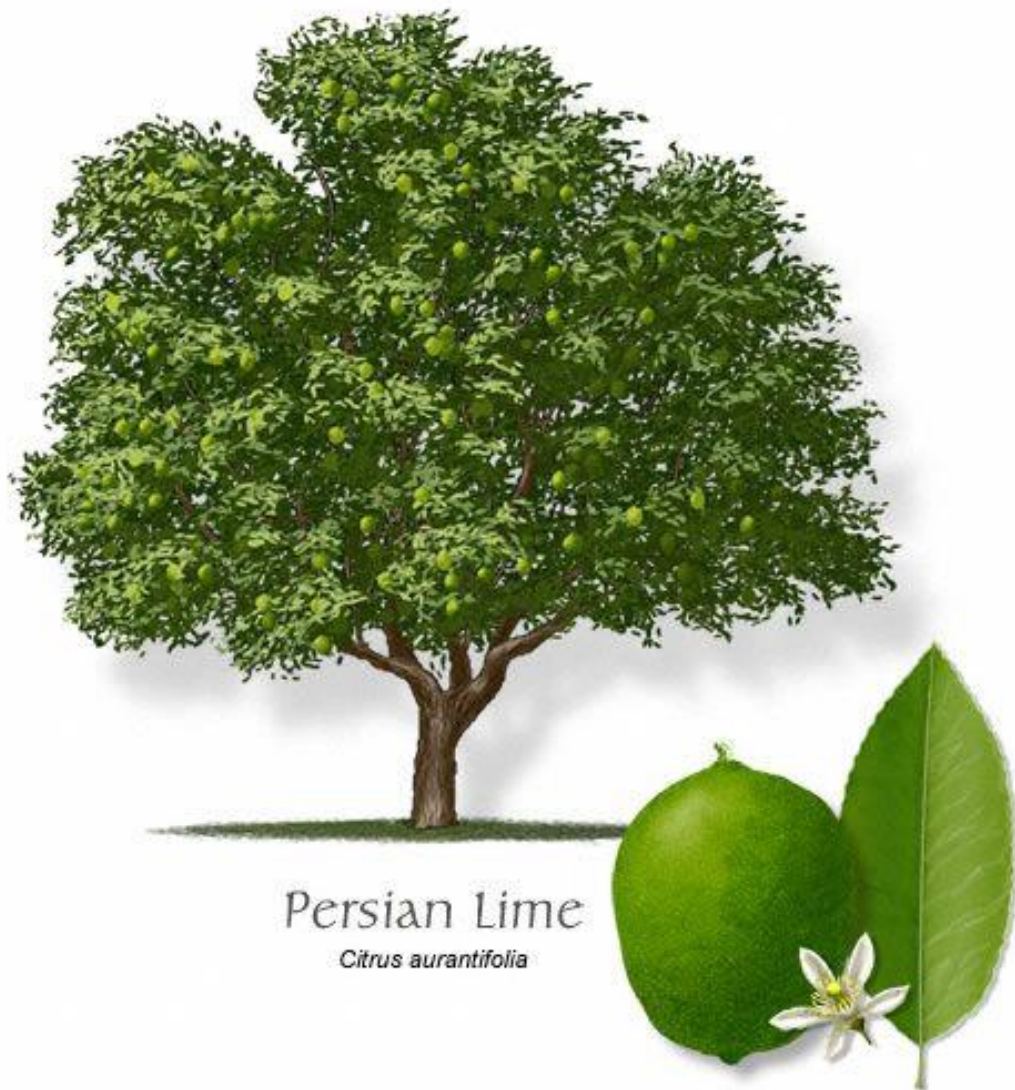


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Agricultural Science

Persian Lime
(*Citrus x latifolia*)



Persian Lime
Citrus aurantifolia

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Introduction

This monograph is based on the Persian Lime which is a very common tree from the citrus family. This lime is a hybrid that comes from the key lime and lemons, and it's a very easy plant to grow in the require conditions. This is a Lime that is used all over the world, and the main exporter export enormous quantities to huge consumers like the US and other world powers. Its origins come from the Middle East, mainly from Iraq and Iran but was later develop in America and now the market is all over the world. It has an average half meter growth rate per year and 8 to 10 years to achieved their full growth. The propagation and colonization of the Persian Lime is very easy because all the insects, that from the characteristic and abundant white flowers of the tree take the pollen and the seeds and help this Lime tree spread. The Persian Lime is used in different recipes because of his representative sour and because it provides and helps in the absorptions of minerals, between other positives aspects of the Persian Lime in a meal. This Lime also have some medical uses between reduction of obesity to helping diabetes.

1. Ecology

1.1 Distributional Context

1.1.1 Affinities

The *Citrus x latifolia* or Persian lime is a tree of the citrus family that produce the most common type of lime. The Persian lime is of hybrid origin. It is the result from a cross between key lime (*Citrus aurantiifolia*) with lemon (*Citrus × limon*). *Citrus x latifolia* is typically a medium-sized tree, 4.5 to 6.0 m tall, with wide-spreading branches. Is often thorn or nearly so, the flowers are white and have no pollen. The fruit is oval that is 4 to 6.25 cm wide and 5 to 7.25 cm.

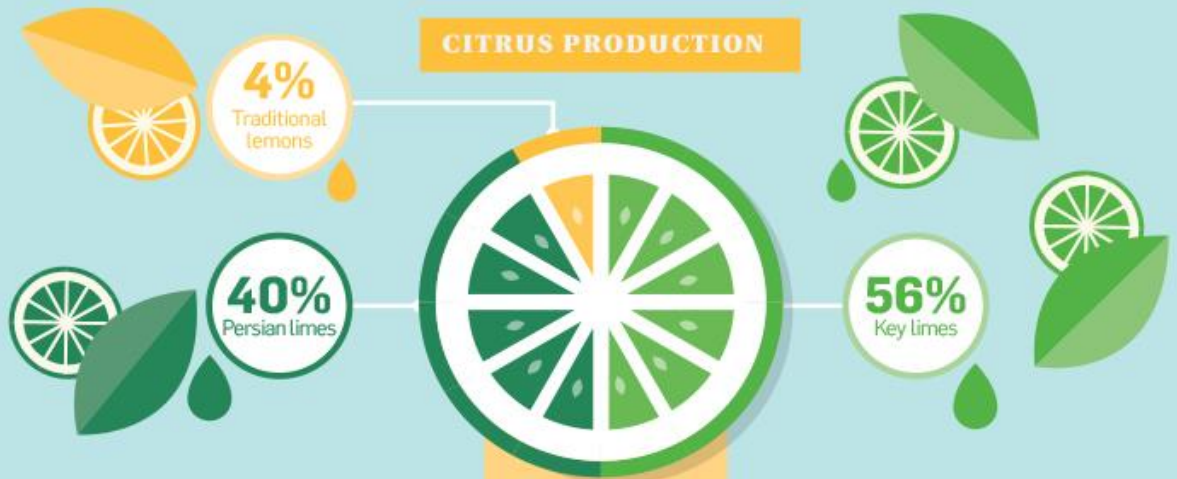
1.1.2 Origin and Distribution

Citrus x latifolia were first grown in southern Iraq and Iran, although other varieties were developed in the U.S. and Florida. Persian lime rose to prominence after southern Florida's key lime orchards were destroyed by a hurricane in 1926. Mexico is now the main grower and exporter of Persian limes for the American, European and Asian markets. Mexico is the larger producer with a total of 1.9 million tons of limes in 2011. And they mainly distribute to 5 countries that are the largest importers of lime oil this are the US, Uk, Japan, Belgium and Ireland. But in recent years Persian lime industry has taken off in Veracruz, dominated by large-scale producers, with over 25% of limes being produced using micro-jet irrigation or other irrigation systems, year-round in micro-climates.

CITRUS FRUITS



CITRUS PRODUCTION



80% of Key limes cultivated in Colima, Michoacán, and Oaxaca

61% of Persian limes and lemons cultivated in Veracruz



45% of Persian lime exports go to just 20 countries

25% total output exported

ANNUAL PRODUCTION
2
BILLION TONS

8.7% annual increase for Persian limes from 2007 to 2012

Persian limes cultivated on **82,900** hectares produced 1 billion tons in 2013



INCOME FROM EXPORTS
\$327
MILLION

75% consumed locally

90% of limes imported to the US come from Mexico

1.1 Persian Lime Top Producer

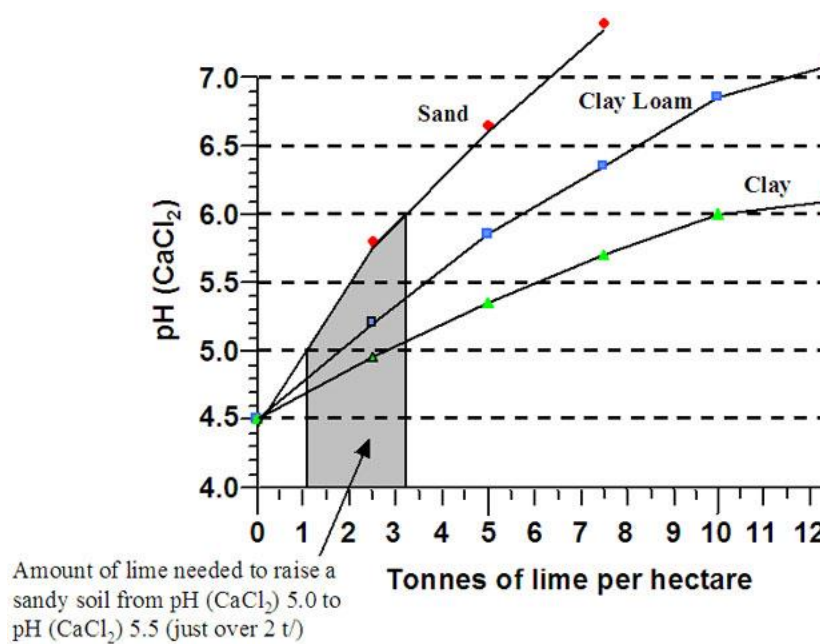
1.2 Environmental Factors in distribution

1.1.1 Elevation and Climate

Persian limes require a semi to tropical climate. *Citrus x latifolia* trees do not require pollination to set fruit. To grow the *Citrus x latifolia* it is needed a cold temperature but the damage of the plant begins at -3 C and if it goes below -4 C it will die. The *Citrus x latifolia* can grow in tropic temperatures, from about 18 C and 20 C, and in altitudes of about 2250 meters.

1.1.2 Geology and Soils

The *Citrus x latifolia* as the majority of the limes grow best in a soil with pH from 6.0 to 7.5. Its recommended to make the soil tested so the pH is correct and also because it can provide nutrients. The sandy loam soil is the one that is used the most, but the clay loam soil is also a good option to it. According to University of California Marin County Master Gardeners, a good rule is to add organic material equal to no more than 25 percent of the planned depth of the planting area. The Persian Lime grow very good in Yucatan Peninsula which is composed of carbonate and soluble rocks.



1.2 Soil Needed in Persian Limes

2. Biology

2.2 Life Cycle and Phenology

2.2.1 Life Cycle

The cycle of life of the Persian Lime begins when the seed is planted; the seed contains the genetic material in the embryo. When conditions are right the seed will germinate, and begin growing. Later the seed will begin growing a root system that will absorb all the nutrients and the water of the soil, then the leaves will start growing and they will start the process of photosynthesis that will produce energy, with this the plant will begin growing. 3-5 years later it reaches maturity and they are ready to reproduce. The flowers grow and it contains the pollen that is used by the pollinators to carry the pollen to other flowers' ovules. Once this happens the ovules grow into seeds and the ovary takes the shape of a seed pod: In this case, this is a slightly oval fruit with divided sections filled with cells that contain the characteristic flavor of the lime. When the fruit is consumed either by humans or animals the seeds fall into the soil, restarting the life cycle.

2.2.2 Phenology

Lime trees grow at a rate of 13 to 24 inches each year from the seedling stage. Seedling trees begin at 3 to 6 years and reach full production in 8 to 10 years. Fruit is harvested during two periods each year, May–June and November–December. The ideal time to harvest limes is when their color changes from dark to light green and the surface skin is soft.

2.3 Reproductive Biology

2.3.1 Pollen

The Persian Lime tree has flowers that contain both the male and female organs of the plant; the male part produce pollen and the female part has the stigma or ovary. The pollen produce is transfer usually by insects or birds to a stigma and like this it will fertilize the ovules inside.



1.3 Persian Lime Flower

2.3.2 Pollination and Potential Pollinators

The Persian limes are not self-pollinating; this means than they need someone or something to help them pollinize. Female parts of the flowers in the Persian Lime tree need male pollen so they can produce fruit. Lime trees are self-fruitful; this means their flowers contain both male and female parts, so they provide their own pollen.

Some of the pollinators are:

- Bees
- Wasps
- Some Flies
- Moths
- Beetles



1.1 Bee Pollinizing

2.3.3 Fruit Development

The Persian Lime tree reaches start flowering and then it begins to produce the lime. Once the tree's white flowers have appeared, fruit will be ready for picking in 90 to 120 days. Persian limes can be picked when they have a diameter of 1 3/4 inches, when the fruit has a dark green. Fruits that have not matured completely not have enough juice. Once the limes picked up, they will stay fresh in a refrigerator for about 10 days.

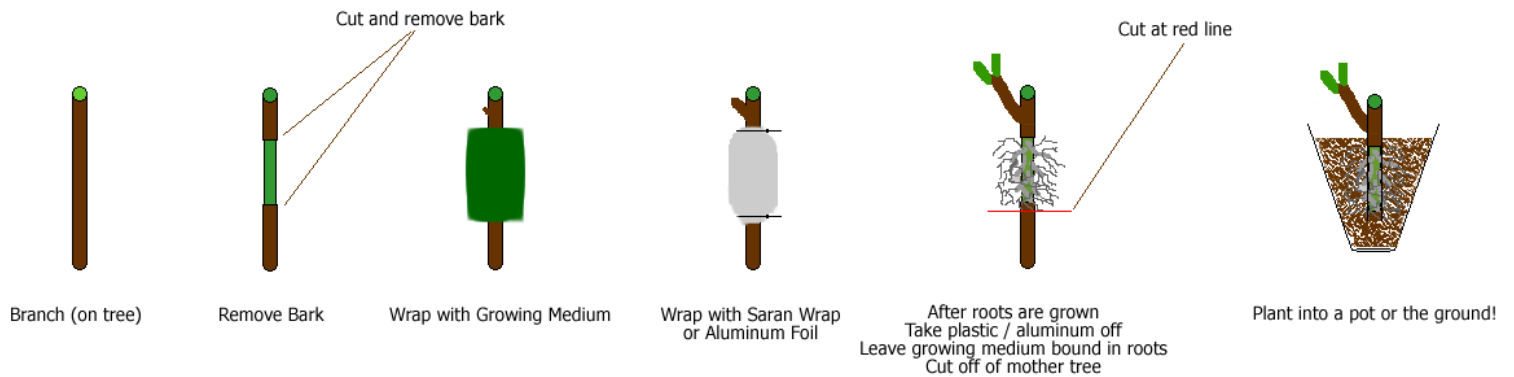
3. Propagation and Management

3.1 Nursery Propagation

3.1.1 Propagation from seed

The propagation of the Persian Lime by seed is a very reliable process because according to SFGATE one seed can produce the growing of multiple trees that are almost identical to the tree that produced the seed (father tree). The seeds don't need a special care like other fruits does, and they can be plant in every month of the year if there are plant in the indoor. 5 years later of growing will produce a totally grown tree that will produce the fruit. Other propagation method according to the same source is the "Air Layering" that consist of a type of clonation of the same tree. A stem of a tree is treated and rooted before cut it from the tree, later this stem is planted and in a certain time (Usually weeks or months) it began to grow roots and the tree start producing limes with only one growing season.

Air Layering Propagation Method



WhenToPlant.Com CC Share License

(Air Layering – Garden of Tomorrow)

3.1.1.2 Storage

The storage of a seed of the Persian lime is a very important process if the seed want to be preserved for a very long time. The most efficient way to storage a seed is to place it in a cool, dry environment; this way it will preserve better than in a wet, warm environment. Seeds are dried to optimum moisture content, evaluated for quality sealed in moisture-proof containers.

3.1.2 Vegetative Propagation

3.2.2.1 Grafting

They are different types of grafting like *The whip graft, The cleft graft, The modified cleft graft, The side graft, Budding* between others. For the Persian Lime tree the most effective way to graft a tree is to use *Budding*, this method is when an scion is cut from a healthy tree and then place it in cut from the bark where the green part of the tree is exposed. This way the fruit propagation will be quicker because another branch is created.

3.2.2.2 Cuttings

Cuttings is a simple method of propagation. The process is easy; Cut a 10-inch-long branch with leaves at a 45-degree angle. Remove leaves in the bottom 2 or 3 inches. Wound wood cuttings in the bottom of the branch, 1 to 2 inches by making vertical cuts in both sides. Wounding makes more hormone of the rooting and let water absorb into the cutting while increasing cell division. Then our more or less 1 teaspoon of rooting hormone in a clean saucer and dip the branch in it. Then plant it into a hole in a pot with soil, mix well the soil. 1 year later, plant the tree into the ground.

3.2 Planting

The easier and more efficient way of planting a Persian Lime from the seed is directly planted into a pot or a bag with soil in it. Before this the seed have be wash and well dry (let dry for a couple of days). The seed need $\frac{1}{4}$ to $\frac{1}{2}$ inch deep in the container with a loamy, well-drained soil. It grows better in rocky, alkaline soils but responds well to sandy soil also. Then keep the soil moist and place it in a sunny spot; germination occurs when a couple of weeks passed by, when seedling achieved at least 6 inches' tall place it on an individual pot. Winter protection is essential because Persian limes are very cold sensible.

4. EMERGING PRODUCTS, POTENTIAL MARKETS

4.1 FLAVOUR IN PERSIAN LIME

The flavor of the Persian Lime is very acid citrus fruit, but the Persian lime is very acid more than lemons. According to (Diffen, 2011) lime has more calcium, Vitamin A and phosphorus than lemon and the taste is defined as bitter/sweet/sour. But have some similarities, because they have the same family and come from the same kingdom. Figure 5.1 shows how the lime has a huge difference between the citric acid and the sugar and how in comparison with Orange, Grapefruit and Lemon it a lot acidic than the others.

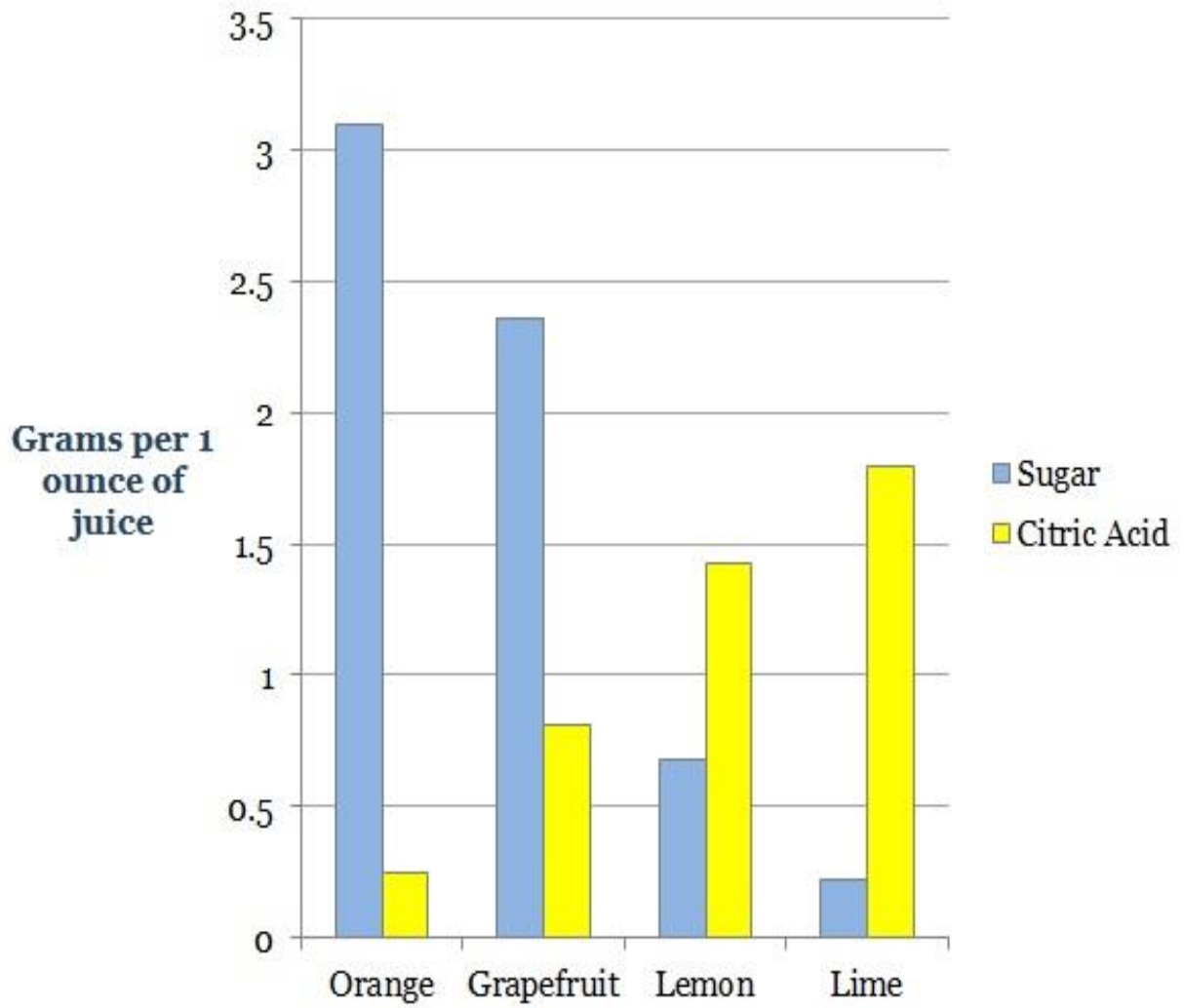


Figure 5.1 Acid Vs. Sugar (Serious Eats.)

4.2 FOOD RELATED WITH PERSIAN LIME

The Persian lime is used in different recipes because it has a characteristic taste. The most recognized dishes are for example different types of curries and is also vital in margaritas. The use of lime in dishes is very common and they exist all types of recipes from all types of societies that they use the lime as an essential ingredient. According (Baker, 2017), from sunset “A squeeze of lime juice is vital to many classic dishes” ... “We've flavored dishes for every course of the meal with this exquisitely mouth-puckering citrus” This demonstrates how lime is recognized all over the world by its famous flavor and its impact in different types of dishes.

4.3 Market

The major producer of Persian Lime is Veracruz, Mexico. But in the latest years the production of it has been compromised because of different factors that have affect not only the quantity of production but also the quality of it. The factors that mainly affected Lime production were the dry weather seasons and also the heavy rainfall from hurricanes that Veracruz went through in 2010 (The Packer, 2011). They are slowly recovering from this disaster of year they went through. The market of Persian Lime according to *The Packer, 2011* “The Persian lime industry tends to be dominated by large producers who have achieved economies of scale. Rain-fed Persian lime production costs average between 11,000 pesos/ha to 18,000 pesos/ha (U.S. \$873.00 to \$1,428.57/ha). Well-tended areas can have production costs as high as 28,000 pesos/ha or more (U.S. \$2,222.25/ha) in Veracruz.” This shows how expensive is the production of this citrus, but it also means that if it is worth it to invest that quantity because the income is huge.

4.4 Medical Uses

The US Department of Agriculture (give date of the reference here) researches shows that 44 grams of lime juice has 11 calories, 4 grams of carbohydrates and 22% of the recommended amount of Vitamin C needed daily; this shows have limes can be an important ingredient that will not only give a tasty flavor to every food, but also will help your body. According to Megan Ware (*MedicalNewsToday*, 2016) “Many studies have suggested that increasing consumption of plant foods like limes decreases the risk of obesity, diabetes, heart disease and overall mortality while promoting a healthy complexion and hair, increased energy and overall lower weight.” Because of this we can know that consuming limes brings nothing but positives aspects for a lifestyle.

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