Urban Orchard

Resource Guide

Produced by TreeFolks, Inc.

With support from

City of Austin Community Forestry

Table of Contents

Contents

Introduction

The fruit you buy at the store is, in all likelihood, the product of a world-wide, industrial scale, agricultural system. We can buy apples from New Zealand, tangerines from South Africa, avocados from Mexico, and bananas from Peru year round and often for less than a dollar apiece. While visually appealing, cheap, and convenient, these fruits often lack the sparkling flavor and sense of accomplishment that comes with freshly picked, homegrown fruit. Transporting these fruits around the world and the farming methods used to produce them can also have negative environmental impacts.

It is possible, however, to grow your own. Fruit and nut trees have the potential to be some of the most rewarding, if challenging, crops that can be grown in the garden. Because of their size, longevity, and particular needs, fruit and nut trees can seem mysterious and out of reach, while the information available in books and online is sometimes not appropriate for central Texas, or may be biased in favor of products such as synthetic pesticides that many people do not want to use.

The purpose of this guide is to provide helpful information on how to plan and care for a successful small scale orchard using safe, environmentally friendly practices, tailored to the unique climate and geography of central Texas. It is intended to serve as a reference manual and provides an overview of what you need to know, from choosing a site to knowing when to harvest your fruit. We also have tried to assemble additional resources that we have found helpful.

About TreeFolks

TreeFolks, Inc. is a 501(c)3 non-profit organization with a mission to empower central Texans to build stronger communities through planting and caring for trees. Since 1989, we've planted over 1.7 million trees throughout central Texas.

Plan Before You Plant

It is very important to plan out the orchard before planting anything. Consider the resources on hand in the space you have available, your ability and interest in terms of watering, pruning, and pest control, and your tolerance for losing a crop. Growing fruit is a long term investment. It may take 5+ years before you harvest anything. Be considerate and realistic about your own needs and abilities, and only plant things that you are willing to care for. In most cases, it is more realistic, easier, and more sustainable to change your expectations than to try and grow a crop that is not suited to the conditions in your garden. Therefore, a thorough knowledge of the conditions in your garden, and the needs of various trees, is needed before you can decide what to plant. This guide is meant to help you through this process.

Soils and Fertility

The foundation of any garden is its soil, and your orchard is no exception. Fruit trees can live for many years, and as they mature it becomes increasingly difficult and risky to make significant physical changes to their soil environment. Therefore, it is important to pick the best available site and to prepare well before planting.

What kind of soils do trees need, though? Trees, like all plants, depend on their roots to absorb water and nutrients to support growth, and for structural stability. This means that in order to have a healthy tree, the soil environment must be conducive to healthy roots. Roots, unlike leaves, do not produce oxygen. In fact, they use oxygen found in tiny gaps within the soil! Therefore, a good soil will have a loose, open structure to allow oxygen from the atmosphere to filter down into the soil. Roots also need water and nutrients, which are held in place by smaller particles like clay and silt, as well as organic matter.

In general, sandy soils are the most porous, while clay soils are the least. In Austin, we generally have clay soils, though along the rivers and creeks we also

have silt and sand based alluvial deposits. If you have heavy, black or brown soil that forms deep cracks during the summer, chances are it's a clay soil. Even in west west Austin, where soils are thin and rocky, the predominant soil type is clay based. If you are fortunate enough to have a sandy or silty loam, such as can be found in central East Austin and near some creeks throughout the rest of the city, you will have far fewer problems related to drainage and soil oxygen, as these soils are naturally open and well oxygenated. Our clay soils, however, are easily compacted compacted and do not have naturally good internal drainage. They have a tendency, especially in urban areas, to become anaerobic (low in oxygen) and are generally quite alkaline, which affects nutrient availability. Since clay soils are the most common in Austin, and can be problematic for fruit trees, we'll focus on them in this guide, but most of the information will be relevant to all soil types.

Identifying Soil Texture

This simple test allows you to determine your soil type.

- First, scoop up some soil with a trowel from 3-5 different spots surrounding the intended planting location, mix it together well, and then let it dry in the sun for a few days.
- When the soil is dry, crush it into a powder and mix it all together. Remove any rocks, trash, roots, leaves, etc. You want only dirt.
- Fill a 1 quart mason jar ¼ full with the soil and ¾ full of water, add a drop or two of dish soap, then close the lid and shake it vigorously until it looks like chocolate milk.
- Put it on a shelf and leave it alone for several days.
- When the soil particles have completely settled out into layers and the water is clear again, you can mark on the jar where the various particles have settled.
- Measure the thickness of each layer & calculate its percentage of the total thickness to figure out what kind of soil you have using the soil pyramid!

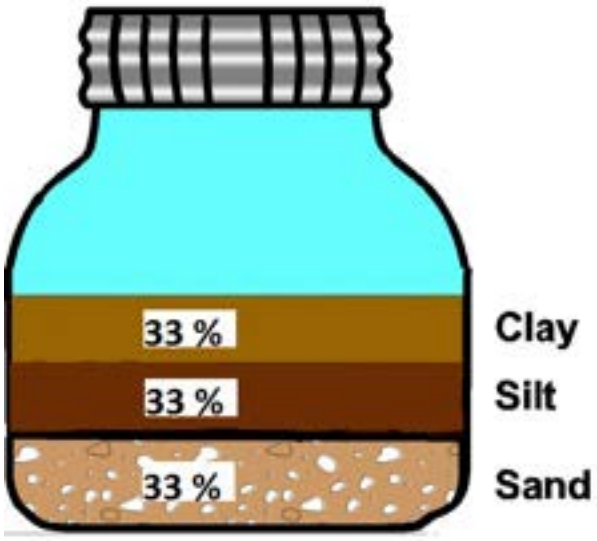

Figure 1 Soil Texture Analysis of Clay Loam soil (Equal Portions Clay, Silt & Sand)[1]

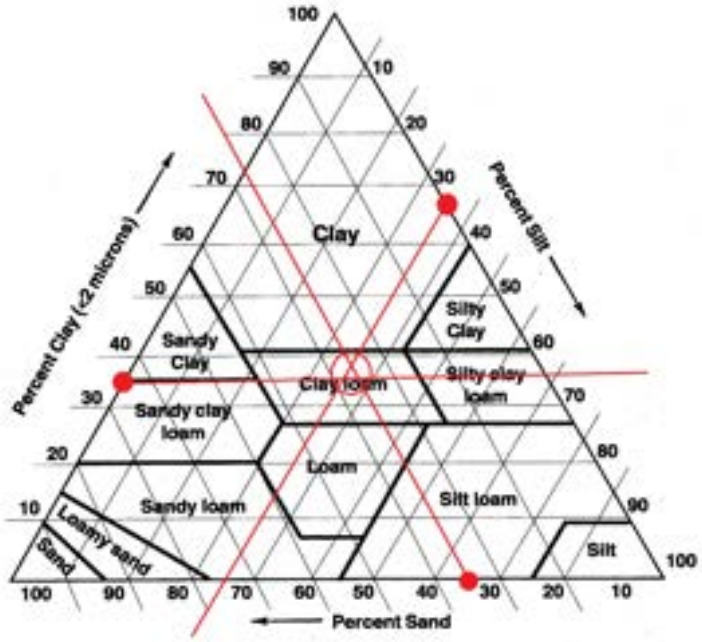

Figure 2 Soil Pyramid Showing Clay Loam Soil[2]

[1] RAIN Global Garden, Quart Jar with Loam Soil. No date. Last accessed 1/11/2016. http://www.rain.org/global-garden/soil-types-and-testing.htm

[2] Garden City Tree and Landscape, No image title. No date. Last accessed 1/11/2016. http://victoriagardencity.ca/soil-how-to-determine-what-type-you-have/

Clay Soils and Water Availability

We all know that water is important for plants. Lucky for us, clay soils can hold a lot of water. Unfortunately, they hold onto water much more tightly than other soil types. Because the clay particles are so small, the pore spaces in the soil are also smaller, which means the droplets and films of water in the soil have a lot of surface area relative to their volume. This in turns means there is much more surface tension holding the water in place. The consequence of this is that the amount of water that the plants are able to pull out of the soil and use is decreased. The 'Available Water' (water that plants are able to use) as a portion of total soil water is therefore less as the clay content increases, while 'Unavailable Water' (water that plants can't use) increases. Unavailable water still serves important functions for the biology of the soil and moderates soil temperature and texture, so it's very important to plant health, but it's not available for direct use by the plants. More information about watering can be found later in the guide.

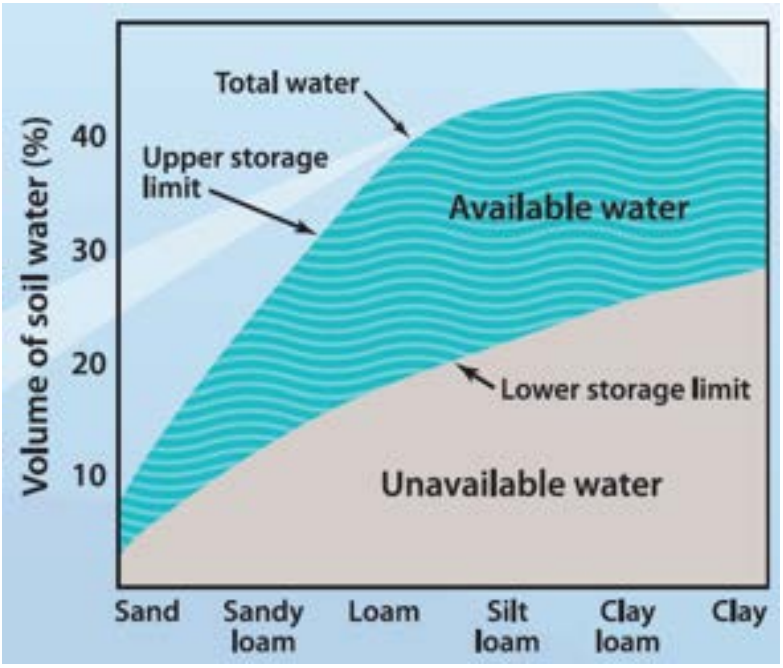

Figure 3 Water Availability by Soil Type[3]

[3] Soil Quality Pty Ltd, *The relative amounts of water available and unavailable for plant growth in soils with textures*

Soil pH and Nutrient Availability

Clay soils are made of tiny plates, so small that they cannot be seen without a microscope. To give you some sense of scale, the diameter of a grain of sand is about 300 times greater than that of a clay particle.[4] As a result, clay particles have have a couple of important traits. As shown above, clay soils can retain more moisture than sandy or silty soils. They can also hold more nutrients. So, that's the the good news. The bad news is, they are easily compacted and hang on to their moisture and nutrients very tightly.

Though small individually, the combined surface area of all the tiny particles in a clay soil is enormous. Each particle in (most) clay soils typically has a negative charge. Water, also present in soil, dissolves minerals found in the soil. Once dissolved, many of these minerals develop a positive charge, and become attracted to the negatively charged clay particles, and are held in place. Positively charged dissolved mineral ions, called cations, are a major part of what feeds a tree's roots, so the ability of a clay soil to capture and retain so many is why clay soils have the *potential* to be so much more fertile than a coarser soil. That potential is affected, however, by the soil chemistry, such as the acidity or alkalinity.

In Austin, our clays are alkaline. That means they have a fairly high pH, a sort of inverse measure of how many hydrogen ions are in the soil. The higher the pH, the fewer hydrogen ions you have on the loose. A soil with a pH of 6 has ten times the concentration of hydrogen ions as a soil with pH 7, and 100 times the concentration of hydrogen ions as a soil with a pH of 8, so small changes in the pH number are associated with big changes in the concentration of hydrogen ions.

Hydrogen ions are positively charged, and are more 'aggressive' in their attraction to negative charges (like clay particles) than other positive ions (for example dissolved minerals). So, if you have lots of hydrogen ions in your soil (low (low pH, acidic soil), they will push the nutrients off of the soil particles and back

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from sand to clay. 2016. Last accessed 1/11/2016. http://soilquality.org.au/factsheets/water-availability

[4] Colorado State University Extension. CMG Garden Notes #214. http://www.ext.colostate.edu/mg/gardennotes/214.html

into the film of water that surrounds soil particles, where roots can absorb them for the plant to use. If you have relatively few hydrogen ions (high pH, alkaline soil), soil), the clay particles will hang on to the minerals tightly and the plants won't be able to use them. It's worth noting that not all plant nutrients behave this way, and there are many soil interactions between plants and nutrients besides pH, but the availability of iron, phosphorous, and boron is quite reduced at pH levels commonly seen in Austin, leading to a host of problems for both fruit trees and vegetables, especially yellowing of the leaves (chlorosis).

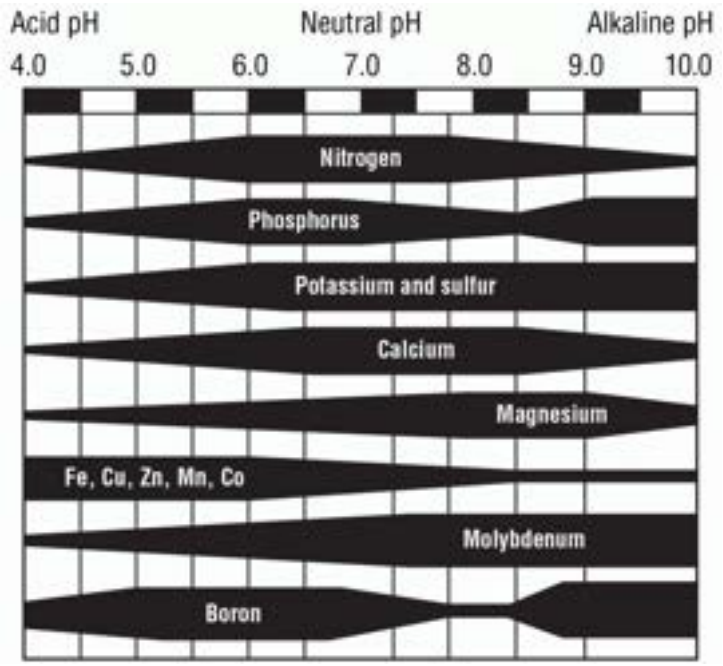


Figure 4 Soil pH and Nutrient Availability[5]

How to Test Your Soil

Sending your soil to a lab

Before planting, and about once a year thereafter, it is a good idea to send a soil sample to a lab for analysis. Laboratory analysis of your soil can serve several purposes. First, it will let you know whether you need to focus on adding any

[5] Snohomish Conservation District, *Effect of soil pH on the availability of plant nutrients*. 2012. Last accessed 1/11/2016. http://www.betterground.org/dont-guess-soil-test/

missing nutrients before planting. Second, it can help you understand any problems related to pH or nutrient deficiencies that can arise. Third, it can help you identify any excess nutrients you have in your soil which might cause problems.

The process for taking a soil sample is fairly simple, but it must be done correctly if you want to have reliable results. Most labs will tell you what to do, but here's the general procedure.

The lab will only test a small sample of your soil, so it is important to send a representative sample. To get a representative sample, use a clean plastic or stainless steel trowel to scoop up the top 6-10 inches of soil (about one shovel depth) of soil from 7-10 random spots around the garden. Make sure not to scoop up fertilizer pellets, animal feces, chunks of rust, or other things which would throw off the soil analysis. Similarly, using a rusty shovel will add considerable iron to the sample, and should be avoided. Mix the samples all together in a big bucket and scoop out about half a cup of the mixed soil. Remove any large twigs, leaves, or rocks. Put this sample in a plastic baggie, and send it to the lab!

Texas A&M University has a soil testing lab that does a great job and is affordable. When submitting your sample, you specify what crop you will be growing, for example hay, vegetables, fruit trees, etc. The lab will tailor the results to show optimum levels of nutrients for the type of crop you are growing and make recommendations on how much of each nutrient you need to apply, if any. The also make suggestions about how to address any excess nutrients that may be present.

Fertilizers and Amendments

Interpreting the results of a soil test when applying fertilizer will require some math. All commercial fertilizers have a 'guaranteed analysis' label, which specifies the percentage by weight of three macronutrients, nitrogen (N), phosphorus (P), and potassium (K), for example 3-4-3 or 5-2-2. You'll have to do some math to know how much to add, if your soil test says to add anything. See the example on the following page to work through the amount of fertilizer to

apply.

Example – Your soil test results indicate that you need to add 2 lbs of nitrogen per 1000 sq ft for the orchard. You decide that you want to use an organic fertilizer, such as alfalfa pellets. At the store, you find an alfalfa based fertilizer that indicates 5% nitrogen, so how many pounds of alfalfa pellets do you need to add to your 800 sq ft orchard?

Nitrogen Required = 2 lbs / 1000 X 800

Nitrogen Required = 1.6 lbs

Fertilizer (Alfalfa) Analysis = 5-2-5

Nitrogen Percentage = 5%

Nitrogen Content (per bag) = .05 X 50 lbs (1 bag weighs 50lb)

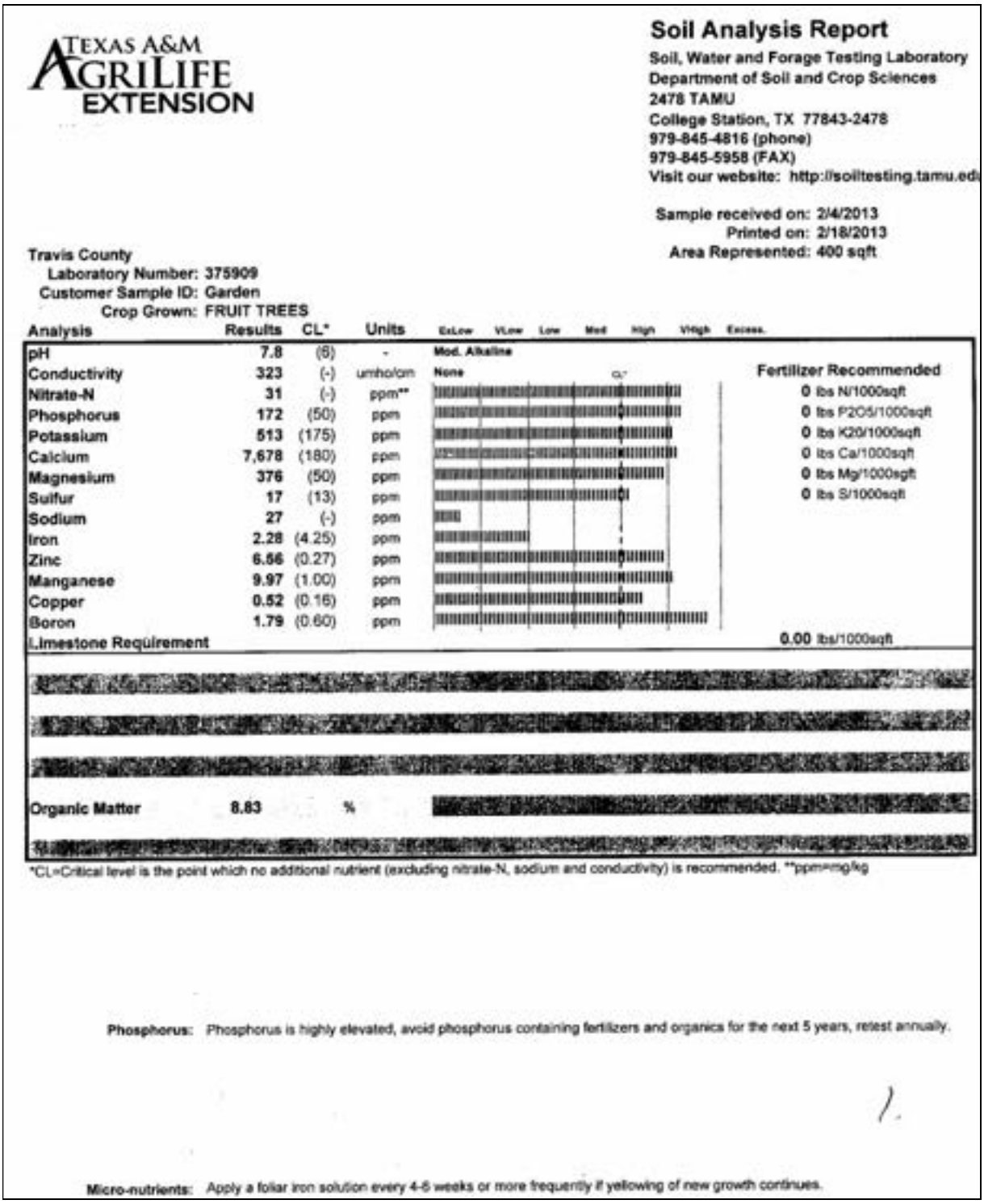
Nitrogen Content (per bag) = 2.5 lbs nitrogen per bag

Nitrogen Content (per lb of pellets) = 0.05 lbs N per lb Pelletes (i.e. 5%)

lbs Pellets Required = 1.6 lbs required /.05 lbs N per lb pellets

lbs Pellets Required = 32 lbs (about 2/3 of a bag)

On the next page, you'll find the results from a soil test, called the Soil Analysis Report, done by Texas A&M. The soil that was analyzed does not need any amendments according to the analysis. In fact, the phosphorus content is too high. This can be a real problem! Excess phosphorus binds up iron and zinc, both of which are already limited by the alkalinity of our soils. So, remember not too add too much phosphorus.



TEXAS A&M AGRILIFE EXTENSION

Soil Analysis Report

Soil, Water and Forage Testing Laboratory
Department of Soil and Crop Sciences
2478 TAMU
College Station, TX 77843-2478
979-845-4816 (phone)
979-845-5958 (FAX)
Visit our website: http://soiltesting.tamu.edu

Sample received on: 2/4/2013
Printed on: 2/18/2013
Area Represented: 400 sqft

Travis County
Laboratory Number: 375909
Customer Sample ID: Garden
Crop Grown: FRUIT TREES

Analysis	Results	CL*	Units	ExLow VLow Low Med High VHigh Excess	Fertilizer Recommended
pH	7.8	(8)	-	Mod. Alkaline	
Conductivity	323	(-)	umho/cm	None CL*	
Nitrate-N	31	(-)	ppm**		0 lbs N/1000sqft
Phosphorus	172	(50)	ppm		0 lbs P2O5/1000sqft
Potassium	513	(175)	ppm		0 lbs K2O/1000sqft
Calcium	7,678	(180)	ppm		0 lbs Ca/1000sqft
Magnesium	376	(50)	ppm		0 lbs Mg/1000sqft
Sulfur	17	(13)	ppm		0 lbs S/1000sqft
Sodium	27	(-)	ppm		
Iron	2.28	(4.25)	ppm		
Zinc	6.56	(0.27)	ppm		
Manganese	9.97	(1.00)	ppm		
Copper	0.52	(0.16)	ppm		
Boron	1.79	(0.60)	ppm		
Limestone Requirement					0.00 lbs/1000sqft
Organic Matter	8.83		%		

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Phosphorus: Phosphorus is highly elevated, avoid phosphorus containing fertilizers and organics for the next 5 years, retest annually.

Micro-nutrients: Apply a foliar iron solution every 4-6 weeks or more frequently if yellowing of new growth continues.

Figure 5 Soil testing results[6]

[6] TreeFolks, Inc., *Soil test results.* 2013. Available from TreeFolks, Inc., Austin, Texas

Table 1 Approximate Analysis of Organic Amendments[7]

	Alfalfa Meal or Pellets	Corn Gluten Meal	Cottonseed Meal	Soybean Meal	Bat guano (high N)	Blood meal	Bone meal
N – P – K	2 – 1 – 2	9 – 0 – 0	6 - 0.4 - 1.5	7 – 2 – 1	10 – 3 – 1	12 – 0 – 0	3 – 15 – 0
Release Time	1-4 months	1-4 months	1-4 months	1-4 months	4+ months	1-4 months	1-4 months
Pros	Available at feed stores, Contains natural plant growth hormones	Very high N	High N	High N, available at feed stores	Stimulates soil microbes	Available at feed stores	Plant available P
Cons	May contain seeds	Germination inhibitor, some are GMOs	Pesticide residues, GMO	~50% is GMO	Cost	Can burn; cost	Cost

	Feather Meal	Fish Emulsion	Enzymatic Fish Liquid	Fish Meal	Fish Powder
N – P – K	Varies	5 – 2 – 2	4 – 2 – 2	10 – 6 – 2	12 – 0.25 – 1
Release Time	4+ months	1-4 months	1-4 months	1-4 months	Immediate
Pros	Long term fertility	Micronutrients, mixable in water	More nutrients than 'plain' fish	N and P source	Micronutrients
Cons	Slow to release	Smells like dead fish	Cost	Heat processed	Heat processed

[7] Colorado State University Extension. Table compiled from information on webpage. Webpage published 2013. Last accessed 1/11/2016. http://www.ext.colostate.edu/mg/gardennotes/234.html

Some organic fertilizers low in phosphorus include cotton seed meal, blood meal, fish emulsion, corn gluten meal, or soybean meal. Slow to release organic fertilizers should be applied in January to give the material time to degrade and release the nitrogen as growth begins in the spring. A second application in mid-summer after fruit set will help the tree as the fruit ripens. Table 1 provides an approximate analysis and some information about a few organic fertilizers.

Organic Matter

Before leaving the topic of soils, it's important to explore the important role of organic matter in the soil. Organic matter, added in the form of mulch, compost, and to a lesser degree organic fertilizers, is a cure-all for almost any problem in your soil. Adding organic matter serves to open up the soil's texture, increasing oxygen penetration, while the decomposition of organic matter releases a steady trickle of acid into the soil, unlocking nutrients for plants to use. Organic matter also acts as a sponge, soaking up and slowly releasing water so that more is available to the plants, and it feeds the soil's microbial communities. When applied as a mulch, it acts as a blanket to conserve soil moisture and moderate the soil temperature, which makes for a more conducive growing environment. Nutrients locked up in the organic matter even fertilize the growing plants as they are decomposed.

After planting, you can spread a 2 inch thick layer of finished compost in a disc 3-4 ft wide around the base of the tree. You can then top dress the entire disc with another 3 inches of coarse wood mulch. Straw or autumn leaves will also work, but they will have to be replaced more frequently. Make sure to keep all the compost and mulch at least 6 inches away from the trunk of the tree. Each year in January and June, spread a 2-3 inch layer of compost around the tree, focusing on the area at the edge of the tree's canopy. Rake into the existing mulch and apply new mulch as needed to a maximum depth of 5 inches. The disc should widened as the tree grows.

Most of the tree's feeder roots are outside of the drip line, and within the

top 12 inches of soil. Feeding a tree outside of the drip line will encourage the roots to spread outwards, making the tree more physically stable and resilient. Fertilization and watering are both discussed in greater detail later in the guide.

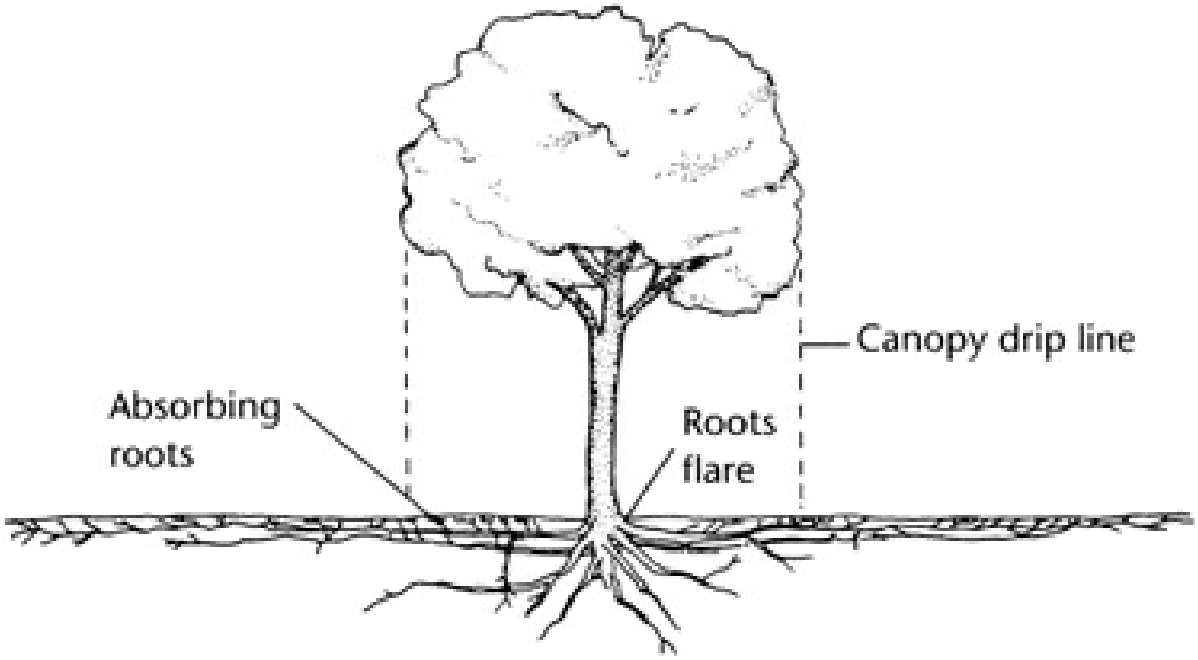


Figure 6 Location of roots on mature tree[8]

When planting fruit trees, you do not need to heavily amend the soil at planting with compost or fertilizer. It is better to add compost and mulch to the surface of the soil, and allow natural processes like earthworms to incorporate it into the surrounding dirt. This is because changes in the bulk density of the soil, such as occur when adding compost or bringing in potting soil, affect the internal drainage of the soil. As water moves across the surface of the soil, it will soak into the loose, fluffy areas created by deep additions of organic matter and fill them up before soaking into the harder, denser soil outside the planting hole. Likewise, the the water will stay in those fluffy soil pockets until the water has drained away from the harder soil, which can take days. Now, you may be thinking that waterlogged soils are not a big problem in hot, dry Austin. Consider, however, that even as little little as a few days of anaerobic conditions in your tree's root zone can kill it. Our

[8] Scenic Hills Nursery, *No image title.* No date. Last accessed 1/11/2016. http://www.oakwilt.com/images/15-51.gif

rainfalls may be infrequent, but they are often very heavy. It is not uncommon to have standing water. Urban development exacerbates this by funneling water from from impervious surfaces like rooftops and driveways into yards, effectively increasing the rainfall several fold for those areas. A fruit tree planted in a poorly drained or low lying spot with adjacent impervious surfaces and naturally heavy soils needs all the help it can get to overcome these challenges and thrive.

Water

While too much water can be a problem, water is of course vitally important to plants. Trees use water to transport nutrients from the soil to their leaves, and to move sugars from the leaves to the trunk and roots. Water evaporating from the leaves, a process called evapotranspiration, creates a suction that pulls water out of the soil, through tiny tubes stretching the length of the tree, and into the leaves, bringing dissolved minerals along with it. The cooling effect of water evaporating from the leaves is one way trees regulate the temperature of their leaves, which affects their ability to perform photosynthesis.

Newly planted trees need to be watered about once a week in order to get established. Established trees, depending on the type of tree and your site conditions, may also need supplemental watering for the life of the tree. Different types of trees need different amounts of water though. A jujube tree, for example, can survive on very little water, while a paw paw tree needs lots of water. Exactly how much water a tree will use each day varies considerably based on the weather, soil type, tree species, microclimate, and the age of the tree, but trees can require a surprising amount of water to produce a good crop. On the following pages, Table 2 shows Texas A&M Fruit Specialist Monte Nesbitt's suggestions for how much water a mature tree will use per day, while Table 3 groups fruit and nut trees into Low, Medium and High water use classes. Table 4 illustrates the amount of water released by temperate fruit trees' leaves under different weather conditions.

A Word of Caution About Water

While sufficient water is very important, many landscape trees die from over watering. For every rainfall event of 1 inch or more, delay watering by at least one week. This will allow time for the water to drain out of the soil and keep it well oxygenated. Remember, the tree's roots need oxygen, and without it they will die. Make sure not to create a swamp around your trees or they will suffer.

Table 2 Water Use of Fruit Trees[9]

Species	Daily water use @ maturity	Inches of Water
Pecan	150 gal	2" per week during growing season
Peach	40 gal	1" per week during growing season
Fig	30 gal	
Citrus	50 gal	45-50" annually

Table 3 Water Use Classification of Fruit and Nut Trees[10]

High Water Use	Pecan, Peach, Apple, Paw Paw, Citrus
Medium Water Use	Fig, Persimmon, Plum, Mulberry, Loquat, Pear
Low Water Use	Pomegranate, Jujube

[9] Texas A&M University Extension. Table compiled from information given in live presentation by Monte Nesbitt on 09/24/2014.

[10] TreeFolks, Inc. *Water use classifications*. 2016. Compiled from multiple resources and personal observations.

Table 4 Water Management Guide for Temperate Fruit Trees[11]

Tree Age / area under the canopy	Gallons of water per day used by temperate fruit			
	Cool and foggy spring or fall day	Warm spring or fall day	Hot summer day, sunny	Very hot and windy, over 100°F
1 ft^2	0.062	0.125	0.156	0.187
1 years old / 4 ft^2	0.25	0.50	0.62	0.75
2 years old / 10 ft^2	0.62	1.25	1.56	1.87
3 years old / 36 ft^2	2.25	4.5	5.61	6.73
4 years old / 100 ft^2	6.2	12.5	15.6	18.7
Large standard mature tree / 300 ft^2	18.6	37.5	46.8	56.1
One acre solid cover	2,715	5,431	6,788	8,146

[11] Paul Vossen, University of California Cooperative Extension. *Water Management Guide for Temperate Fruit Trees.* 2000. Last accessed 1/11/2016. http://homeorchard.ucdavis.edu/daily-water-use-vossen.pdf

The important take away message from these resources is that trees require water, and most should not be left entirely to their own devices if you want to have a reliable harvest. This is not to say your trees will certainly die, or that they will not yield anything without supplemental watering, as indeed many trees around Austin bear fruit regularly without any attention at all. What it does mean, however, is that the tree will not be at its maximum potential in terms of health or yield. When you are considering your orchard, bear in mind the importance of water and your ability to provide it to the site, and balance this against your own priorities in terms of fruit preferences, potential yield and ease of care.

Light

Light is energy. Trees use light energy to make sugar, which fuels the tree's growth, and make the fruit sweet. Without adequate light, a fruit tree will grow slowly, not make very much fruit, and the fruit will not taste as good. Therefore, it's important to put your trees in a place where it will get full sun. At least 8 hours a day of direct sunlight are the bare minimum for most fruit trees. Native understory trees such as Mexican Plum, Paw Paw, or Texas Persimmon can grow well in shady areas, but domesticated fruits like pears, citrus, peaches, figs, and pomegranates need lots and lots of sun. Adequate sunlight will help reduce disease pressures by creating a drier environment in the canopy and giving the tree plenty of energy to fight off pests. Uniform sunlight will also encourage a more balanced physical structure, so try not to plant your tree against an east or west facing wall if possible.

Space

Standard sized fruit trees should not be planted less than 15 feet apart in most cases. Dwarfed trees, or naturally smaller trees like citrus and pomegranate, can be planted closer together. The mature canopy of the trees should not

overlap. This allows for air circulation and space for the roots to grow. Having plenty of air circulation is one of the most important cultural practices to prevent disease in the orchard. Air circulation reduces transmission of fungal spores and makes the environment in the canopy drier and less conducive to the spread of fungal diseases.

Root space is perhaps more important than canopy space, though. A mature tree can send its roots out as much as 3 times the width of the canopy, with most of the roots existing in the top 12 inches of soil. Except for trees grafted onto dwarfing rootstocks, standard fruit trees should not be planted into pots or in areas with constrained rooting areas such as sidewalk cutouts, tree wells, or the strip between the sidewalk and street. In the long run the trees will not thrive or be as productive as it would be with adequate root space, and the roots can damage concrete structures like foundations and culverts.

Climate

Temperate fruit trees, like peaches, apples, and pears, require a certain minimum number of chilling hours for the buds to develop properly. Chilling hours refers to the amount of time during which the temperature is between 32 and 45 degrees Fahrenheit. Once a tree experiences its threshold number of chilling hours, it will begin to break dormancy, sending out new blossoms and leaves. Different varieties of fruit tree have varying chilling hour requirements. In Austin we average about 700 hours, but that can vary by several hundred hours depending on the year and your microclimate. Choose varieties in the 500-800 hour range to make sure they will break dormancy after the last severe freeze, but still get enough hours to develop its buds. If the tree does not get enough chilling hours, it will not break dormancy properly and will be severely stressed.

Some tropical and subtropical fruits *can* be grown in Austin, with luck, care, and attention. Certain citrus trees, such as kumquat and satsuma, are appropriate appropriate for planting in the ground, as they can withstand our normal winter conditions. They will need protection during unusually cold periods and while

young. A string of incandescent Christmas lights and a large sheet or blanket should suffice in most cases. Make sure to fix the blanket to the ground like a tent tent if possible. Wrapping a blanket tightly around the trunk is not as effective as creating a tent with the sides attached to the ground because the ground will radiate a lot of warmth (relative to the air temperature), and because trees do not generate their own heat the way animals do. Creating a conditioned space for them conserves what warmth they may have absorbed before the freeze.

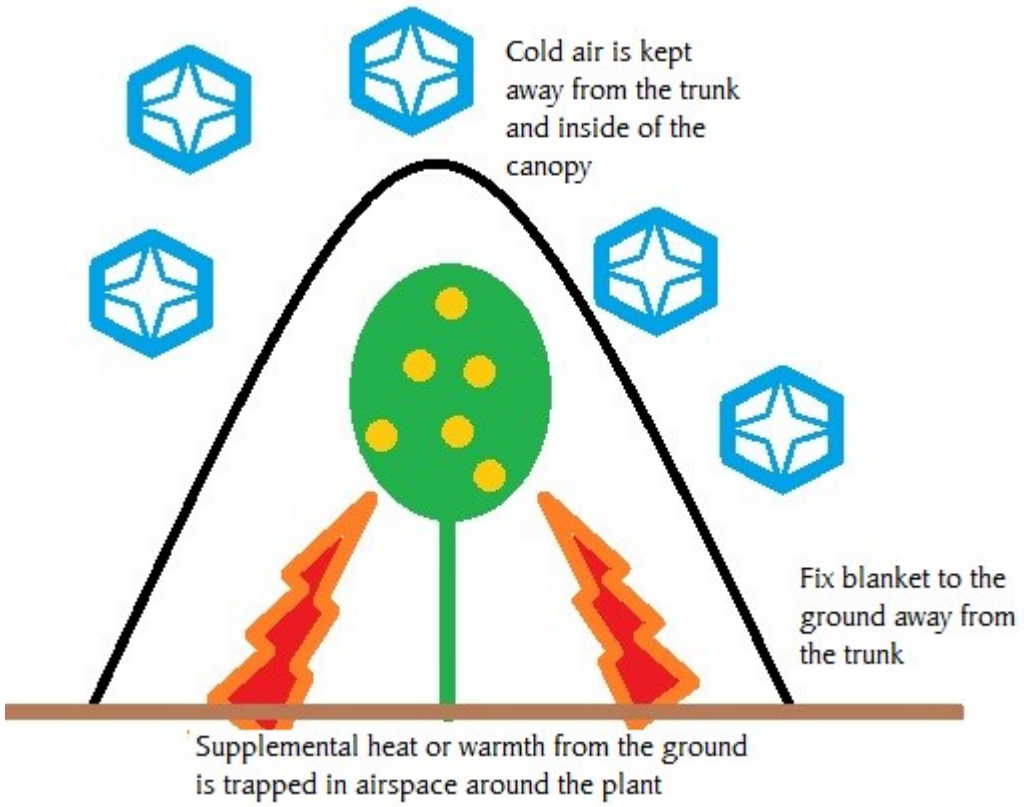


Figure 7 Frost protection of cold sensitive plants

For more sensitive plants such as grapefruits, lemons, papaya, avocado, or bananas, you will need to be very intentional about selecting the most cold hardy varieties available, planting them in the warmest, most protected spots available, and providing plenty of supplemental heat during the winter to keep the plants

alive. It is also important to realize that the cold hardiness of a particular tree, which refers to the lowest temperature that a tree can survive, depends on how old it is, what stage of growth it is in, and how long it experiences the cold. Also, reproductive tissues, like flower buds and young fruit, are usually much less cold tolerant than mature limbs. An avocado tree that can reportedly survive 15 degree degree temperatures when mature may grow in Austin, but may set fruit only occasionally because the developing flower buds would be killed during the winter. This is not to say that you should not experiment and try things that aren't "guaranteed" to work, but that you should be realistic about your expectations and level of investment, and not get discouraged if a cold tender plant dies during cold weather.

Access

Access to your trees is an overlooked, but significant, determinant of success. If your trees are not accessible to you, it will be difficult to give the trees the attention they deserve. As the saying goes, the best fertilizer is the gardener's shadow. Conversely, if your trees are located along a busy sidewalk, you can expect to lose a great portion of the fruit to passersby. Fencing, signs, and nets can help reduce this, but a tree full of ripe fruit is a powerful temptation and it is difficult to entirely stop people from harvesting from your trees if they are within reach. If you have room for multiple trees, plant peaches and pears behind less familiar trees such as Asian persimmon and pomegranate to discourage people from taking the harvest.

Selection & Care

Planting

Fruit trees can be planted from either bare root or container grown stock.

Most temperate fruit and nut trees are better planted from bare root stock during January, while pomegranate, fig, and citrus trees are better planted from container grown stock in late spring, after the danger of frost has passed.

Container Tree Planting

To plant a container grown tree, select the smallest container size available, for example a 3 or 5 gallon size pot. Avoid the temptation to plant a large tree, because larger container grown trees often have significant, and permanent, problems in their root structure. Smaller trees adapt to the planting site more quickly, are more resilient to stress, and will outgrow a larger tree within a few years.

Before removing the tree from the pot, dig a hole twice the width of the pot, and a little bit shallower than the pot. Break up or score the sides of the hole so that it is not a smooth wall. Lean the tree over to the ground. Using your hand, knock the sides of the pot to separate the roots and soil away from the sides of the pot. Put the tree upright again and grab the trunk of the tree at the base and pick it up slightly, then tap the top edge of the pot to gently push it off of the root ball. Do not yank the tree up out of the pot, instead, remove the pot from the tree. This protects the roots from being broken. Now, take a sharp knife or pair of pruning shears and make four vertical cuts along the sides of the root ball, and an 'X' across the bottom. This will sever any circling roots around the outside of the pot. Using your fingers, dig down through the soil at the base of the trunk until you find the first root coming off of the trunk. This is the root flare. The root flare should be at or slightly above the finished grade of the soil after planting. In all likelihood, this means you will pull several inches of soil back away from the trunk of the tree before planting. Don't be surprised or worried if your finished root ball is considerably smaller than the pot. This is your one chance to correct any root issues that developed while the tree was in the pot.

Set the tree upright in the middle of the hole, then place a shovel handle or stick across the top of the hole. The grade of the soil should be at the same level as

as the root flare of the tree. If the tree needs to be deeper, remove some soil. If it If it needs to be raised up, add soil to the hole. When the tree is at the correct level, fill in the planting hole with the soil you removed. Water the tree in slowly but thoroughly, until the water pools on the surface and doesn't soak in. For a newly planted 5 gallon tree, this may mean as much as 20 gallons of water. Apply mulch in a 3-4 inch thick disk around the tree, about 4 – 5 ft across, making sure to keep the mulch at least 6 inches away from the trunk of the tree. It will look like a flat donut. You can use the mulch and loose soil to create a shallow basin around the tree to collect water.

Bare Root Tree Planting

Bare root trees are only appropriate for planting during the winter, which pretty much just means January and February in Austin. In exchange for this time constraint, you have the opportunity to avoid many of the root issues that plague container grown trees. A bare root tree is exactly what it sounds like; a tree which has been dug up from the field and which does not have any soil on its roots. When you buy a bare root tree, it will come with wet sawdust packed around the roots in a plastic bag on the bottom of the tree. Select a tree with flexible branches and twigs, a good, strong main trunk, and no obvious scarring or dead tissues. If the tree has blossoms or leaves on it, don't buy it. Just wait till next year or get a container grown tree.

To plant a bare root tree, dig a hole about 2-3 ft wide and about 8 inches deep. You'll need to make a cone of soil in the middle of the hole to set the tree on top of as well. So, the finished objective is a shallow hole with a round cone in the middle. Remove the plastic wrapper and wash the sawdust from the tree, then spread the roots out to their full extent while setting it on top of the cone of soil. The root flare should be at or slightly above the finished grade of the soil. The roots should spread down the sides of the cone and should not be coiled up at the ends. You may need to make the hole wider in some places or rotate the tree to fit the roots in better. Avoid cutting the roots if possible.

Once you are happy with the depth of the tree, fill in with the soil you removed when digging. Half way through, water the tree in to settle the soil down. Fill in the rest of the soil and water it in again until the water pools on the surface. If the tree's roots are exposed at the surface, you can add some extra soil to cover them. Apply mulch in a 3-4 inch thick disk around the tree, about 4 – 5 ft across, making sure to keep the mulch at least 6 inches away from the trunk of the tree. It will look like a donut. You can use the mulch and loose soil to create a shallow basin around the tree to collect water.

Pruning

No part of fruit tree care meets with more resistance than the need for good, thorough pruning. At the same time, water is probably the only thing more important to the health and performance of an improved fruit tree. A lot of resistance to the idea of pruning is that it seems unnatural. Let us clarify: improved fruit trees are not natural!

Fruits that are available commercially are the product of intensive selective breeding. The same is true of the fruit tree that you buy at your local nursery (or get from TreeFolks). Every time a fruit breeder crosses two varieties of a species of tree, it's like rolling genetic dice. The chance of crossing two varieties and only getting the most desirable fruit characteristics of both varieties is very low. When it happens, the breeder takes that considerable accomplishment and clones it by grafting buds or "scions" from that tree onto the roots of another tree, the rootstock.

The little scion is pre-programmed to grow like a branch, not a tree, and the fruit it bears is much larger than what grows on the wild predecessors under natural conditions. Furthermore, the rootstock will continually try to exert itself by sending up shoots (root suckers) which do not have the same fruiting characteristics as the scion and will always be prone to pests because they are in the shade of the top growth. The only way to ensure the health of the tree is with good corrective pruning.

There are three basic methods of fruit and nut tree pruning. The stone fruits (peaches, plums, apricots, nectarines) are pruned using the “Open Vase” method. Pome fruit (apples, pears, quince), nuts (pecans, walnuts), and Asian Persimmons, are trained to a “Central Leader” form. Citrus, jujube, fig and pomegranates can be left almost entirely unpruned. They only need to have broken or diseased limbs removed, or be pruned to maintain a particular size. We’ll focus on the open vase and central leader techniques below, as well as briefly describe how to make a pruning cut.

Open Vase

Stone fruits are pruned using the “Open Vase” method. Stone fruits don't have deep, strong, roots holding them in place. This training method gives the mature tree a low profile to the wind so it will be less likely to blow over. Open Vase pruning also exposes the maximum amount of foliage to sun and air flow, & makes is easy to inspect and care for the tree. Stone fruits are not long lived trees, and the open vase system is designed to keep the fruiting wood as healthy and accessible as possible.

If you plant a bare root tree, start by cutting the tree off at about 30” from the ground & above a good bud. That’s it for the first year. If you plant a container-grown tree, start pruning as though the tree was already a year old.

In the first dormant season (after the leaves fall the year after you plant the tree) you will do some of the most important training in your tree's life. Choose three or four limbs that emerge somewhere between 2-4 ft. up from the ground and point in roughly opposite directions, like a Mercedes car logo or a cross. They don't have to be the same size, but if any of them are really long, cut them off at 24-30” from the trunk. These will be your permanent “scaffold” limbs. Cut everything else off. Always cut off any growth that comes from the base of the tree. These are called “root suckers.”

Figure 8 Open Vase Pruning of New Trees[12]

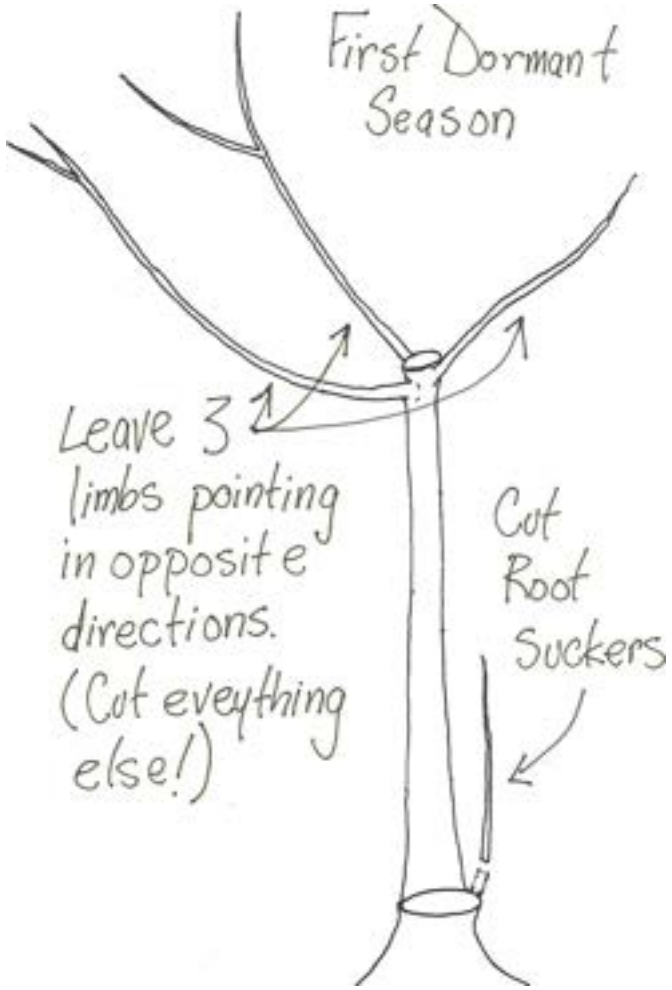


Figure 9 Selecting Scaffold Branches [13]

[12] TreeFolks, Inc. *Open Vase Pruning of New Trees*. 2016. Available from TreeFolks, Inc., Austin, Texas

[13] TreeFolks, Inc. *Selecting Scaffold Branches*. 2016. Available from TreeFolks, Inc., Austin, Texas

The tree is pretty well established when it leafs out in its 2nd growing season. It will probably have blossoms the 2nd spring. You can leave them on to enjoy, but pick them off as soon as they fade. You will not get fruit this year. You should be starting this season with three limbs on the tree you planted just over a year ago. You can wait until winter to do more pruning but it's better to do some "corrections" during the growing season.

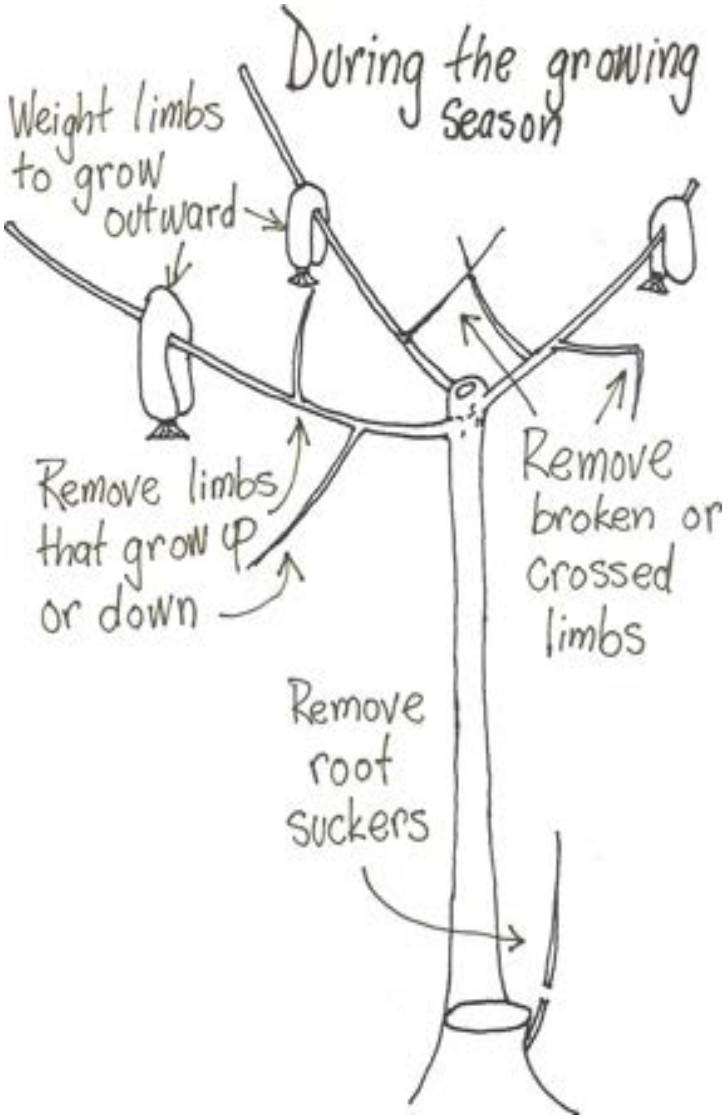


Figure 10 Training Scaffolds for Open Vase [14]

[14] TreeFolks, Inc. *Training Scaffolds for Open Vase.* 2016. Available from TreeFolks, Inc., Austin, Texas

When the scaffold limbs reach 24-30" long, cut them back to that length. You should make your cut just past a branch or bud that points straight out to the side (either side). This cut will force your scaffold limbs to fork, which will be stronger than a long straight branch. Your scaffold limbs may try to grow straight up. You need to gently train them to grow more outward. One method is to fill an old sock or plastic bag with a little sand and drape it over the limb. Start with it close to the trunk and move it outward until the limb droops to a 45 degree angle. Alternatively, you can simply prune to buds and branches that naturally grow more outward rather than upward. Additionally, cut off root suckers periodically during the season. Also cut limbs that grow towards the center of the tree or towards the ground. If you catch them when they are small, you can pinch them off with your fingernails.

It should be pretty clear by the third season what you're after in this pruning method. You've pinched back limbs when they reach about two feet or cross other limbs and pinched off limbs that grow up or down. You can see now that the tree is developing into the shape of a wide funnel.

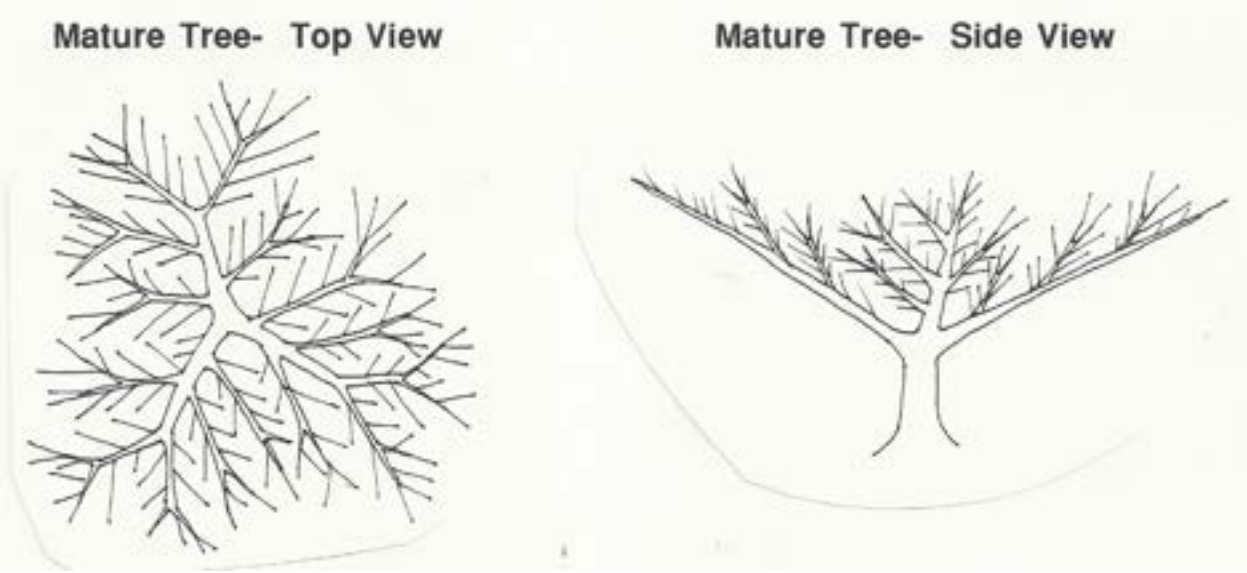


Figure 11 Mature Open Vase Tree[15]

[15] TreeFolks, Inc. *Mature Open Vase Tree.* 2016. Available from TreeFolks, Inc., Austin, Texas

In the third year you can leave some fruit on the tree to mature. For the best size and quality, you should thin the fruit before they reach the size of your fingernail. Remove fruit that has formed in a space too small for it to mature. Remove all but one fruit from areas where they are clustered. Remove fruits that are near the ends of thin branches, and anything with insect damage. You should remove at least 50% of the immature fruit.

During the course of the season, continue to pick immature fruits that have been damaged by insects or rubbing branches. Thinning is almost as hard as that first severe pruning you did when you planted the tree. But remember, seeds are about the same size, regardless of how big the fruit is, so you get much more fruit in relation to the seeds when you thin for larger fruit. Damaged, windfallen, or unused fruit is a breeding ground for insects and disease. Thinning gives you better fruit on a healthier tree.

After your tree has started to bear fruit, you need to do some maintenance pruning every year during the dormant season. You need to do all of the same corrective pruning that you have all along (removing root suckers, upward and downward growth, and crossed branches). You also need to thin excess branches.

Any given branch will bear fruit for only a short time. Removing non-productive older branches makes sure your tree has enough light penetration and air flow to ensure that it's bearing as much fruit as it can. The difference between old and new growth is different in different tree species but you should be able to tell from the color of the bark.

Central Leader

Pome fruits (apple, pear, quince), nuts (pecan, walnut), and Asian persimmons are trained to a "Central Leader." These trees have deeper, stronger roots so they can withstand heavier winds. The Central Leader method makes the best use of vertical space for maximum air flow and sunlight through the branches. It is also the strongest form a tree can have, so use this style to prune your shade trees as well.

If you plant a bare root tree, start by cutting the tree off at about 30” from the ground & above a good bud. That’s it for the first year. If you plant a container-grown tree, start pruning as though the tree was already a year old.

Figure 12 Central Leader Pruning of New Trees[16]

In the first dormant season you'll do very important pruning and training. You will need to choose which of the branches that grew the first year will be the trunk (central leader) of your tree. Choose a branch that grows as close to straight straight as possible. It should begin close to the top of the existing trunk. Inspect Inspect the point where it attaches. If it appears undamaged, carefully remove all other branches from the tree. If your new central leader isn't growing straight up, you may need to use a small stake to train it upward. Drive the stake gently into the ground next to the original trunk on the opposite side of the new central

[16] TreeFolks, Inc. *Central Leader Pruning of New Trees.* 2016. Available from TreeFolks, Inc., Austin, Texas

leader. Tie the central leader loosely with plant-tie tape or strips of cotton cloth.

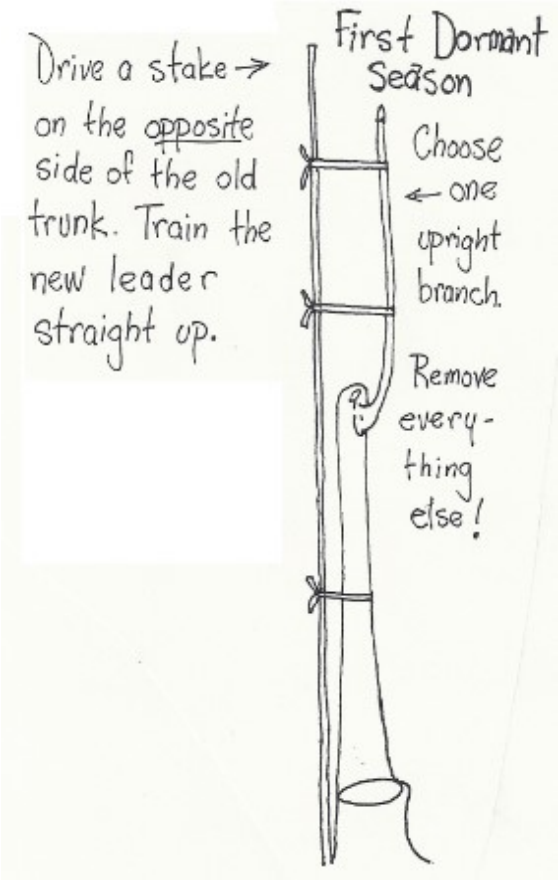


Figure 13 Training the Central Leader[17]

After a full year of growth with your new central leader chosen, your tree will start looking like a tree again. Before your tree leafs out in its third spring, you should begin to choose your permanent "scaffold" limbs. Starting at least 24" from from the ground, choose a limb that's growing outward without any damage. Remove all limbs below that point, especially root suckers. Look up the trunk of the tree until you find another undamaged limb about 1/3 of the way around the tree and about 12 inches up the trunk from the first limb, then remove any branches between this limb and the first limb. Continue this pattern until you reach the central leader. The idea is to leave limbs that won't sag under the weight weight of fruit and rub on limbs below, and to maximize airflow and light

[17] TreeFolks, Inc. *Training the Central Leader.* 2016. Available from TreeFolks, Inc., Austin, Texas

penetration. Ideally, your limbs will be arranged like a spiral staircase winding up the central leader. The limbs on some trees, especially pears, will try to grow straight up. You have to train them to grow outward. One way is to wedge a wooden splint between the limb and the central leader to pry it down to at least a 45 degree angle. If you use this method, be careful not to damage the delicate bark. Another method is to fill an old sock or plastic bag with sand and drape it over the limb. Start with it close to the trunk and move it outward until the limb sags down to at least a 45 degree angle.

Once the tree has established scaffold limbs, pruning will becoming much more straightforward. Grafted trees will continue to send up root suckers which should be removed as soon as possible. Dead and dying wood should be removed throughout the season, especially any blackened shoots on apples and pears. This is usually caused by fire blight, a common bacterial disease. Sterlizie your pruners with Lysol or a bleach solution between each cut to avoid spreading the disease to new branches. You can do most other pruning during the dormant season if you prefer, but pruning will not hurt the tree even in the growing season.

Remove any branches growing straight up or straight down, as they can interfere with other branches. *Don't* remove the stubby twigs on apples and plums, and pears, as these are the fruiting spurs. If you remove them, the tree wont set fruit! Remove any fruit with insect scars or damage to reduce insect pressures in future years. Those tiny worms will grow into adults that can lay many many hundreds more eggs! Pick any fruits that are growing too close together to mature without touching. Finally, thin out the fruit from the smallest and outermost branches. You should end up with about 30% of the fruits that the tree tree originally sets for apples and pears. Small cloth bags around each fruit will help protect them from squirrels and birds, as can plastic bird netting over the tree.

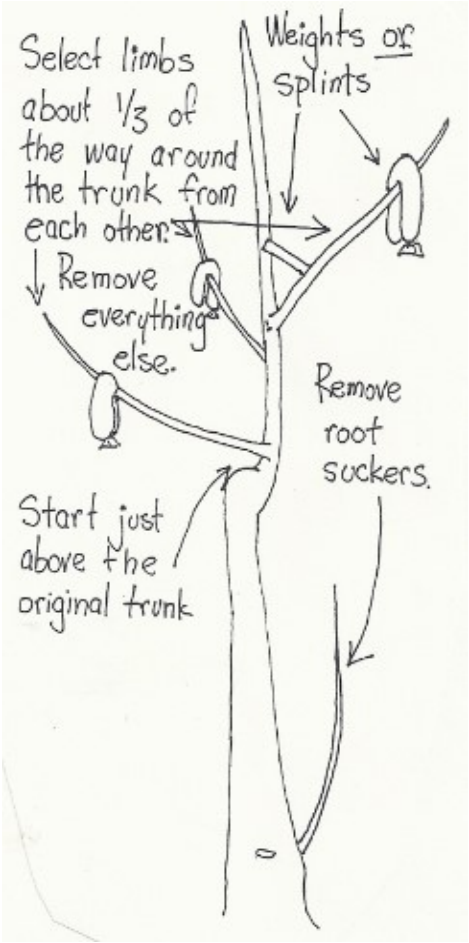


Figure 14 Training Branches for Central Leader[18]

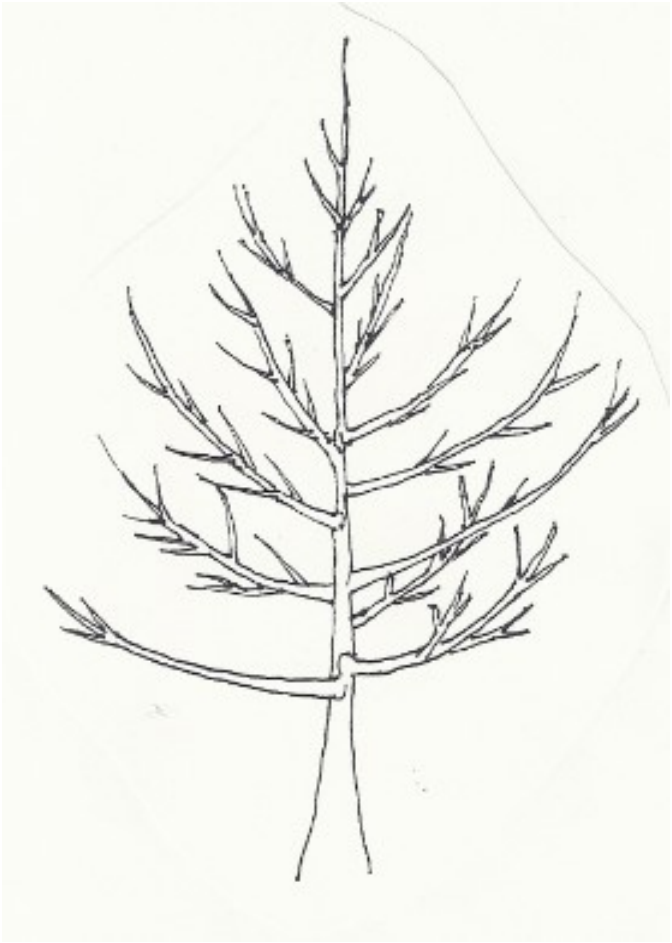


Figure 15 Mature Central Leader Tree[19]

[18] TreeFolks, Inc. *Training Branches for Central Leader.* 2016. Available from TreeFolks, Inc., Austin, Texas

[19] TreeFolks, Inc. *Mature Central Leader Tree.* 2016. Available from TreeFolks, Inc., Austin, Texas

How to make pruning cuts

Small pruning cuts can be made with a pair of sharp hand pruners. Bypass pruners, named because the blade *passes by* a metal hook to make the cut, are preferable to anvil style pruners, because they cause less damage to the bark tissues. Pruning cuts should be made just outside of the branch collar, with the outside face of the blade closest to the trunk or branch that will remain on the tree.

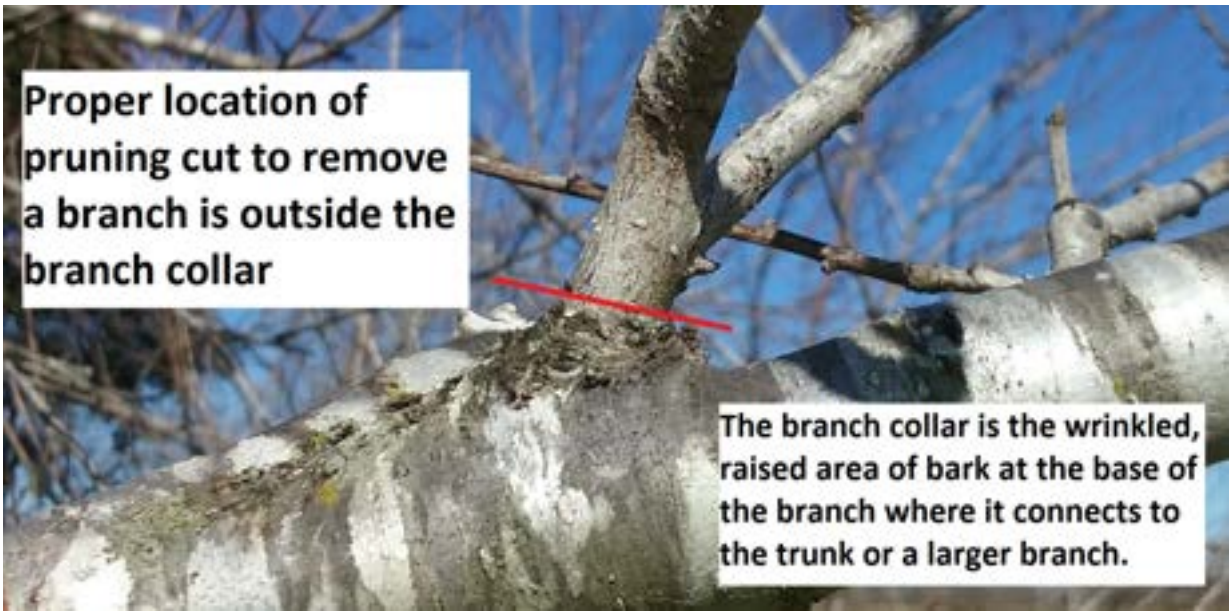


Figure 16 Location of Pruning cuts[20]

[20] TreeFolks, Inc. *Location of Pruning Cuts.* 2016. Available from TreeFolks, Inc., Austin, Texas

Figure 17 Making the Cut[21]

Notes on Specific Fruits

Apple and Pear

Apples and pears produce fruit on what are known as 'fruiting spurs'. These are the short stubby twigs that form flower buds. Fruiting spurs form on two year old wood and are semi-permanent on apples and pears. They should not be removed except for disease or structural reasons, as they are where the fruit forms. You can recognize a flower bud because it is larger than a leaf bud. Leaf buds are formed over the whole tree, while flower buds are limited to the spurs. In the image below, the twig on the left has leaf buds, while the twig on the right is a fruiting spur with a flower bud.

[21] TreeFolks, Inc. *Making the Cut.* 2016. Available from TreeFolks, Inc., Austin, Texas

Figure 18 Leaf buds and fruiting spur on apple branches[22]

Most apples and pears are *not* self-fertile, though some are. This means you must have two different varieties of tree in order to get fruit. Two trees of the same variety will not work, because all trees of a particular variety are in fact clones of each other, grown from cuttings. Unless you have room for multiple trees, selecting a self-fertile tree is highly recommended to ensure pollination. Even if you do have room for multiple trees, selecting multiple self-fertile trees is probably a good idea. In Austin, apples are ripe in the middle of summer. Depending on the variety, pears ripen August to October. Both are susceptible to fire blight, a disease which causes blackening and death of young tissue and is spread by bees when the pollinate the flowers, so it's more or less unavoidable. Make sure to sterilize your pruners between cuts with Lysol, alcohol, or bleach when removing blighted tissue, and throw the trimmings into the trash, not your compost. Bleach will corrode your pruners and is not recommended.

Citrus

Citrus trees set fruit on new flushes of growth that emerge from the axils (where the leaf connects to the stem) of leaves that grew on branches late in the

[22] The Walden Effect, *No image title.* 2012. Last accessed 1/11/2016. http://www.waldeneffect.org/20120306applebuds.jpg

previous growing season as well as at the tips of the current season's growth flush. Late season buds will bloom first in the springtime as the tree emerges from dormancy, while new buds will bloom as the tree is growing a bit later. Citrus trees, trees, when grown in tropical climates, will have buds, blooms, and fruits at various states of ripeness all at the same time. In temperate climates, we are limited to a spring bloom and late fall harvest. As a rule, citrus will drop most of their blossoms blossoms without setting fruit, and drop many small green fruits. It's sad, but unavoidable. In general, there is no need to thin the fruit or prune for fruit production. As long as citrus trees get adequate moisture and plenty of nitrogen as as they are flushing out new growth, you need only worry about squirrels and freezes. Satsumas, which are a great choice for Austin, ripen in October. Pick all your fruit before any freezing weather or it will be lost. Satsumas do not need to be orange colored to be ripe. Vividly orange rinds are caused by cool nighttime temperatures, which may not happen until after the fruits have passed the ideal balance of sweetness and acidity. Sample a fruit once a week or so starting in October to see when they are to your liking, realizing that the skin might be green still. Satsumas are hardy to the mid to upper teens when mature, but need protection when young. New growth and flower buds are more cold sensitive than than older branches. Prune them to remove weak or crossing branches and to keep the tree at a manageable size.

Figure 19 Satsuma blossoms[23]

[23] TreeFolks, Inc. *Satsuma blossoms.* 2016. Available from TreeFolks, Inc., Austin, Texas

Fig

What we eat from fig trees isn't actually a true fruit. Rather, it is a swollen, inside out flower stem. If you cut open a fig, you will see many small hair like structures pointing towards the middle of the fruit. Each of these is actually an individual flower. The kind of fig trees we can grow in Austin do not require pollination to produce figs, which makes them a great choice for the home orchard. Figs set 'fruit' on the current season's growth, which means you can prune them back severely each year to maintain a compact structure and still get a harvest, though severe pruning is not good for the tree. Some fig trees will even produce two crops in a single year, one in the summer and one in the fall. In Austin, fig season starts in July. Figs can be damaged during unusually cold winters, but will generally bounce back even if they freeze to the ground. Most are hardy to the low teens. Squirrels and birds are the biggest threat, though sometimes wasps will eat them too. Look for varieties with a closed 'eye' to reduce spoilage on the tree. An interesting fact about figs is that you can generally grow a new tree by taking a 12 inch long cutting from an existing tree during the winter and planting it about 8 inches deep into the ground, and then ignoring it. Believe it or not, this gives you a decent shot at a new fig tree!

Figure 20 "Chicago Hardy" fig tree with fruit[24]

[24] TreeFolks, Inc. *Fig with fruit.* 2016. Available from TreeFolks, Inc., Austin, Texas

Mulberry

All over Austin, there are wild mulberry trees growing next to parking lots, along ditches and fences, and pretty much anywhere else that doesn't get regularly mown and is underneath a bird. These fast growing trees produce one of the earliest fruits of the season, ripening in May. If you just want to eat a few berries, it's probably easiest to just find a tree in your neighborhood and visit it when the fruits are ripe. If you want to grow your own, there are several named varieties of exotic mulberry that can produce very large fruits of excellent quality. Mulberries don't require any special care or attention beyond watering and structural pruning, but the birds will eat all the berries if you don't put a net over the tree. Prune them to a central leader. Fall web worms can be a problem, but knocking the webs open with a long stick will open the worms up to predation from wasps, or you can spray the nests with B.T., an organic insecticide. They aren't likely to seriously harm the tree though, unless it is an especially bad infestation.

Figure 21 Native mulberry trees in early May[25]

Peach and Plum

Peaches and plums are called stone fruits because they have one large, very hard seed in the middle, like a stone. Both are vigorous growers that must be pruned annually to control the growth and promote appropriate fruiting.

[25] TreeFolks, Inc., *Mulberry.* 2012. Last accessed 1/11/2016. http://treefolks.org/wp-content/uploads/2012/04/IMG_1260-e1334172413405.jpg

Peach trees can put on several feet of new growth annually, and, if left unchecked, will set far more fruit than the tree can support. Unless a concerted effort is made to reduce the number of flower buds and promote a strong branching structure, peach trees will literally fall apart under their own weight within a few short years. Peach trees bloom on the previous year's growth. Therefore, the main object of pruning is to keep the tree a manageable size and reduce the number of flower buds by heading back or removing about 40-50% of the new growth each winter. Fruiting wood will be red in color, while older wood will be grey. You also need to remove any crossing branches, branches pointed downwards, towards the interior of the tree, or directly upwards, and any water sprouts and root suckers. After pruning, the tree will look radically different. Peach trees are self-pollinating and do not require another tree to set fruit. Peach trees can be expected to live about 12-15 years before succumbing to pest and disease pressures, with years 4 – 10 being the most productive. Always clean up fallen, diseased, or insect infested fruits to help control pests and disease.

Plum trees are in between peach and apple in terms of fruiting characteristics. They are vigorous growers, but set fruit mainly on short lived spurs, spurs, which form on 2 year old wood. Since the spurs only live a few years, your objective is to control the growth of the tree to maintain a good structure, while also providing for the formation of new fruiting spurs to replace those that die or are removed. Follow the same guidelines as for peaches, except reduce the new growth less aggressively, by about 25-30%. Plum trees are not self-fertile in most cases, so you will probably need two varieties. While peach trees set fruit mainly at the outside of the tree's canopy, plums will set fruit throughout the canopy on these spurs, so they can support a heavier crop. Plum trees will live about 15 years.

Figure 22 Ripe Peach[26]

Figure 23 Pecans[27]

Pecan

Pecan trees are large trees that can live a long time and may take 7-10 years to begin producing a sizeable crop, but may outlive for many decades. They should be pruned to a central leader. Pecan trees are not self-pollinating, and are wind pollinated. As long as several of your neighbors have pecan trees nearby, you should not need to worry about pollination. The biggest problem with pecans is that they are weak wooded and tend to drop limbs throughout the season, so avoid planting it where it will grow over your driveway or house. There are plenty of pests and diseases that will attack pecans, from squirrels to scab, but none is likely to be an existential threat for the home gardener. Pecan scab is a fungal disease which spreads from diseased tissues during prolonged wet spells. Remove diseased wood and keep your orchard tidy by disposing of old leaves, branches, and fruit or nut husks every year. This practice will go a long way towards reducing disease pressure for all your trees, not just the pecans. Pecans also produce a chemical in that makes it hard for other plants to grow, so avoid planting them next to your garden or other fruit trees.

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[26] TreeFolks, Inc., *Peach.* 2012. Available from TreeFolks, Inc., Austin, Texas

[27] State Symbols USA, *No image title.* No date. Last accessed 1/11/2016. http://www.statesymbolsusa.org/symbol-official-item/texas/state-tree/pecan-tree

Persimmon

The Asian persimmon is relatively uncommon in Austin, but grows very well and produces lots of delicious fruits. There are many varieties, with the most significant distinction being between astringent and non-astringent varities. Astringent persimmons cannot be eaten until they are completely soft, like pudding in a plastic baggie. Once they are completely soft, they are delicious, but must be handled carefully to avoid making a mess. Non-astringent persimmons can be eaten when they are still a bit firm, but taste better when soft. Persimmon trees are one of the easiest, most reliable fruit trees that can be grown in Austin and require little care beyond watering to get them established. Pruning is not generally needed, but they should approximate a central leader style. The fruit ripens in late fall after the tree has dropped its leaves in a glorious show of red, yellow and orange. Really, these are beautiful trees.

Figure 24 "Fuyu" Persimmons in downtown Austin[28]

Pomegranate

Pomegranates are native to the Middle East, where they grow in conditions that put Austin's summers to shame, making them among the most drought hardy fruiting trees available. Pomegranate trees naturally develop into a dense, multi trunked shrub. Traditionally, the tree is allowed to develop 3-5 main trunks with new growth being managed for fruit production. Since pomegranates fruit on new

[28] TreeFolks, Inc., *"Fuyu" Persimmons in downtown Austin.* 2012. Available from TreeFolks, Inc., Austin, Texas

new growth, the goal of pruning is to maintain an open structure for light and air circulation, as well as to keep the tree at a reasonable size for ease of harvest. Unlike most other fruit trees, however, the pomegranate *can* be left completely unpruned and still produce an acceptable harvest for many years. Pruning simply improves the fruit set and quality. Other benefits of pomegranates is that they rarely need to be watered, and do not suffer from many serious diseases or pests in central Texas. However, if the trees are heavily watered after a prolonged dry spell, spell, the fruit can split open. Pomegranates can also develop heart rot, aka black heart, which is caused by fungi that infect the flower at bloom. The disease is uncommon, but there is no cure and you can't tell which fruits have it until you open them up. Throw the diseased fruit away rather than on the ground to help control the spread.

Figure 25 Pomegranates[29]

Jujube

Jujube trees are really uncommon in Austin, but grow incredibly well here. They are native to south Asia and the Middle East, as so many of our agricultural crops are. Similar to pomegranates, they thrive in hot, dry climates. The fruit is somewhat drier than an apple, but similar in texture. When they are ripe, jujube fruit turns brownish red and is very sweet. Each fruit has a single seed in the

[29] TreeFolks, Inc., *Pomegranate.* 2015. Available from TreeFolks, Inc., Austin, Texas

middle. The fruits can be eaten fresh or dried; some people say they taste like dates. Jujubes are hard to find in the nursery, but if you have space, they make an interesting addition and conversation piece.

Figure 26 Jujube fruits in late summer[30]

Pests and Diseases

Cultivated fruit trees can be very attractive to insects, birds, and other animals, for much the same reason that people like them – they taste good! In managing the orchard, we should have a strategy for dealing with this competition. There are at least four approaches to handling competition from pests and diseases. They are: avoidance, acceptance, exclusion, and extermination.

Plant Disease Triangle

Plant diseases only occur when there is an overlap of a host, a pathogen, and the right environmental conditions, also known as the plant disease triangle. If you you remove any one of those three things, you will not have disease. The easiest to to control of the three is the host. By selecting trees that do not suffer from the kinds of diseases that are common in our region, those diseases are avoided. Of

[30] TreeFolks, Inc., Jujube. 2016. Available from TreeFolks, Inc., Austin, Texas

course, this approach only works to a point, because we *want* to have apples and pecans, and every other kind of delicious fruit.

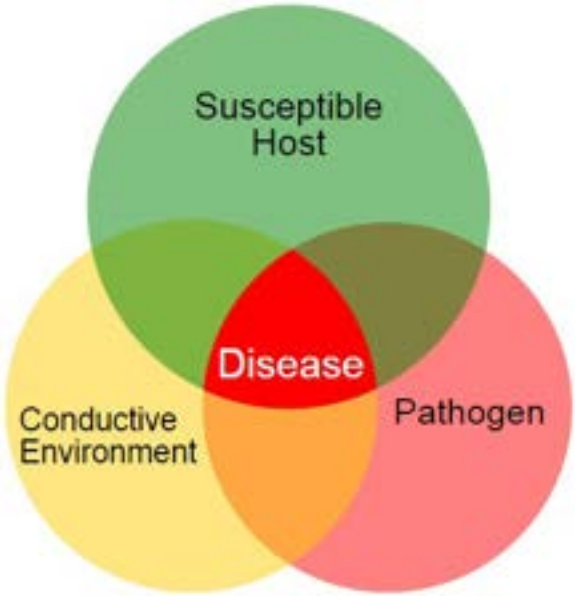

Figure 27 Plant Disease Triangle[31]

Another way to avoid disease is by modifying the environment. Proper pruning and cleanup will go a long way towards shifting the conditions to be less conducive to disease. Remember, sunlight and breeze are some of the best medicine for your fruit trees. You want an open, airy and bright tree canopy because wet conditions are perfect for the spread of bacterial and fungal disease. Likewise, dark, wet leaves on the tree or soil surface can provide a good environment for breeding diseases and harmful bugs, and the debris can even harbor their spores and eggs. Some people have found shallow tillage of the soil surface to a depth of 2-3 inches on nights where the temperature drops below freezing can help kill the larval or dormant instars (life stage) of some pests by freezing them.

Thirdly, acceptance of the pests allows us to grow a wide variety of fruit trees, even in the presence of pest pressures. If we can change our expectations of

[31] Johannes Roessel, Plant Disease Triangle. 2008. Last accessed 1/11/2016. https://commons.wikimedia.org/wiki/File:Plant_Disease_Triangle.svg

of how much yield to expect, how many spots or worms the fruit is allowed to have, or whether the birds have taken a bite out of the fruit, then it is possible to grow perfectly edible and delicious fruit without exerting a great deal of effort towards pest control. We will have other work to do, for example trimming off the the bad parts of the fruit, but that can be done while sitting at the kitchen table rather than on a ladder with a spray rig.

After selecting disease resistant trees and accepting a certain degree of loss, we can begin searching for ways to exclude the pests and diseases. This is where most of the labor is, and where organic approaches have the most effect. Excluding vertebrate pests (birds, squirrels, & humans) is best done with netting. Put a plastic bird net over your tree as the fruits are nearing ripeness or when you notice unacceptable levels of damage. Leave it on until the fruit is ripe, and remove it when you harvest.

Insect pests can be excluded by a number of things. Cloth bags over each fruit can be somewhat effective, as long as you get the bag over the fruit before the eggs are laid. Micro-pulverized kaolin clay, sold under the brand name Surround™, makes the surface of developing fruit inhospitable to pests, but it must be applied several layers thick and reapplied after every rain event. Some people find plantings of strongly smelling plants such as leeks and herbs help deter or confuse insects.

Preserving or creating habitat for beneficial organisms is another important way to control pests in the orchard. Wildflowers and native perennials offer food and shelter for pollinators and predatory insects, which are important members of the garden ecosystem. There are many publications about how to create wildlife habitat in your garden, as well as classes offered throughout the city by various people and entities.

If we have done everything we can to avoid, accept, and exclude pests, there are still some Earth friendly options for exterminating them. Dormant oil sprayed on the branches and leaves smothers scale insects, aphids, and some insect eggs. Biorational pest control products, including microbial inoculants and biopesticides

such as *Bacillus thuringiensis* or *Bacillus subtilis*, as well as beneficial organisms like parasitic nematodes and ladybugs, offer a way to kill pests and disease causing organisms with minimal environmental or human health risks. Nevertheless, creating and caring for habitat to support beneficial insects is more effective and more sustainable over the long run than purchasing beneficial insects.

Before undertaking *any* pesticide applications, it is of the *utmost importance* that you correctly identify the pest that you are trying to control, verify that the product or procedure you are contemplating will in fact be effective in dealing with the pest, and make sure it will not harm other organisms. Pest populations are also highly adaptive, and can develop resistance to almost any product if it is used repeatedly over long periods of time.

It is important to remember that any pesticide product must be used in accordance with its label, and with careful contemplation of the unintended effects its use may have on other people and organisms. Do not apply pesticides of any kind if you are unsure what pest you are dealing with, if the product is missing its original label, or on windy or rainy days.

References

List of Figures

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List of Tables

Additional Resources

California Rare Fruit Growers – http://www.crfg.org/

Grow Organic Apples - http://www.groworganicapples.com/

The Natural Gardener – http://www.naturalgardeneraustin.com/

Orchard Equipment & Supply - www.oescoinc.com

Peaceful Valley Farm Supply - http://www.groworganic.com/

Sustainable Food Center - http://sustainablefoodcenter.org/

Texas Organic Farmers and Gardeners Association - http://www.tofga.org/

Texas A&M University Extension - http://agrilifeextension.tamu.edu/