic significance to your community?
- How can community skills, volunteer work, creativity and funding help in preparing, maintaining and harvesting edible trees? How can these trees and stewardship activities educate people and bring the community together?
- Does your community have edible trees in public spaces? Who maintains and harvests them? What ordinances relate to these trees? Are there any concerns about edible trees?
- How long will the edible trees live? What are the plans for long-term tree stewardship?

Opening a pomegranate to eat fresh off the tree.

The local community gathers here for farmer's markets and seasonal festivals.



Example of a simple site base map with dimensions and utilities marked. You can use a base map to help you draw site conditions and future tree planting locations.

Understanding Site Conditions

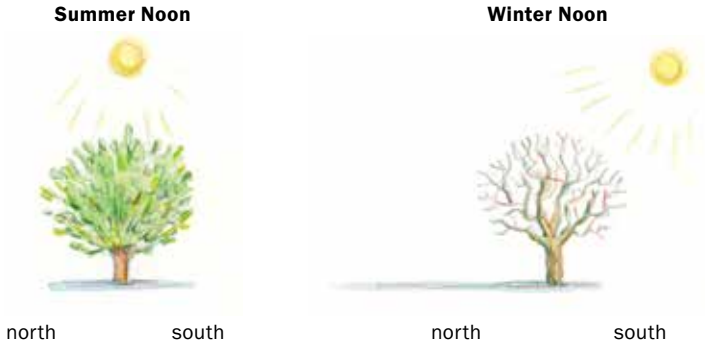
Walk around your site. Take a close look at land slope, sun, shade, soil, signs of strong winds, patterns of water flow and other site characteristics. Think about what your site is like on freezing nights, in windstorms and when it is raining hard.

One way to help you visualize site conditions and good places to plant trees is to start with a site base map. This can be a simple sketch, or an aerial photo or site plan with written notes added. It is helpful to show property boundaries, roofs, driveways, vegetation, walls, and other physical features, along with which direction is north (south, east or west).

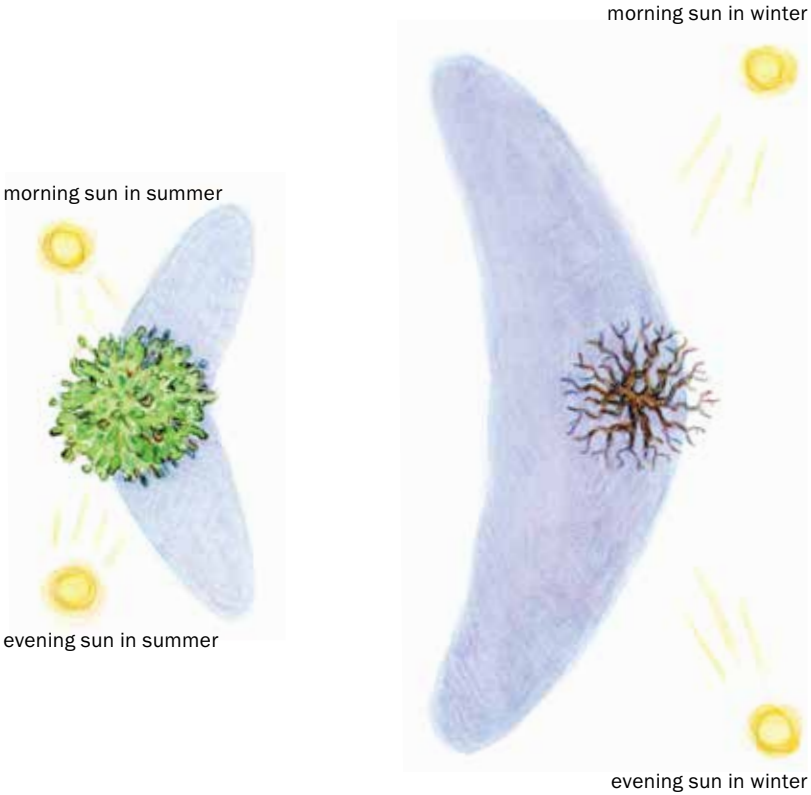
You can use the site base map to show conditions at your site such as sun and shade patterns, where cold air drains, wind directions, types of soil, potential water sources and water flow patterns. Sections below describe these conditions and others. The *LEAF Network website* illustrates how to draw these conditions on a site base map.

Always find out and show where utility lines are located. **Use extreme caution if you are digging near buried utility lines. Do not plant trees over buried utility lines or under overhead utility lines.**

An underground utility line is marked here in red. Always determine the location and depth of buried lines before you dig. Use extreme caution when digging near buried utilities.



Patterns of shade cast by trees at noon in summer and winter, as seen from the side.



Patterns of summer and winter shade cast by trees from morning to afternoon to evening, as seen from above.

Microclimates

Patterns of sun, shade, wind, soil and water along with the position of vegetation, buildings and other structures create *microclimates*. Microclimates are small, localized climatic conditions that may be warmer, colder, dryer, wetter, windier or calmer than other areas of the site. Understanding these patterns will help you choose where to plant trees to help them thrive now and in the future.

Shade Patterns

In Arizona summers, the sun shines from the *northeast* in the morning, reaches nearly overhead at midday and sets in the *northwest* at sunset. Direct sunlight can be very hot, with areas next to west-facing walls even hotter. Shade cast in summer can be a relief, but the air temperature is often still hot.

In Arizona winters, the sun moves across the *southern* sky from sunrise to sunset each day. Shade on the north side of buildings and walls can be deeply cold in winter. South-facing walls, if heated by the sun, can be somewhat warmer than overall outside temperatures. In fall and spring, milder air temperatures can moderate direct sun and deep shade throughout the site.

Native trees are generally heat and sun resistant. They can shade houses, reducing household cooling costs and lowering outdoor temperatures around them. But even native trees can suffer when pruning exposes formerly shaded bark and stems to full sun, so avoid heavy pruning in summer. When pruning in cooler seasons, newly exposed bark and stems should be exposed to direct sun gradually. Nonnative edible trees may need partial shade from long hours of direct summer sun, especially in southern deserts. Place heat- and sun-sensitive trees east of buildings to provide them with shade during hot afternoons. Trellises, shade cloth and porches can help create partial shade, especially for trees on the west side of buildings.

During hot summers, urban areas with extensive roofs, parking lots, streets, and other pavement absorb heat all day and radiate heat back out at night, stressing trees and people. This is called the *urban heat island effect*. Potential future higher temperatures could increase this effect. Shaded pavement can be substantially cooler than sunny pavement. At the same time, trees provide evaporative cooling to the air around them, much as misting systems do. Where possible, plant heat-tolerant native edible trees to shade roofs, walls and pavement (avoid medium and high water-use trees in low-elevation urban areas). Use urban stormwater runoff to help water the trees.

In winter, the north sides of buildings are shaded all day. This cooler microclimate can supply the chill hours that some trees need to fruit (see pages 9, 11 and 12). On the other hand, trees that are cold sensitive will benefit from being planted on the south side of buildings where the walls absorb daytime heat and release it at night, buffering cold overnight temperatures. In those Arizona climates where winter warmth is welcome, planting trees that drop their leaves (rather than planting evergreen trees) on the south side of buildings will allow sun to enter south-facing windows.

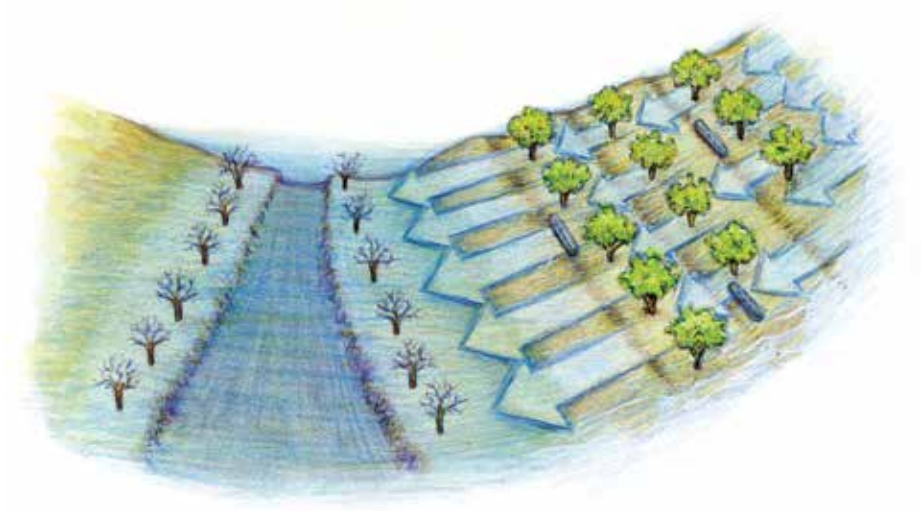
Shade is cast by native trees in a parking lot.

A citrus tree on the east side of a brick building benefits from morning heat and light all year, while being shaded from hot afternoon sun in summer.

Deep shade is cast all day by leafy citrus trees arching over a sidewalk.

Cold Air and Chill Requirements

When night approaches, especially in fall, winter and spring, cold air from higher elevations in a landscape can flow slowly downslope and collect in low spots at the bottom of the slope (much like syrup flowing over pancakes pools on a plate). Is your site located at or near the bottom of a drainage, canyon or wash? Do you occasionally or frequently have frosts or heavy freezes in colder times of the year? Have plants been damaged by this in the past? In desert areas, the accumulation of cold air at the bottom of slopes could benefit trees that need a certain number of chill hours to bloom and fruit. If your site has pooling cold air, trees with longer chill hour requirements could be placed in these low-lying areas. However, the blossoms of these trees may also be vulnerable to late spring frosts.



Cold air drains down slopes and pools in low areas. You can plant citrus and other cold-sensitive trees on slopes if they need protection from cold air. In desert areas, plant deciduous fruit trees that need more chill hours in locations where cold air pools.

Accumulations of cold air could be a problem for trees that are cold sensitive. Since this cold air may cause late spring freezes, do not place cold-sensitive trees in low-lying areas. Instead, place them in warm locations such as the south side of buildings where heat absorbed by walls in daytime can radiate to nearby plants at night. Since cold air flows past slopes to pool at the bottom, placing cold-sensitive trees higher on hillsides (if soil is deep enough to support them) can increase the chance of fruit production. Due to potential climate change, the number of chill hours in different Arizona regions may decrease in the future. However, having fewer chill hours does not necessarily mean having fewer freezing nights and less frost risk, so continue to protect vulnerable trees from cold. Look for tree varieties with greater tolerance to heat and cold to create more resilient systems.

Wildfire

Do you remember having had a wildfire at your site? Is there evidence of past fires such as blackened tree trunks on older trees? Wildfires are a particular threat where fire-prone forests or grasslands are located next to urban and suburban areas. Wildfires can be started by natural or human-caused events. Once started, they can be driven by wind, drawn uphill, or drawn by available fuels with unpredictable results. In areas prone to wildfires, keep tree canopies at least 10 feet from structures. If trees are placed closer to buildings in fire-prone areas, make sure trees are well watered, well trimmed and in good health. Based on climate change predictions, there could be an increase in the number, size and severity of wildfires in the future. See the *LEAF Network website* for more detailed information for how to prepare fire-prone sites for the potential threat of wildfire, including the use of Firewise practices.

Soil

Soil conditions affect water retention, the oxygen and nutrients available to tree roots, and the health of soil microbes that support trees. When walking around your site, notice soils that look sandy, clayey, or have caliche present. Notice places where leaves, twigs, and animal scat collect and enrich soil. Think about what you know about soil from holes dug in the past. Shaking a few cups of soil with water in a glass jar and watching the particles settle can show you the balance between different sized grains of gravel, sand, silt and clay. For more detailed testing, contact your local Cooperative Extension specialists about how to have soil tested, what to test for and how to improve soil fertility. Collect soil samples from multiple locations if you are having it tested.

Most fruit and nut trees need well-drained soil that is around three feet deep. Generally, trees grow best in a mixture of sand, silt, clay and organic material. However, some trees prefer sandy soil with fast drainage. Others grow better in silty or clayey soils that are high in organic matter and moisture. Native trees can often tolerate lower organic matter and higher salt, sand or clay content than nonnative fruit or nut trees.

Soil Treatments

The acidity of soil (referred to as pH) is critical to tree health and may require on-going adjustment before and after planting. Most fruit trees grow best in soil with a pH between 6.0 and 6.5. If your soil pH is below 6.0 (too acidic), you can raise the pH by adding lime (calcium carbonate). If soil pH is higher (alkaline), you can add compost, gypsum or other soil amendments to lower the pH. Alkaline soils occur in some northern and southeastern parts of Arizona.

If soils are compacted and dense, loosen them around the area where trees will be planted so roots can grow more easily through the soil. Soils high in clay do not drain well. Adding compost and organic material to these soils when planting your tree could improve drainage. Score the sides of the tree-planting holes so roots can more easily penetrate dense clay. Soils that are too sandy drain quickly and will have trouble maintaining moisture. Sandy soils may also be low in organic matter and nutrients. Add well-composted organic matter to the sand in the planting hole to improve soil quality. Over time, adding mulch and compost to the surface will also increase water retention and soil nutrients.

Caliche soils are a frequent problem in Arizona. Caliche is a hard, chalky white soil layer high in calcium carbonate, which adheres soil particles together and prevents good drainage and root growth. Caliche has a high pH, which inhibits nutrient uptake. If caliche is present, you may need to crack caliche layers with a shovel, pick or digging bar before planting trees, then add amendments. You can also dig the caliche out and backfill the hole with a balanced mix of sand, silt, clay and organic material.

In some cases, adding nutrients and amendments could burn young roots. Instead of putting amendments in the planting hole, you can till them into the top of the tree's soil to percolate slowly down.

Fruits, leaves, twigs, and pods collect under a mature hackberry shrub, enriching the soil.

Wind

Forceful winds can dry out air, trees and soil. At your site, are there particularly strong winds? What direction do they blow from? How do winds affect your trees and your own comfort? Winds can be created by climate patterns, by the effects of mountains, and by local constrictions in canyons and even between buildings. In parts of Arizona, hot, dry winds can blow from the west/southwest in late spring and early summer while strong winds can blow from the southeast in late summer. Signs of strong, persistent winds can be seen in permanently wind-shaped trees. To deflect and dissipate strong winds, plant hardy native edible trees as windbreaks upwind of buildings and sites. Plant more sensitive fruit trees downwind of hardy native trees and buildings to protect them from strong winds. Do not plant tender trees in locations where winds are concentrated such as in canyons or between buildings. Climate change could bring stronger winds and more intense storms that could damage and uproot trees. Tree-care strategies to protect against winds include trimming dead branches regularly and moving water supplies farther out from tree trunks to encourage wider root growth and stronger anchoring of the trees.

Human and Wildlife Use

Edible trees attract humans and wildlife alike, and these should be considered in your edible tree site design. Are there paths that people regularly use when walking across your site? Should these paths be maintained when new trees are put in? Providing good access to people in and around trees will make care and harvesting easier. Soil removed to form water harvesting basins can be used to create raised walking paths. In design, take into account that falling fruit could damage vehicles and create walking hazards for people. Does wildlife regularly cross your site? Will this benefit or be a detriment to your edible trees? Insects, birds and other wildlife are drawn to edible trees, and their activities should be accounted for in site design.

A windrow of Arizona cyprus trees make an excellent windbreak when they are planted close together. Note the consistent tilt of the trees toward the right (downwind) due to the force of the prevailing wind.

Tree Spacing

Trees need more space and water as they grow. Imagine fully grown trees (whether standard-sized, semi-dwarf or dwarf) when designing tree spacing. Plant trees far enough apart so their canopies will not overlap and the roots will have good access to soil and water. Avoid putting trees against shared boundary walls, since part of the tree canopy will be over your neighbor's yard and roots could impact wall foundations. Put trees far enough away from buildings so roots don't grow into building foundations and canopies don't overhang roofs. Plant trees at least 2 feet from street curbs. Do not plant trees under overhead utility lines or over buried utility lines. Plant wind-pollinated trees within 50 feet of one another to ensure good pollination. Fruit trees that require cross-pollination by honeybees should be planted 100 feet or less from one another.

Dwarf and Semi-Dwarf Trees

Generally, the bigger the canopy, the more water the tree uses. Choosing dwarf and semi-dwarf trees could reduce water use, especially for trees with high water demands. Dwarf and semi-dwarf trees use less space because they are bred to be small or are grafted onto rootstocks that keep them from reaching full size. These trees can be planted closer together than standard-sized trees, increasing the number of trees in a given space while leaving room for tree care and harvest. Fruit is the same size, color and quality as standard trees and is produced at an earlier age. Dwarf trees also may work well in containers. Dwarf and semi-dwarf trees need to be pruned, fertilized and cared for just as standard trees are. Periodically pruning standard-sized trees to reduce canopy size could reduce water needs and make it easier to reach fruit.

Multistory Plantings

To make the most of limited water and nutrients, most *overstory* edible trees can be interplanted with *midstory* shrubs and *understory* herbs, cactus and vines, creating a diverse *multistory* structure. Tall trees provide shade, higher humidity and frost protection for smaller plants while improving soil conditions below their canopies. Native mesquite, palo verde and ironwood trees shelter companion plants from harsh sun and add beneficial nitrogen to the soil, increasing nutrient availability.

Planting a diversity of edible trees enriches the landscapes and food choices and can attract beneficial insect pollinators and those that prey on pests. Note that some edible trees, such as juniper, pinyon and walnuts can have components in their roots or fallen needles or leaves that do not combine well with understory plants. In multistory plantings, determine appropriate tree spacing first. Think about how you will comfortably access the trees when you consider where to place shrubs, cacti, vines and plants under them. Design an open, structurally diverse environment you can easily care for and harvest.

An overstory ironwood tree shades midstory and understory shrubs and ground cover plants to create a productive edible landscape (left). Midstory wolfberry and chiltepine shrubs produce delicious fruit for people and wildlife (right).

Water Supplies

You can't grow trees without water. Most native edible trees—if properly placed—will not need much additional water beyond rainfall once they are established. However, nonnative fruit and nut trees will require consistent, deep watering to produce quality fruit. Using a combination of native and nonnative edible trees will balance water demands and give you a diverse harvest. Use as many on-site water resources as you can, including harvested rainwater, graywater and air conditioning condensate. You might also need water from groundwater wells, surface water sources, and public and private water utilities.

Harvest Rainwater

Rain is high quality water that falls freely from the sky, right where you need it. Take a look around your site. Where does rain run off your roof to the ground? Where does water flow, pool and soak into the ground after a rainstorm? Does water flow onto your site from uphill or off your site downhill? Knowing where rainwater falls, flows and pools is the first step in determining where and how to harvest it.

Start with Passive Water Harvesting

Large amounts of rainfall and runoff can be harvested directly into depressions shaped in the soil, a strategy called *passive water harvesting*. Rainwater harvesting depressions don't just collect rainfall. They also harvest soil and organic matter carried by water, reduce erosion, hold mulch in place, and help infiltrate graywater and other water supplies. You can dig passive depressions in many shapes, sizes and locations to match the slope of your land and the rainwater needs of your trees. Depressions collect both direct rainfall and water flowing toward them. The addition of berms (compacted earthen ridges constructed on the downslope side of depressions) can increase harvested rainwater. Rounded depressions are often called basins. Swales are typically linear depressions built on the contour of the land to hold water, or built at a slight slope to direct water from one part of a site to another. Information about types, sizes and construction techniques for passive depressions is provided at the *LEAF Network website*.

Useful tree planting locations can include low spots; gentle land slopes; and land near roofs, sidewalks, driveways, streets or others locations where rainwater collects. If possible, dig depressions when soil is moist. Trees can be planted next to depressions where roots can grow toward nearby soil moisture. They can also be planted within depressions if they are placed on raised soil mounds or terraces to keep standing water and mulch away from tree trunks.

It is beneficial to shape and size depressions to soak water into the soil where roots are actively growing—called the *drip line* of the tree. Since trees get larger over time, larger basins sized for full-grown tree can be constructed from the start, with smaller inner basins to water smaller seedlings.

An apple tree planted in a small passive water harvesting basin. Rocks reduce erosion on the downslope berm. Mulch retains moisture and adds nutrients. The basin also harvests snow. As the tree grows, the basin will be enlarged to infiltrate water at the drip line of the tree.

Consider Adding Rainwater Tanks

Having made the most of passive water harvesting, collecting rainwater off roofs into tanks will allow you to store rainwater for later use—a strategy called *active water harvesting*. Tanks can be placed above ground or underground, and range from 50 gallons to tens of thousands of gallons in storage capacity. If the tank water is higher in elevation than the tree-planting area, you can water trees by hand with a garden hose attached to the tank. If the tank is lower than the tree, or if pressurized flow is needed for a drip irrigation system, add a pump to deliver water. Besides storing rainwater, above ground tanks can provide shade, hold up porch roofs, act as privacy barriers, and moderate hot and cold temperature extremes around them. Decide what size tank you need and where to put it based on your roof area and how much water your trees need. Larger tanks could hold more water to sustain trees through the longer dry spells or droughts that could occur in the future.

Average rainfall varies month-to-month and place-to-place in Arizona, with higher rainfall in the monsoon and winter seasons. Visit the *LEAF Network website* for information on how to estimate your site's rainfall and active water harvesting capacity.

Large rainwater tank is filled from the adjacent gutter and downspout, harvesting water from a large roof. Water is piped down the wall in a water-tight downspout, then through an underground pipe and up into the tank. Tank is tapped with a hose bib. Water is delivered to adjacent landscape via gravity flow using a garden hose. Tank is positioned away from the building foundation in case the tank should leak.

The owner of an outdoor washing machine discharges graywater to a different pipe with each wash. Each pipe drains to a different edible tree. The soaps used are made for graywater systems.

Air conditioner condensate water runs out of a pipe onto the soil next to a house (left). One cup of water can be harvested from this pipe every five minutes (right) by attaching a hose and running it to a nearby edible tree.

Harvest Graywater

Water from showers, bathtubs, bathroom sinks and washing machines is called *graywater* and is produced daily in occupied households. Instead of flowing into sewers, this water can be piped outside to provide a steady water supply for edible trees. In Arizona, you may reuse graywater by following state and local codes and guidelines on how to collect it, transport it and apply it to soil. Do not apply graywater to the leaves or fruits of trees. Use soaps and cleaners designed for graywater reuse. Keep in mind that graywater can be salty, while harvested rainwater is virtually salt-free. Infiltrating graywater in passive water harvesting basins will allow rainwater to periodically dilute the salts left in the soil by graywater. The volume of graywater available to support trees depends on how much water is used in showers, baths, bathroom sinks and washing machines and discharged through the graywater system. The available graywater volume will likely be about the same month-to-month at a site that is occupied year round.

Harvest Air Conditioning Condensate

Many sites have air conditioning (AC) units located outside buildings. Moisture from air can condense on the cold parts of the AC units and collect at the bottom of the units, where it is often diverted through a drainpipe to the ground or sewer. If this water is routed toward a nearby edible tree instead, it can help support the tree, especially during more humid times of year when more water condenses. The volume of AC condensate changes month-to-month depending on humidity and the frequency of AC use. Projected increases in temperatures could mean greater use of air conditioners and a higher volume of available condensate water.

Harvest Stormwater

Stormwater is concentrated rainfall runoff that flows off sites onto roads, into stormwater basins and/or down stormdrains to riverbeds. Because stormwater picks up pollutants from the environment, the U.S. Environmental Protection Agency encourages strategies that help clean and filter stormwater. Harvesting rainwater and stormwater into vegetated basins makes it possible for plants and soils to reduce pollutants in the water. Harvesting stormwater from streets onto adjacent strips of land is a good strategy to treat stormwater and reduce street flooding. In some Arizona cities, you may request a permit to divert water runoff from streets to an adjacent public right-of-way where water harvesting basins have been constructed. Here, edible trees can provide shade, improve aesthetics and yield a food harvest. To give people safe and comfortable access to sidewalks, trees must be regularly trimmed—especially if they are thorny. Large stormwater basins are often constructed at commercial and public sites to manage stormwater. Landscaped areas at commercial sites can also catch stormwater. Incorporating native edible trees into these areas would further increase their benefits. Where supplemental irrigation is provided, nonnative trees could be considered for planting if the long-term water supply is secure.

If Needed, Use Other Water Supplies

Many sites get drinking water—known as *potable water*—from on-site wells or off-site water utilities. Use your non-potable rainwater, graywater and AC condensate water supplies first to support edible trees, and then add potable on-site and off-site water resources if needed to supplement irrigation. Developing these non-potable supplies makes even more sense when you consider that drought and other climate-related changes could result in water rationing, lower groundwater levels, reduced surface water flows and other challenges to drinking water supplies.

A sidewalk scupper diverts stormwater runoff from the street to adjacent right-of-way land, reducing street flooding, cleaning stormwater and supporting native edible trees.

Street runoff flows down along the curb and gently through a curb cut to an adjacent planting basin, supporting growth of native edible shrubs.

Develop Your Tree Planting Design

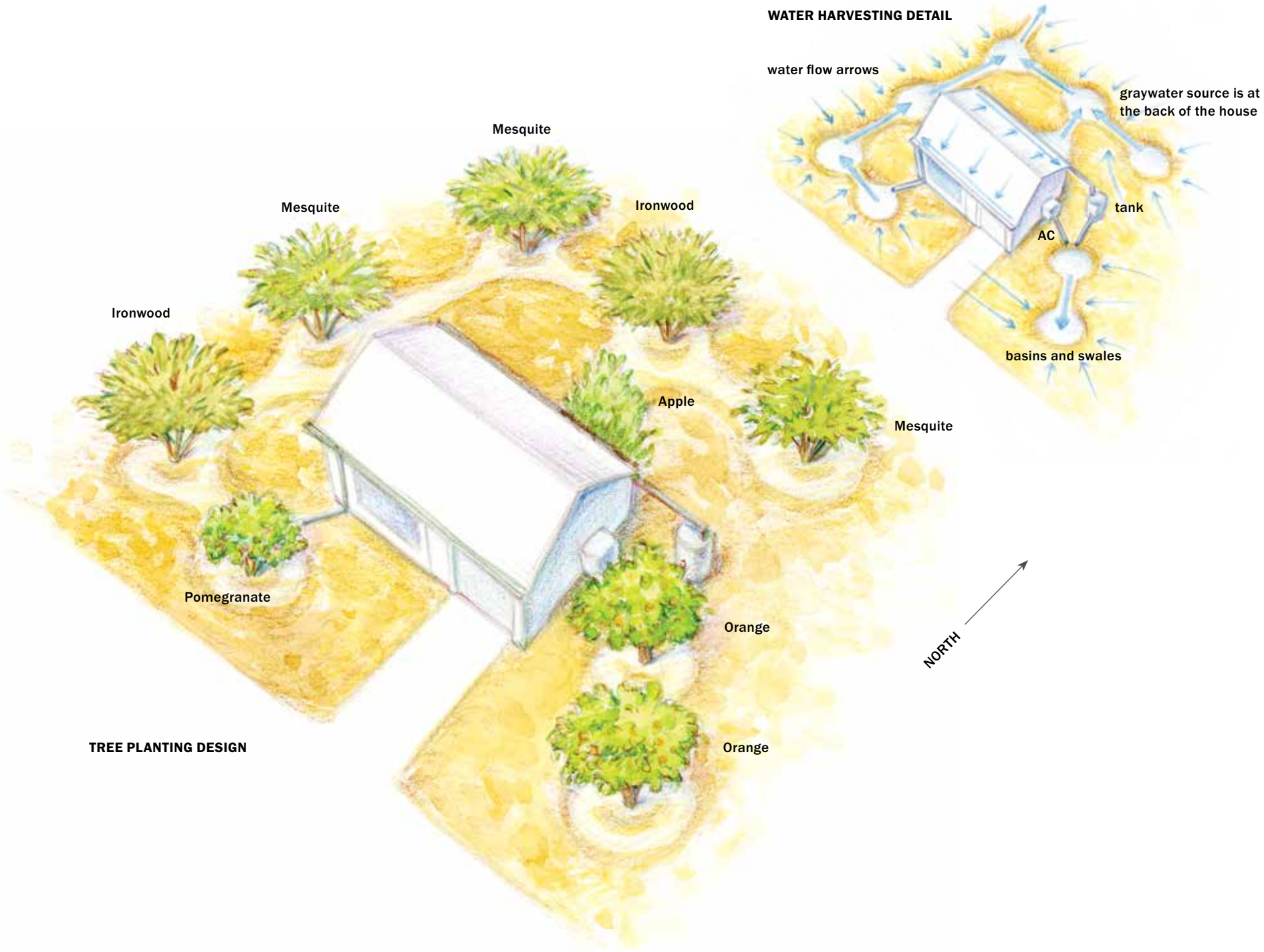
Develop a clear plan for your edible tree planting site. Think about trees at their mature size and develop water harvesting and other water-use strategies to meet their long-term needs. Choose trees that grow well in your general area and in the microclimates at your site. Take into account site-specific issues such as sun and shade, strong winds, cold air drainage, wildfire potential, wildlife, and other site characteristics.

It is very important to know where all above ground and underground utility lines are before you plan, dig or plant. Contact Arizona 811 (formerly known as Blue Stake) to mark buried lines between the street and your property line. If you do not know where lines are buried within your site, hire a private utility-locating service to mark them for you. ***Do not plant over buried utility lines or under overhead utility lines.***

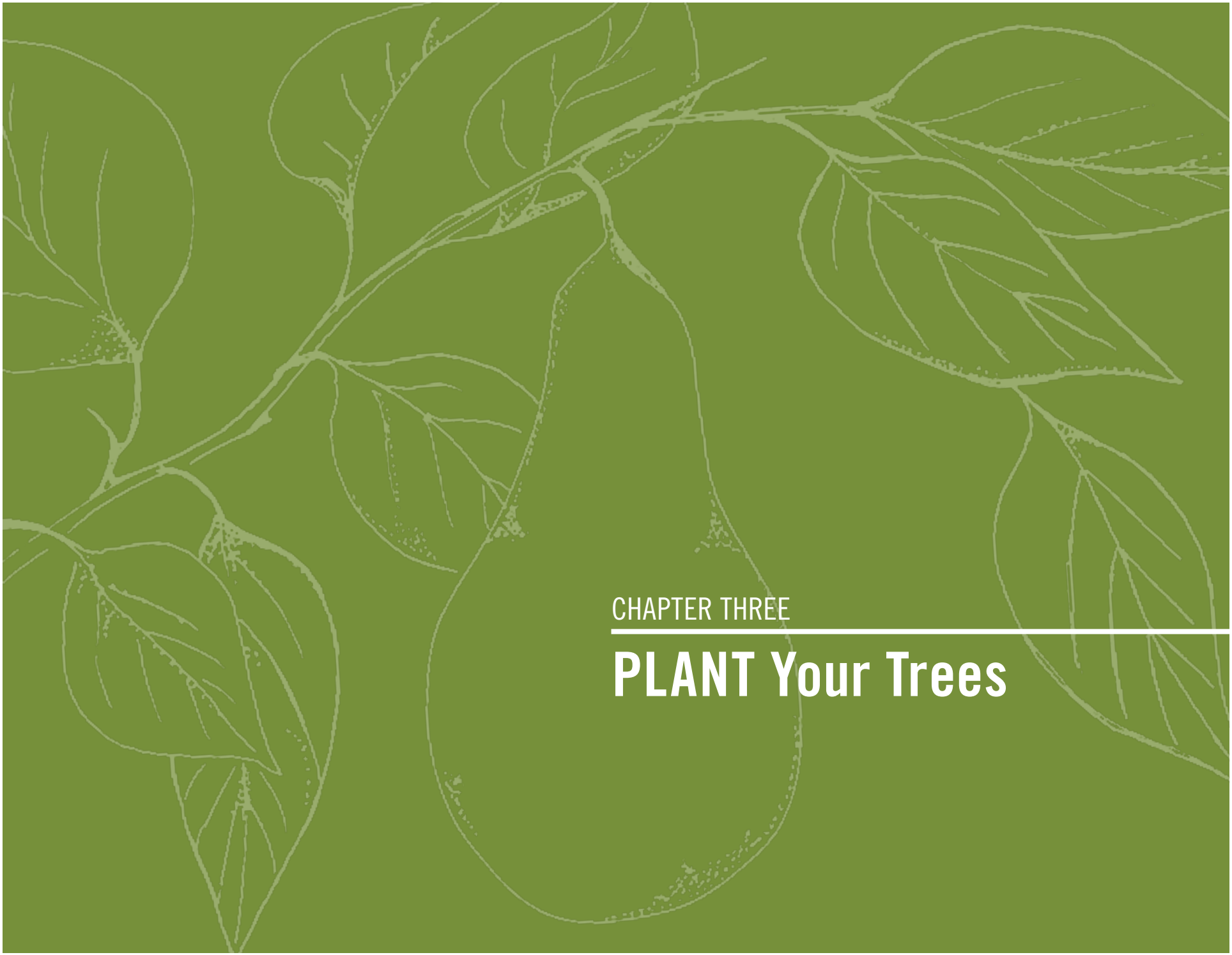
Given appropriate microclimates, plant trees where they are easily accessible to those who will tend and harvest them. Place high-maintenance trees close to where people will frequently see them and maintain them. Use tree placement to benefit the site by providing shade, windbreaks and beauty. Plan ahead for people who will use the trees and site. If children will be the primary users—such as at a school—plant thornless, dwarf trees and prune standard trees to a shorter stature. If the elderly and disabled community will use the site, prepare walking paths that meet specifications of the Americans with Disabilities Act. Selecting more than one kind of edible tree—or different varieties of the same tree—can extend the ripening season to provide fruit, nuts, pods and seeds over several months. Be sure to check how trees are pollinated to select and space them correctly. A planting design for high elevation Arizona sites is shown at the *LEAF Network website*.

The planting design shown at right is appropriate for mid-desert elevations, and includes the following trees and elements:

- Hardy native mesquite and ironwood trees planted west and north of the house to shade intense summer afternoon sun.
- Cold-sensitive orange tree east of the house is warmed by morning sun and heat radiating off the nearby wall in winter. Orange tree to the southeast is warmed by winter sun all day.
- Apple tree needing chill hours to bear fruit is planted on the north side of the house to keep it in deep shade all winter.
- A pomegranate planted east of a native ironwood is shielded from dry westerly winds in May and June.
- A rainwater harvesting tank collects water from the northeast corner of the roof. Tank water buffers hot and cold air temperatures, benefitting the nearby orange tree. Hose delivers water by gravity flow to the apple and orange trees.
- All trees are planted in passive water harvesting basins on raised mounds. Southwest roof downspout flows to the closest basin. Swales direct overflow water from one basin to the next and intercept additional runoff from the landscape. Basins are mulched.
- AC condensate water is piped to adjacent orange tree. Apple tree receives graywater from washing machine (back of house).
- Native midstory and understory plants will be placed under native trees to increase diversity, productivity and wildlife habitat.


WATER HARVESTING DETAIL
water flow arrows
graywater source is at the back of the house
tank
AC
basins and swales
Mesquite
Mesquite
Ironwood
Ironwood
Apple
Mesquite
Pomegranate
Orange
Orange
NORTH
TREE PLANTING DESIGN

The best time to plant a fruit tree was twenty years ago. The second best time is now.



CHAPTER THREE

PLANT Your Trees

PLANT Your Trees

Acquire Your Trees

Trees can be purchased in soil-filled pots or as *bare root trees* without soil around the roots. Young trees are available through nurseries, catalogs and local growers. Purchase high quality trees that come with a guarantee. While it might seem expensive, the cost of a good tree will be the smallest expense of your tree's life. Trees 1 to 2 years old adapt best to new locations. Choose trees with no signs of disease, damage or lack of vitality. Trees should be 4 to 5 feet tall with trunks one-half inch to three-quarter inch in diameter. Bare root trees require special care to prevent the roots from drying out, so carefully follow the instructions provided with these trees.

You can also plant the seeds of native edible trees and many fruit and nut trees directly in the ground. Collect seeds from native trees that have good tasting seeds and pods growing far away from nonnative varieties that might cross-pollinate them. Some seeds need to be chilled (*cold-stratified*) to mimic winter conditions before germinating. Other seeds need physical or chemical abrasion (*scarification*) to break down hard seed coats and allow germination. Seeds that need light to germinate should be placed near or on top of the soil. Others need to be planted deeper. Soils should be well drained and have well-composted organic material. Keep planted seeds moist and generally between 65°F to 70°F until germinated.

Fruit trees planted from seed can have different qualities than parent trees. As a result, cuttings from desirable fruit tree varieties are often grafted onto strong rootstock to ensure reliable quality fruits. Many trees can be also be propagated by rooting cuttings from healthy trees to create clones of these well-adapted parents. These include pomegranates, figs and many other fruit trees.

Graft union on a young lemon tree. The graft union should be placed at least 2 to 4 inches above land surface.

Pomegranate seedlings planted from cuttings, growing out in pots before being transplanted into the ground.

Prepare Your Watering System

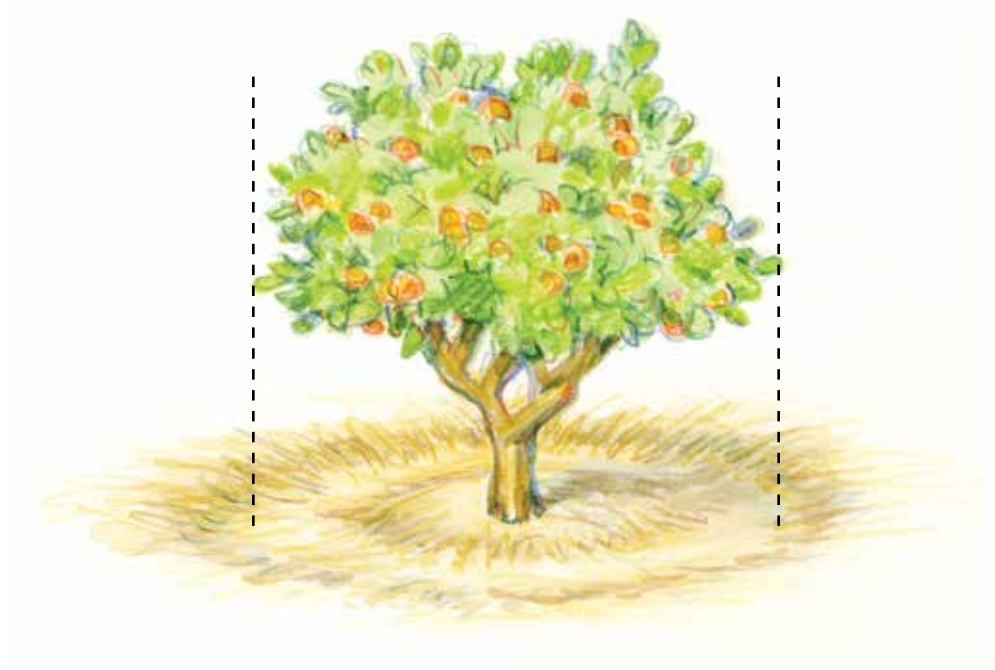
Before trees are planted, shape the earth for passive water harvesting and install piping for any additional water supplies that will be needed. Keep in mind the tree-canopy drip line location of adult trees when sizing and positioning depressions and piping. The *drip line* of a tree is the outer perimeter of the tree canopy where raindrops “drip” down from the leaves. The roots of mature trees will generally extend horizontally, wider than the tree’s drip line. You can size passive water harvesting depressions for the eventual mature size of trees and/or construct a smaller basin to harvest water for the small seedling until it grows to maturity. In both cases, plant the tree on a small mound or terrace to keep water and mulch away from the tree trunk.

Shape passive water harvesting depressions to capture runoff from adjacent lands, roofs, driveways and other impermeable surfaces, along with receiving water from tanks. Avoid digging into and around the roots of existing trees. Make sure basins infiltrate water quickly to avoid mosquito breeding. Since rains can be intense and cause erosion, it is important to design overflow routes that direct excess rainwater safely out of depressions to lower elevation depressions or other planting areas.

Install plumbing lines to distribute graywater and AC condensate. Install tanks, piping, hose bibs, distribution lines and pumps. Rainwater tanks can deliver rainwater through drip irrigation systems with sufficient pump pressure. These systems can be designed to switch from rainwater tanks to potable water supplies when tanks are empty. Switches must be reliable and automatic *backflow prevention devices* or *air gap systems* must be built into irrigation system designs to make sure rainwater does not back up into potable water supply pipes. Ask local zoning officials and/or water utility officials for requirements regarding backflow prevention in your area.

Tanks can overflow in rainstorms, so construct an overflow pipe to move water away from the tank to nearby trees and other beneficial locations. Fine-mesh screen placed over tank inlets and outlets will keep out mosquitos and other critters.

Install drip system lines before planting trees. Determine the number, size, location and timing for delivery through emitters or microsprinklers based on maximum tree water needs. Adjust emitters and sprinkler patterns so they cover soils to just beyond the drip line of trees, and expand watering areas out as trees grow. Adjust water rates seasonally and use potable water only when on-site rain, graywater and AC condensate are not available.



A large water harvesting basin sized to supply water at the drip line of a mature tree. The young tree can be planted with a smaller internal water harvesting basin to supply it as it grows toward this mature size. Plant the tree on a small mound.

Community members plant a tree in public right-or-way. The depth of the planting hole should equal the depth of the root ball, and the width of the planting hole should be about twice as wide as the root ball. Water the tree after planting to settle the soil around the root ball.

Place Your Trees in the Ground

The best time to plant fruit and nut trees is in the dormant winter season. At higher elevations, trees can be planted when soils have thawed or warmed slightly, before buds break into leaves. In deserts, plant trees in winter before spring warming. Native desert trees can also be planted at the start of the monsoon season when humidity and soil moisture are high.

Having determined where to place each tree, dig a planting hole twice as wide as the spread of the tree's roots but only as deep as the root ball or bare roots. Improve the soil as needed to ensure healthy plant growth, as discussed on page 20. Place the tree in the planting hole with the root ball resting on the bottom. The *root flare* of the tree—the area at the base of a tree's trunk where a tree's roots begin to grow underground—should be covered completely, but do not bury the trunk deeper than its root flare. If the tree is bare root, spread the roots outward in the hole and enlarge the hole if needed so roots can extend straight in their natural direction.

If you are planting a grafted tree (most nursery varieties are grafted), place the *graft union*—the point where the two plants have grown together—2 to 4 inches above the soil surface. Gently fill soil around the tree and carefully compress it to avoid air pockets around the roots. You can remove shoots on the first 18 inches of tree trunk above the ground. Water trees during or right after planting so soil settles firmly and fills in the air pockets around the roots. The final soil level should just cover the roots.

Mulch the Tree Basin

Organic mulch can conserve moisture around trees, suppress weeds, reduce erosion, reduce soil compaction, build soil structure, provide nutrients and even cushion fruits as they fall. Mulch increases the rate of water infiltration by supporting beneficial soil-burrowing life. Projected climate change could result in higher evaporation rates and more water loss from soils, which mulch helps counteract. Mulch also stores carbon from fallen leaves and pruned branches of trees. Mulch might keep soil cool longer in spring to delay flowering times in frost-sensitive areas.

Fill basins with a layer of organic mulch 3 to 6 inches deep composed of well-composted leaves, wood chips, chipped desert vegetation, straw or grass clippings. Be careful that mulch materials are not diseased and not placed where they increase the fire hazard. Do not use wood chips that could contain high quantities of natural resins or toxins, such as eucalyptus or juniper. Organic mulch will decompose and can float away in runoff events, so add more mulch as needed to maintain a thick layer. The mulched area should extend from near the tree trunk to just beyond the drip line of the tree. Keep organic mulch from piling up against the tree trunk, since too much moisture against the trunk can encourage root rot and attract damaging insects and rodents. You can place a hardware cloth ring around the tree trunk—making sure to enlarge this as the tree grows—to keep mulch away from the trunk, provide airspace and keep rodents from chewing the bark.

Inorganic mulches consist of rocks, cobbles, gravels and other minerals that allow water infiltration but do not decompose. Do not use decomposed granite, which can shed fine-grained materials that can clog soils. Inorganic mulches will not float away and do not tend to hold moisture close to tree trunks. However, inorganic mulches can be hard to weed around. They do not release nutrients to the soil and can get extremely cold or hot depending on the season. Place inorganic mulches around trees out to the drip line.

Fertilizers and Amendments

Do not add fertilizer or soil amendments to the planting hole—these can damage the young tree's roots. Instead, work light organic mulch or compost into the soil around the tree. Once trees are established, add surface compost or pour liquid compost tea (water that has had compost soaked in it) over the tree root area.

Manage Grass and Weeds

Minimize competition from grass and weeds around trees. If planting trees in a lawn, remove sod from about 3 feet around the base of the tree and keep soil around young trees free of weeds and grass until the trees are well established.

Label the Trees

Trees can have very long lives. Prepare a permanent record of your trees for yourself and those who will care for them in the future. Tree tags are useful, but may fall off or damage trees. Alternatively, draw a map showing tree locations, species names, common names, planting dates, plant varieties, rootstocks, cultural notes and other information. Write down instructions on tree maintenance and watering frequency.

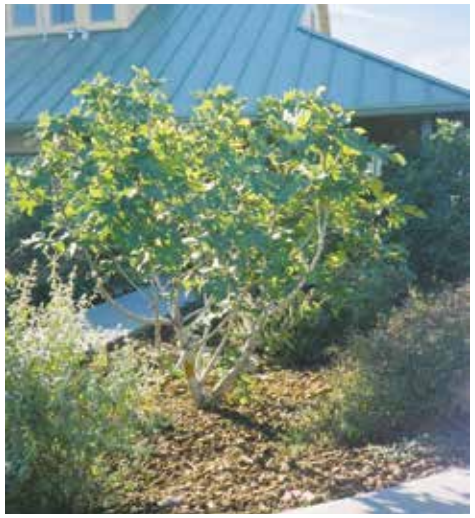


Fig tree planted in a water harvesting basin, heavily mulched to reduce the evaporation loss of water and enrich the soil.

Tending a fruit tree is like making a friend. Like all friends, they thrive on our attention and care.

CHAPTER FOUR

CARE for Your Growing Trees

Hose positioned below the drip line of a quince tree (white line), where roots are actively growing.

CARE for Your Growing Trees

Watering

Trees require the right amount of water at the right time to produce a bountiful harvest. Watering too often or too much—especially in heavy clay soils—can lead to root-rot and disease. If trees receive too little water, leaves will wilt, fruit may be small and shriveled and the tree may become stunted and fail to produce. For tree-specific monthly watering suggestions, see the *Arizona Edible Tree Directory* at the *LEAF Network website*.

Where to Water

The roots of mature trees extend horizontally to a distance wider than the canopy drip line. Water mature trees at and slightly beyond this drip line. Do not water the base of the tree where moisture could get trapped in tree bark and lead to fungal growth and disease.

How Frequently to Water

Newly planted trees must be kept well watered until the roots grow into adjacent soil. In warm weather, fill new tree basins once or twice a week with water. Water needs for trees are highest in April through June, and then decrease during the July to September monsoon season. Water needs for fruit and nut trees remain high if trees are leafed out and producing fruit. Water requirements generally decline in fall and winter as temperatures drop and trees stop producing and drop their leaves. For citrus and other trees that do not drop leaves in winter, water needs will continue at higher levels. Trees that need *more frequent* irrigation include those that are newly planted, young, not planted in basins, on drip systems, shallow-rooted, non-dormant, and in soils with less organic matter and soil life—such as sandy soils. Trees that need *less frequent* watering include those that are planted in clay soils, in basins, mature, deep-rooted, dormant, and planted in soils with more organic matter and soil life.

How Much to Water

The water an individual tree needs depends on the species, variety, canopy size, general climate, microclimate, and other factors. Categories of low, medium and high water-use trees provide general estimates. However, look closely at each tree's health and soil moisture, and then adjust watering to the season, rainfall and temperature as needed. Trees that need *more water* include those planted in sandy soils and trees that are nonnative, young, shallow-rooted, fully leafed and producing. Trees that need *less water* include those trees that are planted in clay soils, native, mature, deep rooted and dormant.

How Deep to Water

The active root zones of trees are 1 to 3 feet below the soil surface. Water should penetrate at least 2 feet to foster deep root growth and long-lived trees. Irrigate long enough to soak the soil deeply—being careful not to overwater clay soils. If watering does not penetrate more than a few inches, water more frequently since roots might dry out quickly. Check watering depth by pushing a metal rod or stick into the soil to see how deeply it easily penetrates, or dig 4 to 6 inches down to check soil moisture. To flush salt buildup, water trees very deeply about once a month during summer. Irrigating with harvested rainwater helps dilute salts.

Feeding

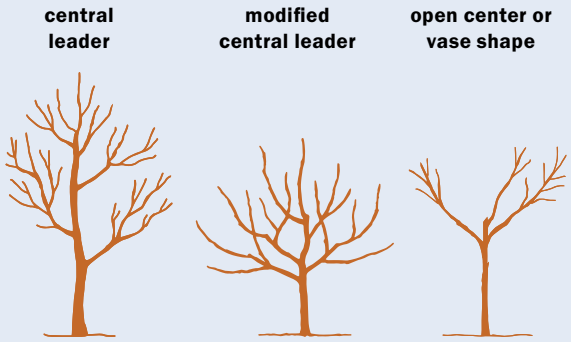
While many soils naturally contain needed tree nutrients, soils with insufficient nutrients can result in less growth and fewer, smaller fruits. Native trees are good at using nutrients from poor soils and may not need additional inputs. Fruit and nut trees have good root systems to extract water and minerals, but soil nutrients can be used up producing large fruit yields if the soil has insufficient organic matter. Periodically fertilizing fruit and nut trees with compost encourages new growth and higher yields. However, too much fertilizer can damage trees. Do not fertilize the year you plant because it can "burn" young roots. Determine annual needs for fertilizer or compost based on tree size and age. Just prior to spring budding, apply soil amendments around the tree or into the first irrigation water of the spring.

Nitrogen is the nutrient most needed for tree growth. Native trees including mesquite, palo verde and ironwood make nitrogen available to desert soils through their roots. Well-composted manure and plant materials can provide necessary nitrogen (N), phosphorus (P) and potassium (K) and the many micronutrients that support growth. Common commercial fertilizers contain N, P and K to amend soil as needed. Deficiencies of iron and zinc can develop, especially in caliche soils and soils with a high pH. Sprays are available to treat deficiencies.

Rich compost provides nutrients to soil and reduces evaporation loss from well-constructed water harvesting depressions. Rock spillways direct overflow water from one depression to the next, slowing water and reducing soil erosion. Potential tree-planting sites (white circles) next to depressions allow trees to benefit from soil nutrients and harvested water.

Thinning Fruit; Pruning Branches

Pruning branches is critical just after planting and in the first few years of growth. Pruning young trees can promote sturdy branch development, distribute sunlight, create airspace, control size and make trees easier to harvest. Pruning vertical branches at the tip stimulates development of horizontal branches, which yield more fruit. Prune deciduous trees in winter or early spring when branches are bare and easy to see, sap is slow and wounds have time to heal. Three common pruning patterns are described here.



A tree trained to a ***central leader*** takes up less space and can be high yielding, but fruit on high branches may be harder to harvest.

A ***modified central leader*** tree has the central leader pruned back at a reduced height so that the tree develops a wide scaffold, with a balance of vertical and horizontal branches.

To create the ***open center*** or ***vase shape***, choose two to four evenly distributed branches the first winter and remove or severely prune the main vertical shoot and other side branches. Choose one or two more branches and remove others the second season. This should be used primarily for stone fruit trees, but can result in sun damage to trees planted in the low desert.

Annual pruning encourages new, productive fruiting wood, and increases fruit yield. Prune interior branches and new vertical growth to allow air and sun to reach all tree branches. Remove root suckers, dead or diseased wood, parallel limbs, limbs that produce shading, limbs that cross and portions of limbs that bend down. Cut broken limbs back to the base. If two limbs touch one another, one should be removed. Make clean cuts in line with the branch collar at the limb juncture, and don't leave stubs. Leave healthy one-year-old growth on outer branches for future shoot growth and fruit production.

Carefully thin overly abundant small fruits, damaged fruits or malformed fruits to improve mature fruit size and quality. Thin stone fruits (peaches, plums, apricots, etc.) after flower petals have fallen and fruits are large enough to see, spacing fruits 6 to 8 inches apart. Thin apples and pears within 30 days after blooming to help reduce the alternate-year bearing that can occur in these trees.

Multiple apples growing from the same point on the stem. Thinning fruits early in their growth will result in larger individual fruits and a reduction in alternate year bearing.

Preparing for Extreme Conditions

By choosing the right types and varieties of trees, you can help avoid tree damage from extreme temperatures, storms or droughts. However, since all trees can be affected by an increasingly unpredictable and erratic climate, be prepared to protect trees from extremes now and in the future.

Extreme Cold and Frost Events

Keep track of local weather and temperature forecasts during the bloom time of sensitive fruit trees. Frost danger can be higher in early spring, so plant cold-sensitive trees in warm microclimates away from cold air pockets. Choose late blooming or cold-hardy tree varieties to help avoid frost damage, though hard late-spring frosts can damage even these.

If freezing is forecasted, move frost- and cold-sensitive dwarf trees that are in containers to locations near south walls or under roofs. Wrap young or frost-sensitive trees in sheets, blankets, cardboard or fiberglass—though these could blow off in a nighttime storm. A more permanent option is to build structures or cages over small trees and drape them with tarps, blankets or shade cloth to protect them from frost (as well as sun) when needed. If possible, place lamps or heaters within tree canopies or under trees to emit warmth overnight. Moisten soil before predicted cold nights, since damp soil retains heat better than dry soil.

Extreme Heat Events and Drought

Most fruit and nut trees prefer full sun, but the intense sunlight in southern Arizona can burn exposed bark, leaves and fruits. To prepare for intense desert sun and heat, plant hardier natives on the west sides of less hardy trees to shade them in the afternoon. Plant sensitive trees in the shade created on the east sides of buildings. When pruning trees, leave some branches that shade the trunk. If the trunk is exposed, plant shrubs around the base of the tree to shade the trunk. Hang shade cloth over sensitive trees in direct sun. During extended droughts, even native trees may need more water. Projected climate changes could result in higher average temperatures, higher evaporation rates and prolonged droughts. Check soil moisture and tree conditions to make sure the trees are receiving enough water, especially during the hot dry months of April through June. Mulch more heavily to conserve soil moisture, keeping in mind that wood mulch absorbs water. Water at tree drip lines and check soil moisture by pushing a metal rod or stick into the soil to see how deeply it easily penetrates, or dig 4 to 6 inches down to check soil moisture.

A sheet protects a blooming pear tree from a late season snowfall. The orchard is also surrounded by a deer fence and covered with bird netting to protect fruit.

Treating Tree Problems

Managing Dead Material Under Young Trees

To avoid diseases, grow trees in diverse systems and keep trees well irrigated, fertilized, pruned and harvested. Prune dead and diseased branches from all trees and burn or destroy diseased or pest-infested branches to keep problems from spreading. Under mature trees, the insects, invertebrates and soil microbes that decompose dead material are likely to be well established. However, young fruit and nut trees may not yet have this protection and can be vulnerable to diseases and spores from dead material. Rake away fallen twigs, leaves and fruit from under young nonnative trees each year. Chip and compost rakings for several months to help destroy pathogens. After the compost is well aged, you can put it in basins and along paths to keep soil moist and add nutrients to soil.

Insects

If your tree has a problem and you see insects, first identify the problem, then try to identify the insect, and then determine if the insect is the cause of the problem. While some insects hurt trees, others serve as pollinators and control damaging insects. Try introducing plants that attract beneficial insects to prey on damaging insects. Consult your local Cooperative Extension specialist and others experts to identify problem-causing insects and find the best treatment. Climate change could weaken trees, leaving them more vulnerable to damaging insects or diseases.

Pruned cuttings from nearby trees are composting under new wood chip mulch in a deep water harvesting basin to prepare them to be returned as useful mulch around trees.

Based on observation of the fruit, apples still on the tree are being damaged by ants. Ants are actively eating an apple that has fallen to the ground .

Seven-foot tall deer fence protects fruits trees from being browsed by deer, javelina and other non-burrowing animals.

Bird netting placed over a small family orchard protects multiple fruit trees from being pecked by birds.

Animals

Wildlife can enrich our environment, but they also forage on edible trees. Keep deer out with 6- to 8-foot high fences placed far enough from trees so deer cannot browse branches over the fence. If rabbits, squirrels, skunks or packrats are a problem, harvest fruits early, keep fruit and debris off the ground, hang bright lights at night and keep wood piles away from trees. Live traps might also be effective. Gophers chew roots and irrigation lines. Traps can help keep them at bay until trees are a few years old and have stronger root systems. Birds eat non-beneficial insects, but also eat or damage ripening fruit. Harvest soft fruits early, place nets over trees and hang shiny objects to deter birds. Interplant with bird-friendly trees to satisfy birds and people alike.

Weeds and Invasive Grass

Weeds and grasses compete for water and nutrients, so clear these from the ground within 3 feet of a tree. Since invasive weeds and grasses can be difficult to control after trees are planted, you can try covering the future planting area with black plastic or cardboard to shade these plants out. For larger tree-planting areas, cover crops can be sown early, cut before they seed, and then mixed into soil a month before trees are planted to add organic matter and control weeds. However, select cover crop species carefully so you do not accidentally spread invasive species (for example, wild oats—*Avena fatua*—is an invasive species in the southwestern U.S.).

Viruses and Diseases

Virus and disease pathogens should be carefully identified before applying treatment, and then controlled to prevent their spread. Choose disease-control methods wisely. For information on specific tree diseases and/or treatments, talk to your local Cooperative Extension specialist. Try natural disease-control methods first, since chemical treatment residues might linger on trees, fruits and soil and affect people, wildlife, birds and beneficial insects.

Gather children and elders, new immigrants and long-time residents to harvest and celebrate Arizona's trees.

CHAPTER FIVE

HARVEST the Abundance

When using a ladder, as in this olive harvest, work in pairs with someone standing at the base of the ladder to stabilize it.

HARVEST the Abundance

Safety First

Know what you pick! Make sure fruits, nuts, seeds and pods are correctly identified. **Look up** for power lines, roofs and overhead obstacles. **Look down** for holes, tools, cactus, rattlesnakes, and other hazards. Locate any wires or cables that run through the tree canopy and stay clear of those areas even if you need to leave fruit unpicked.

Sturdy gloves, eye coverings, long-sleeve shirts, long pants and closed-toed shoes can protect you from scratches, pokes, and insects. Any honeybee you encounter in Arizona could be an aggressive *"Africanized bee."* If you encounter a feral beehive around trees, get all people out of the area immediately and consult with a professional beekeeper or licensed pest control company on next steps. Have easily accessible and well-equipped first aid kits at the site and discuss safety practices before starting work. Ask if anyone has health or safety issues, such as allergies to bee stings or the fruit or nut being picked. Use the right tools and equipment for the job. Lean tools against trees rather than setting them on the ground where they could become tripping hazards. Watch your sides and back when swinging tools around. Understand and use proper lifting techniques and use lifting and moving equipment for heavy containers.

Ladders. If ladders are used, they should be well built, sturdy and safe. Only physically able people should be on ladders, with a person standing at the base as a spotter. Do not over-reach to pick fruit too far above or to the side of the ladder. Instead, move or extend the ladder to safely reach the fruit.

Caution. Bacteria, mold, fungus, bird droppings and other materials can contaminate fruits, nuts, seeds and pods. DO NOT collect off the ground. DO NOT harvest food with dark spots, mold or other problems. This is especially important for mesquite pods.

Equipment and Techniques

Hand picking is the preferred method to harvest fruit. It is faster than picking with tools and a twist of the wrist can properly pluck the fruit without breaking the skin. Some fruits are prone to *plugging*—a hole that forms in the skin of the fruit because the stem pulls away when picked. These are best removed with hand clippers when possible, and include tangerines, tangelos, calamondins, loquats and figs.

Single-pole fruit pickers or telescoped double-pole pickers are equipped with baskets to catch harvested fruit. The pole pickers can gently pluck fruits, nuts and pods from trees, especially the upper canopy. Catching fruit in nets or tarps held up under the tree will help keep fruit clean, make collection easy, and prevent damage, especially when dropping from heights.

Poles can extend to varying lengths; however the longer the pole the harder it is to manage. Rakes with finely spaced tines can be used to harvest olives, jujubes, and the pods of mesquite, carob, ironwood and palo verde. When fruit it too high to reach from the ground or with an extended pole, ladders might be needed (see the safety notes on ladders).

Over-the-shoulder cloth, canvas, or plastic bags can be used to gather fruit, but are not good for storing it. Crates work well to transport large, sturdy fruit such as grapefruit. More tender fruit such as apples, jujubes and pomegranates are best harvested in boxes, buckets or flexible crates (not hard crates, which can bruise them). Plums, pears and nectarines benefit from boxes as well. Store small products like nuts in solid buckets or boxes rather than crates with openings. Delicate peaches, apricots and figs are best placed in egg cartons or partitioned boxes. Small, delicate fruits should not be piled on top of one another for storage as the weight can damage the bottom fruit. Be careful using plastic bags for temporary transport and storage as they hold moisture, can damage the fruit and can quickly lead to mold development.

Extended pole with basket being used to harvest apples high on the tree (top left). Fruit rake with attached bag to harvest small calamondin fruit (top right). Scissors (or clippers) are good for harvesting one fruit at a time (bottom left). Fruit can be picked the old fashioned way, by hand (bottom right).

Tree Species	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEPT	OCT	NOV	DEC
Almond								NUT				
Apple						FRUIT						
Apricot					FRUIT							
Carob								DRY POD				
Cherry					FRUIT			WILD FRUIT				
Citrus, Many	FRUITS											
Date Palm							FRUIT		DRIED FRUIT			
Elderberry					FLOWER			FRUIT				
Fig						FRUIT						
Hawthorn									FRUIT			
Ironwood					FLOWER	GREEN SEED	DRY SEED					
Jujube									FRUIT			
Juniper										FRUIT		
Loquat			FRUIT									
Medlar										FRUIT		
Mesquite						DRY POD						
Mulberry						FRUIT						
Oak									SEED			
Olive										FRUIT		
Palo Verde				FLOWER	GREEN SEED		DRY SEED					
Peach						FRUIT						
Pear (Asian)							FRUIT					
Pecan	NUT									NUT		
Persimmon									FRUIT			
Pinyon Pine									NUT			
Pistachio								NUT				
Plum					FRUIT							
Pomegranate								FRUIT				
Quince								FRUIT				
Saquaro						FRUIT						
Sapote									FRUIT			
Walnut									NUT			

Harvest from this University of Arizona olive grove was pressed into oil and bottled. Each five-gallon bucket of harvested olives yields about 20 ounces of olive oil.

Peaches canned for later eating and use in baked goods. Ironwood seeds soaked and sprouted for use in salads.

When to Pick

This harvest calendar (pictured left) provides general guidelines for harvest periods. However, ripening times could differ due to weather, sun and wind exposure, slope, elevation, variety and other factors. Keep your eyes on the trees to judge when to harvest. Mature soft fruits should be harvested right away to avoid decay and beat the birds to them. Many types of citrus fruit can stay on trees until you are ready to use them, and some continue to sweeten and get tastier on the tree. Keep an eye on the weather to avoid damage to citrus and other tropical trees due to late freezes or rainstorms. Risk of frost could make it worth harvesting early.

Prepare and Preserve

Enjoying the produce from your trees is the fun part! Native mesquite, palo verde and ironwood provide flowers, pods and/or seeds. These may be eaten fresh, sprouted, roasted, cooked in savory dishes, or dried and ground into flour for baked goods. Spring ironwood blossoms may be eaten fresh, sprinkled on salads, used as garnish or candied. In early summer, native tree beans are picked in the green stage, parboiled, removed from the pod and served cool or warm with your choice of seasoning. In mid- to late summer, mature and dry seeds are easily split out of pods. Freeze them briefly to reduce common bruchid beetle activity, and store them completely dry. Mature ironwood seeds can be soaked for a period before sprouting. Once sprouted, they can be seasoned or roasted.

The sweet fruits of citrus can be eaten fresh, juiced, zested, dried, or made into marmalades, butters or candied rinds. Stone fruits and berries can be eaten fresh; made into jams, jellies and chutneys; cooked into delicious pies and breads; frozen into sorbets and made into many other delectable dishes. Fruit such as dates can be dried, made into date syrup or fermented into vinegar. Nuts from pecan, almond, and walnut trees are rich in essential oils and protein and can be processed for eating and/or pressed for their oils. Olives can be pressed for their oil or cured, dry salted or otherwise seasoned to eat in the long tradition of their European origins.

Communities joining to share the work, the fun and the bounty of calamondin and pear harvests.

Share and Celebrate the Bounty

A productive lemon tree can yield 500 pounds of fruit in one season, a pomegranate 300 pounds and a grapefruit more than 1,000 pounds. Refrigerating, juicing, milling, grinding, zesting, canning, drying, dehydrating and other food preservation processes help you enjoy and feast on the harvest long after it is picked. There will often be more than enough food to share with family, friends and your community. Community relationships are strengthened by planting, harvesting and enjoying the bounty of edible trees together. Gleaning groups, food banks, churches and other community organizations can help you harvest your trees and distribute the nutritious produce to benefit many people.

Cultural, historical and familial connections to edible trees bring history and people's stories alive for children, elders and everyone in between, making trees the inspiration for celebrations at blossom time, harvest time and eating time.

Native trees are important to many desert creatures, so share the bounty with native animals by lightly harvesting trees in wild habitats. In addition, be sure you know who owns the property and have permission to harvest.

As you grow your own site and expand into new ones, remember the core values of carefully selecting appropriate trees; creating resilient planting sites; sharing the bounty; working as a community to learn about, grow, harvest and celebrate edible trees; and preparing for the on-going care of trees with long lives.

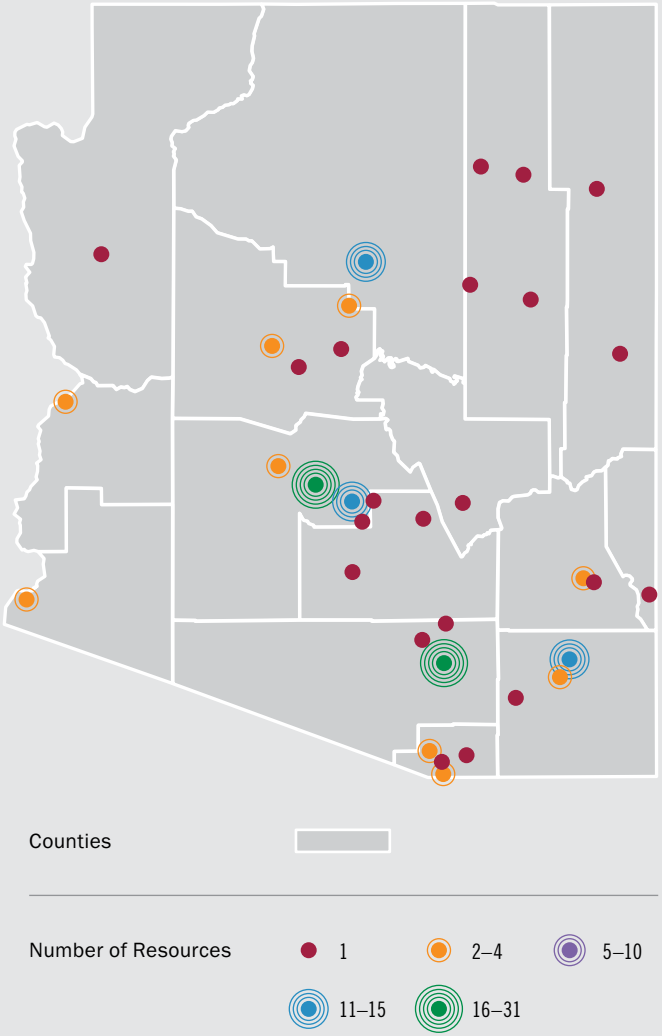
Join the LEAF Network

People from many non-profit organizations, businesses, government agencies, plant nurseries, farms, orchards and educational facilities can help you understand how to design, plant, harvest and enjoy edible trees. Resources around Arizona are shown on the map and listed at the *LEAF Network website* **leafnetworkaz.org**

Join the growing LEAF network to share your edible tree information, assistance, food and celebrations and to be informed of upcoming events and opportunities.

The LEAF Network partners with LEAF on the UA Campus, here participating in the University of Arizona Food Day event.

Statewide Resources



For more information on resources across Arizona, see the *LEAF Network website* **leafnetwork.org**

GLOSSARY

Active water harvesting. Collection of rainwater off catchment surfaces into a tank (sometimes called a cistern) to store water for later use.

Caliche. A hard, chalky white soil layer high in calcium carbonate, which adheres soil particles together and prevents good drainage and root growth.

Chill requirements. The number of hours at temperatures between 32°F and 45°F that trees need in winter to stimulate proper bud growth, fruit set and fruit development.

Curb cuts. Gaps cut in street or parking lot curbs to allow water to pass from streets or parking lots to an adjacent right-of-way or other planting areas.

Deciduous trees. Trees that drop leaves in winter (note some trees drop leaves during drought and are called “drought deciduous”).

Dioecious trees. Individual trees of a species can be either male or female, but a single tree does not contain both male and female flowers, nor flowers with both male and female parts.

Drip line. The outer perimeter of a tree canopy where raindrops “drip” down from the leaves. The soil under the drip line is where roots are actively growing and the best place to water.

Dwarf and semi-dwarf trees. Trees created through breeding or by grafting cuttings onto rootstocks that do not allow them to reach full size.

Edible tree. For purposes of this Guide, native and nonnative trees that produce fruits, nuts, seeds and pods that suit human tastes.

Firewise Communities. A program to recognize communities that take action to prepare and protect their homes against wildlife threats. See information at: http://www.firewise.org/usa-recognition-program.aspx

Microclimates. Small localized climatic conditions that may be warmer, colder, dryer, wetter, windier or calmer than other areas of the site.

Mulch. A cover put over soil to reduce water loss to evaporation, consisting of organic material including composted leaves or wood chips or inorganic materials such as gravel or rocks.

Multistory planting. A combination of “overstory” trees, “midstory” shrubs and “understory” plants placed within the same planting area to create a diverse “multistory” structure providing mutual benefits such as shading, soil enrichment and habitat.

Native edible trees. Edible trees that grow naturally in the wildlands of Arizona without the need for human care.

Nonnative edible trees. Edible trees that have been introduced to Arizona from other areas of the world.

Passive water harvesting. Collection and infiltration of rainfall and water runoff directly into the ground, often in depressions shaped in the soil around trees.

Plugging. A hole that forms in the skin of a fruit because the stem pulls away when the fruit is picked.

Pollination. The transfer of pollen from the male part of a flower (stamen) to the female part of a flower (pistil) either in the same flower, or in another flower, so the plant produces fruits, nuts, seeds or pods.

Potable water. Water of suitable quality for drinking and cooking.

Propagation. The process of creating new trees from seeds, cuttings, grafting, layering and other techniques.

Rain. For purposes of this Guide, “rain” is used as a general term for precipitation, including rainfall, snowfall, sleet and other forms of precipitation.

Right-of-way. A narrow strip of publically owned land located adjacent to streets, where sidewalks are sometimes located. If it is legally permissible, stormwater runoff from the street could be diverted through curb cuts to support edible trees planted on these right-of-ways.

Root flare. The area at the base of a tree's trunk where a tree's roots begin to grow underground.

Runoff. Rainfall and other forms of precipitation that drain off a structure or landscape.

Tree cultivar. A variety of tree that originated or has persisted in cultivation by people, sometimes through selective breeding.

Tree variety. Taxonomic subdivisions of tree species with differing characteristics.

EQUAL OPPORTUNITY

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