



Horticulture in Pecan IPM



Pecan IPM Toolbox

Introduction

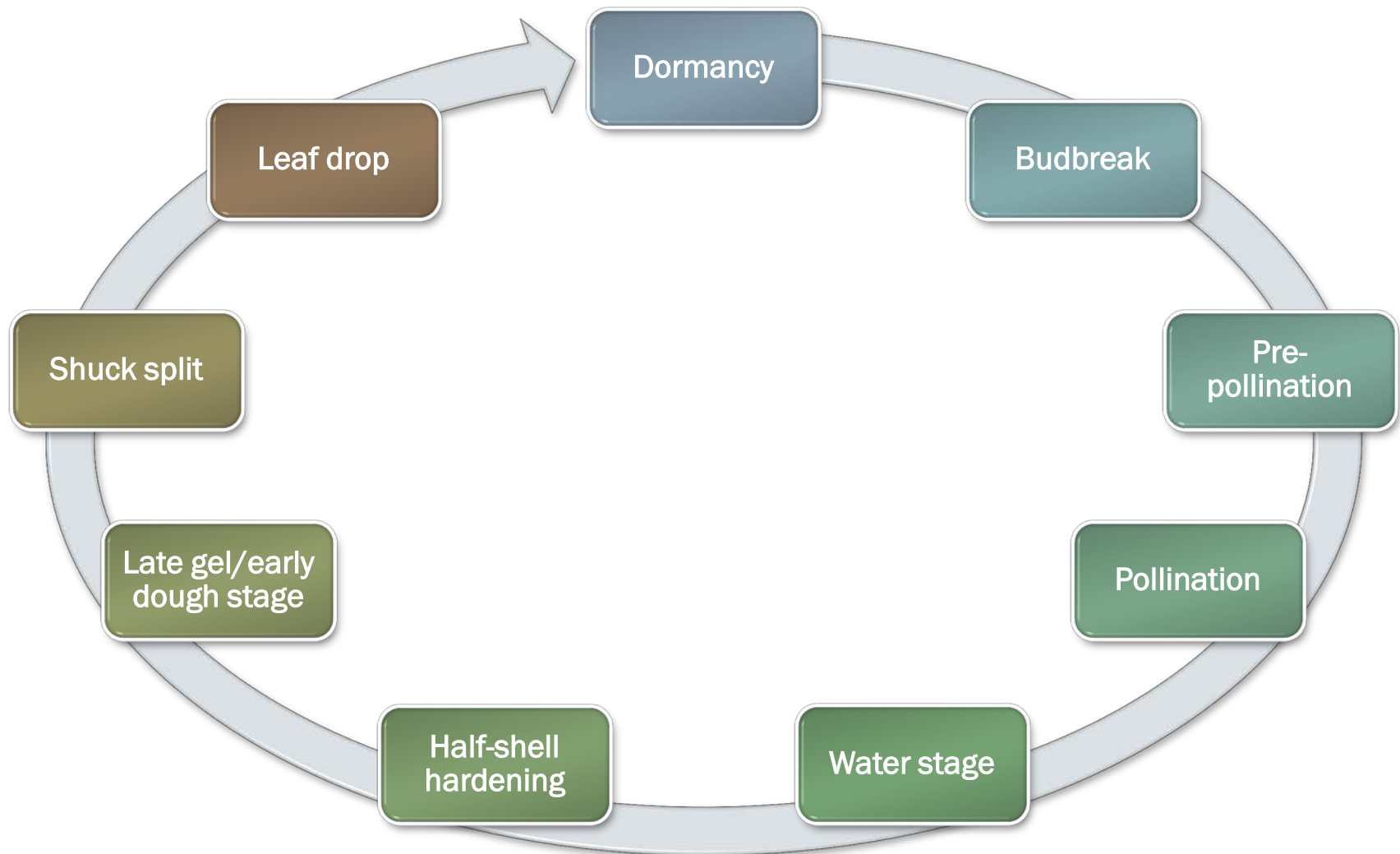
Horticulture in IPM



- ☞ Insect and disease control are both closely tied to the development of the plant. Control of scale, phylloxera, leaf tatterers and defoliators, first generation pecan nut casebearer, hickory shuckworm, pecan weevil, stem end blight and pecan scab can be keyed to various plant development stages.
- ☞ Although various pests are present during the whole year, each pest has a specific time frame during which it can cause economic damage.
- ☞ Weather conditions, the biology of the pest and the susceptible plant stage all combine to establish a favorable time at which economic damage can occur. These time frames are called "damage windows." As the biology of the pest reaches its damaging stage and the plant reaches a stage vulnerable to attack, the pest can cause economic damage.
- ☞ An economic threshold anticipates the pest level at which controls should be applied to prevent damage beyond the cost of control. By observing the plant stage, the grower can anticipate when a given pest may cause damage. As the damage window approaches, pest densities can be monitored and controls applied.

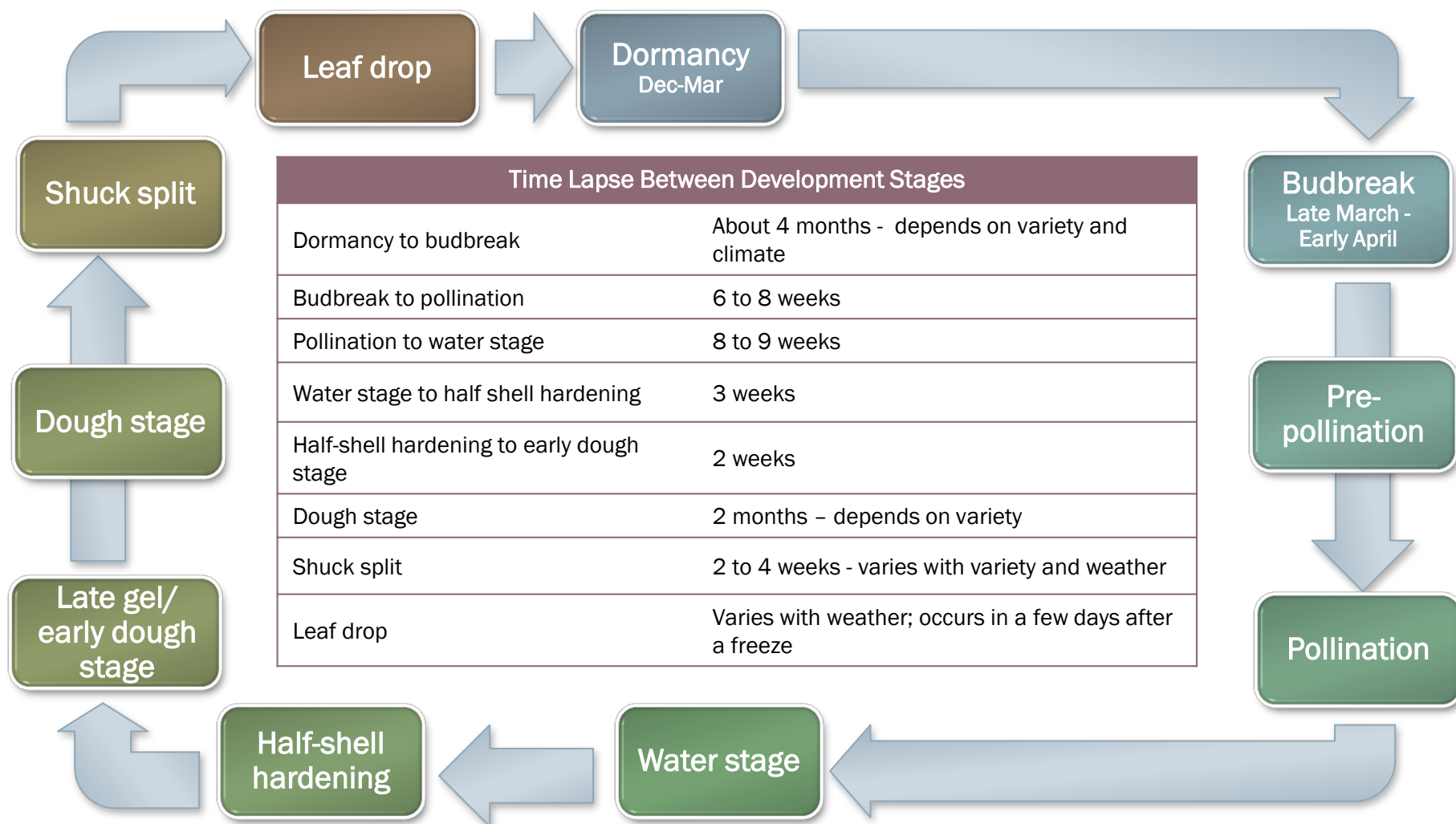
Pecan Development Stages

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Pecan Development Stages

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Pecan Development Stages

Horticulture in IPM



Stage, Timing and Activity

Dormancy	December – March	Period between leaf drop and bud swell
Bud break	Late March, early April	Leaf primordia emerges 1-inch from subtending shoot
Pre-pollination	April – May	Leaf expansion phase
Pollination	Mid-May to early June	Stigmas of pistillate flowers turn from green to red / brown
Water stage	Mid-July to early August	Water begins to fill the kernel cavities
Half-shell hardening	August	Shell hardened halfway down shuck; nut has reached full-size
Late gel / early dough	August to September	Gel layer has reached 3/4 of the way to base; dough layer (kernel) begins to form at distal end of the nut
Shuck split	Late September to October/November	Sutures of shucks begin to split apart; harvest can begin
Leaf drop	October to December	Leaves begin to dehisce as trees prepare for dormancy

Pecan Nutrition: Leaf Sampling

Horticulture in IPM



Adapted from an article by the LSU AgCenter,
Pecan Research-Extension Station



Photo courtesy of Noble Foundation

Pecan Leaf Sampling

Foliar analysis provides assessment of tree health. A leaf sample is best for determining the amount of essential minerals being absorbed from the soil or foliar treatments. Nitrogen, potassium, zinc and other nutrient deficiencies can be identified from leaf samples.

Soil sampling is still recommended, however, to determine soil texture, certain mineral levels or imbalances, soil pH and any toxic mineral levels, and/or to determine fertility needs in new plantings.

Pecan Nutrition: Leaf Sampling

Horticulture in IPM



Pecan Leaf Sampling

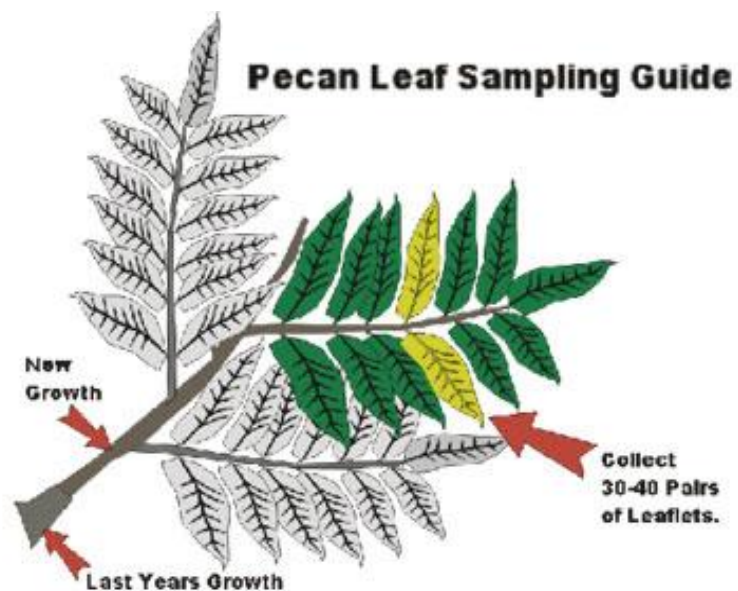
When to sample?

Pecan leaf analysis should be made in **July**.

How?

Collect the middle pair of leaflets from the middle leaf of the current season's growth. Take samples from shoots that have terminated their growth for the season and have fully expanded leaves. Continue this procedure until 40 pairs of leaflets have been collected from at least 10 trees. This constitutes one sample.

See figure at left.

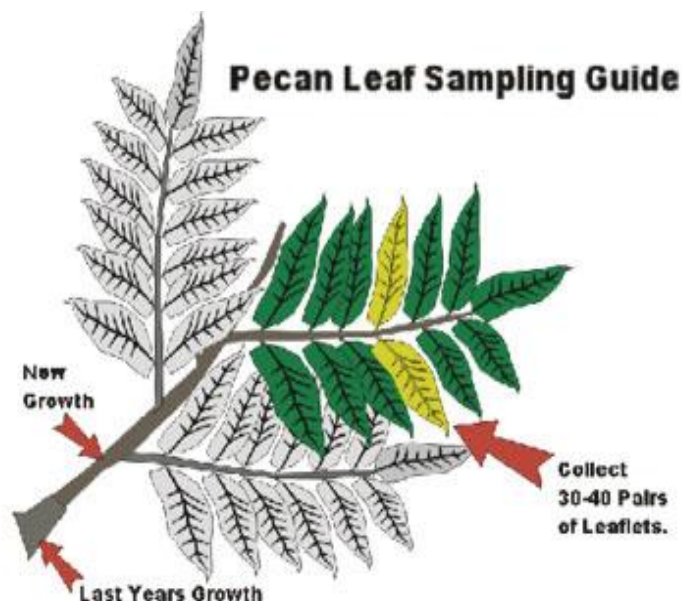


Pecan Nutrition: Leaf Sampling

Horticulture in IPM



Pecan Leaf Sampling – cont'd



Select shoots in the sun and near the ends of branches, not small branches arising from large limbs nor shaded branches near the center of the tree. Collect from all sides of the trees. Avoid taking leaflets damaged by insects or diseases or those that are otherwise contaminated.

Leaflets in one sample should all be from one variety, but this is not essential. Avoid damaged or dirty leaves. Keep samples from young, non-bearing trees labeled separately from samples of older, bearing trees.

[Get the printable version of the sampling instructions.](#)

Pecan Nutrition: Leaf Sampling

Horticulture in IPM



Pecan Leaf Sampling – cont'd

Sample preparation for shipment:

Contact the laboratories listed on the right side of this page to confirm how to prepare the samples and to determine the current fees for this service. Some laboratories accept clean fresh green leaves and others may require leaves to be dried before shipping.

The nutrients normally analyzed are:

nitrogen, phosphorus, potassium, magnesium, calcium, sulfur, zinc, iron, manganese, boron, copper and molybdenum. Local state university laboratories performing pecan leaf analyses include (see table at right):

Pecan Leaf Sampling Laboratories

[Plant Analysis Laboratory](#)

LSU Department of Agronomy
126 MB SturgisHall
BatonRouge, LA 70803-2111
(225) 578-1219

Agriculture Chemistry Laboratory
Agricultural Chemistry Building, Room 102
LSU
Highland Rd.
Baton Rouge, LA 70803
(225) 342-5812
(Indicate "Pecan Plant Tissue Group" on sample)

[MSU Soil Testing & Plant Analysis Laboratory](#)

Box 9610
Mississippi State, MS 39762
(662) 325-3313

[Soil, Water and Forage Testing Laboratory](#)

Texas AgriLife Extension
2474 TAMU
College Station, TX 77843-2474
(979) 845-4816

[Noble Foundation](#)

Attn: Agricultural Testing Services
2510 Sam Noble Parkway
Ardmore, OK 73401
(580)223-5810

Pecan Nutrition: Leaf Sampling

Horticulture in IPM



Pecan Leaf Sampling – cont'd

Samples can be sent directly to the laboratory and the results of the nutrient analysis will be returned directly to the grower with an adequate, deficient or excessive rating given to each nutrient.

If you have questions on the results, contact your county agent or pecan horticulturist. This information will help you plan your fertilization program to remedy or avoid nutrient deficiencies developing in your orchard. Over-fertilization can also be avoided when excessive amounts of nutrients are detected.

Pecan Leaf Sampling Laboratories

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Pecan Nutrition: Zinc

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Zinc Makes Big Leaves

- œ Beautiful pecan trees and regular harvests of high quality pecans begin each spring with frequent zinc sprays.
- œ Good foliage is the secret to optimum growth, healthy trees and regular production.
- œ Mature pecan trees can have double the amount of foliage with three or four zinc sprays in April and May.
- œ Leaves on mature trees are fully grown by June, so spray early and frequently.
- œ Young pecan trees can grow six feet instead of six inches in one year if zinc is sprayed onto the foliage every two to three weeks from April until August.
- œ This is, of course, in combination with a good management program.

Pecan Nutrition: Zinc

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Zinc Sulfate

- ⌘ Commercial pecan producers have used for over 40 years with good results
- ⌘ Use caution. Zinc sulfate can kill many types of plants. Spray only on foliage.
- ⌘ Commercial application for pecan foliage in Texas: 2 pounds of zinc sulfate per 100 gallons of water
- ⌘ Homeowner application: 2 teaspoons of zinc sulfate per 1 gallon of water

NZN

- ⌘ Highly soluble liquid
- ⌘ Less toxic to other vegetation and readily available at many garden centers.
- ⌘ Developed by Dr. J. Benton Storey of the Texas Agricultural Experiment Station
- ⌘ Commercial application: 1-1/4 quarts per 100 gallons of water
- ⌘ Homeowner application: 2 teaspoons of zinc sulfate per 1 gallon of water

Other Forms of Zinc

Other forms of zinc, such as zinc chelates or tree injectors have been tested, but have not been found to be an effective source of zinc for pecans in Texas.

Pecan Nutrition: Zinc

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Wavy leaf margins and interveinal chlorosis of pecan rosette. Photo courtesy of [University of Georgia CAES](#).

Zinc Rosette

Zinc is utilized by pecan foliage for the manufacture of a growth hormone called indole-acetic-acid. Without zinc and indole-acetic-acid pecan growth is greatly reduced. The leaves will be small and the shoots will be short and in clusters, forming what is commonly called "zinc rosette." Zinc is not readily translocated from shoot to shoot; consequently, frequent zinc sprays are needed if new growth is to receive zinc. This is also why good coverage is important. Since aerial application does not give complete tree coverage, commercial growers have to depend on ground sprayers for zinc applications.



Soil pH Is Important for Zinc Absorption

Most pecan trees in the southwestern U.S. grow in alkaline soils. Improved pecans absorb little or no zinc from alkaline soils. The abundant zinc in the soil is not soluble in soil water and, therefore, not available to the tree.

Native pecans appear to partially satisfy zinc needs from leaf litter and natural flora on undisturbed soils. Soil applications of zinc are of no significant value to pecan trees in alkaline soils in the western United States. Foliar applications of zinc allow uptake to occur via young leaves. Pecan trees growing in acid soils, as in the southeastern U.S., may require less or even no zinc amendments.



Effects of Relative Humidity on Zinc Absorption

- ∞ Relative humidity has a great effect on foliar absorption of zinc
- ∞ The wet young leaf absorbs zinc from the zinc-laden spray droplet.
- ∞ Leaves dry quickly in the low humidity of far west Texas; absorption ceases when the spray dries.
- ∞ Along the Gulf Coast, absorption can be extended as drying takes longer.
- ∞ Zinc should not be concentrated to 2X or 4X rates because foliage burn can result during periods of high humidity.
- ∞ The use of spreaders is not recommended because they can cause accelerated drying and reduced zinc absorption.



Shoot Growth and Leaf Analysis

A pecan grower can determine if zinc sprays are effective by observing the amount of terminal growth the trees make during the year.

- ⌘ Mature trees should make 5 to 10 inches of shoot growth each year.
- ⌘ Non-bearing trees should make 24 inches of shoot growth each year.
- ⌘ In addition, leaves collected in July can be analyzed in a chemical laboratory to determine the concentration of zinc in the leaves.
- ⌘ A level of 75 ppm is considered a minimum and 125 ppm is optimum.
- ⌘ It is very important to have the leaves washed before analysis to prevent measuring the zinc that may remain on the surface of the leaf.

[Download](#) instructions for Pecan Leaf Sample Collection for Nutritional Analysis. [PDF]

Pecan Nutrition: Zinc

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Zinc Alone Is Not Enough

Zinc alone is not the answer to perfect pecans. It is, however, a very important cultural requirement. With good zinc management, other cultural practices such as fertilization and irrigation will be more effective. However, fertilization or irrigation without zinc sprays is of little value. So, zinc sprays are one of the pecan grower's most important steps to success each year.

Pecan Nutrition: Nitrogen

Horticulture in IPM



Nitrogen for Pecan Trees

Like zinc, nitrogen alone is not enough. Successful pecan culture depends on good nitrogen management in combination with soil, water, zinc and weed management. Any one treatment alone will not foster good tree growth or regular production.

Regular Bearing

Pecan trees store a large percentage of the food they manufacture each year. As this stored food accumulates, the tree can then begin to bear relatively regular crops. Nitrogen needs to be applied every year, not just when a deficiency is seen.

Unmanaged trees will require at least three years of nitrogen fertilization before good results are obtained. Orchards on poorly drained soil may require a longer period.

Nitrogen Only

Scientists in Texas have not been able to show a significant advantage in using complete fertilizers, such as 12-12-12. Simply use nitrogen fertilizer, such as 21-0-0 or 33-0-0. The cost per unit of nitrogen is less in these formulations.

Pecan Nutrition: Nitrogen

Horticulture in IPM



Nitrogen Application Amounts

Pecan orchards that have been out of production should be examined for spacing, soil drainage and overall nutrient condition, including soil and, especially, leaf analysis (in July). Most likely, they will need nitrogen amendments (see table below).

Often split applications in early and late spring achieve the best uptake. Some producers also apply a "booster" application of ~20 units of N at the initiation of the water stage in years of high production in the belief this can aid in nut filling. This is still under scientific investigation to determine if benefits outweigh costs.

Standard Rates of Nitrogen for Bearing Pecan Orchards

Natives	60 units N per acre
Bottomland orchards	90 units N per acre
Upland orchards	100 units N per acre



When to Apply Nitrogen

- ∞ Initial nitrogen fertilizer application should be applied at bud swell, immediately before pecan tree growth begins.
- ∞ If a split application is made, one-half of the rates from the [previous table](#) is initially applied and the other half applied 7 to 9 weeks later.

Split applications are made to reduce nitrogen loss due to leaching, volatilization¹, etc. before the trees can utilize it. Soil type, weather conditions, type of fertilizer used, etc. affect this and local expertise (and regular leaf analyses) should be consulted to ensure maximum benefits are being realized. Note that over-fertilization can result in excessive vegetative growth and increase susceptibility to aphids and other pests.

¹ Volatilization = invisible process that occurs when a solid or a liquid form of a material is transformed into a gas; evaporation

Pecan Nutrition: Nitrogen

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Nitrogen and Weeds

Grass and weeds can consume a large volume of the nitrogen applied to pecan orchards. To prevent this loss, disk the fertilizer into the soil, to a 1-2 inch depth, immediately after application. A second disking is usually needed 1 month later. Disking also helps prevent volatilization loss of nitrogen.

Shoot Growth and Nitrogen

The best index for determining nitrogen, zinc, soil, weed control and water needs is terminal growth of non-bearing shoots. If all other management practices are in order, low nitrogen can seriously limit shoot growth. All non-bearing shoots on mature trees (over 12 years of age) should be more than 4 inches, but less than 12 inches. If growth is less, add more nitrogen. If growth is more, cut back.

Pecan Nutrition: Water

Horticulture in IPM



Water Management for Pecan Trees

All pecan orchards in Texas can respond positively to irrigation. In general, pecans on very good soil can bear with only 32 inches of rainfall from April to October. However, more water can enhance tree health and regular production.

How Much Water

- 1 inch of water per week
- Optimum: 2 inches per week
- April to October

Mid-winter Water

Pecan roots can dry out and die if no rains occur from September to April 1.

A mid-winter irrigation may be necessary to insure good tree health and regular production.

When to Water

The critical periods occur when weeks pass without a rain. However, the tree and crop have the greatest water needs in

1. March, immediately before growth begins,
2. June, as nuts begin to size,
3. Late July, as kernels begin to fill and
4. Early September, as kernels continue to develop.

Severe droughts during these four periods can result in complete crop failure or serious crop loss. A drought during the last period can also result in a poor crop the following year.

Orchard Spacing: Hedging

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Pecans require a large amount of space in order to grow and bear regular crops of high quality pecans.

Minimum Distances

- ∞ West Texas: 30 x 30-foot spacing minimum
- ∞ Central, south and east Texas: 35 x 35-foot spacing minimum

Space Needs

- ∞ More space needed for roots than leaves
- ∞ All of the functional roots are in the top 32" of soil.
- ∞ Twice as many roots as shoots,
- ∞ Roots extend twice as far out from the trunk as the limbs.
- ∞ So, when the limbs of adjacent trees touch, the roots overlap and are all crowded into the top 32 inches of soil.
- ∞ As trees begin to touch, tree removal is necessary to maintain regular production of high-quality nuts.

Hedging

Hedging is the mechanical removal of portions of the outer canopy of a pecan tree, usually with the aid of a tractor mounted saw. The purpose is to improve light penetration, air drainage, and to physically control tree size and shape in the orchard to delay the need for tree thinning. The amount of canopy removed and the frequency of removal can vary widely by region and by orchard. This is not a universal practice even within a region.



Photo courtesy of Bill Ree

Orchard Spacing: Light

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Light Needs in Pecan Orchards

- ∞ Light must penetrate the space between trees.
- ∞ As shoots are shaded, they die.
- ∞ Shoots and leaves need to develop within 5 feet of the ground line.
- ∞ As trees become crowded, the side shoots die from shading and yields and fruit quality drops seriously.





Proper Spacing Important in Disease Prevention

Space is needed for air movement and sunlight penetration between and around trees. This is essential for the drying of leaves to help reduce risk of pecan scab in spring and summer and economic infestations of black aphid in late summer. Crowded orchards have a much more serious scab and black aphid problems and will often need more sprays.

Orchard Soil: Drainage

Horticulture in IPM



Pecan Orchard Soil

Pecans do best in well-drained soils that have a minimum of 32 inches of top soil. Many orchards and groves do not meet this standard and soil deficiencies must be remediated by management or a low input strategy to maintain profitability with lower yields.

Drainage Test Hole

Dig an 8-inch hole 32-inches deep and fill it with 5 gallons of water.

Internal Drainage Test for Pecan Soil	
<i>Hours to empty</i>	<i>Soil drainage</i>
1 hour	Excellent
8 hours	Very good
24 hours	Fair
48 hours	Adequate
Will not empty	Not a pecan soil

Orchard Soil: Salt Problems

Horticulture in IPM



Salt Problems in Pecan Orchard Soil

- ∞ Orchard soils should NOT have a high sodium content.
- ∞ If the SAR (sodium adsorption ratio) is above 6.0, pecans should not be grown.
- ∞ The total salts should be less than 3,000 ppm.

Sodium adsorption ratio (SAR) = a measure of the suitability of water for use in agricultural irrigation

Weed Management: Regional

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Weed Management in Pecan Orchards

Weed and orchard floor management in pecan orchards is very important. The type of management varies for different areas.

Ed. Note: We need content from other states in the pecan belt. Can you help?

[Texas](#)

Weed Management: Texas

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Far West Texas

The orchard floor management can be either clear cultivation, sod or sod-cultivation combination. In far west Texas, clear cultivation is very functional and is considered by many to be the superior system of orchard floor care. The soil is cultivated 6 to 12 times annually, immediately before each irrigation. Prior to harvest, the orchard floor is rolled and packed to press out the clods. The orchard can then be mechanically harvested without mud or clod problems.

Central and South Texas

In south and central Texas, where orchards utilize mechanical harvesters, a sod-cultivation system is used. Shallow cultivation is used in April and May to maximize the use of fertilizer. A sod is then allowed to develop from June to October and shredded as necessary to prevent weed competition. This sod cover facilitates mechanical harvesting but, since water is not such a critical resource as in West Texas, does not significantly reduce water availability to the trees.

Central Texas and Gulf Coast

In east Texas and along the Gulf coast, sod is used throughout the season. Heavy rains plus clean cultivation produce soggy soils that prohibit tractor movement. Sod cover helps reduce this problem.

Pecan Orchard Weed Management

Horticulture in IPM



Weed Management in Native Pecan Groves

- ∞ Native groves need a sod cover to prohibit erosion during river rises and flooding.
- ∞ Sod is also utilized for cattle grazing in combination with native pecan production.

Weed Management in Small Pecan Orchards

- ∞ Retail orchards harvested by hand are usually clean-cultivated to obtain maximum nitrogen and water usage by the trees.
- ∞ Large, high-quality nuts resulting from this practice receive a premium price on the retail market.

Pecan Orchard Weed Management

Horticulture in IPM



Shredding

- ∞ Sod is normally shredded to a height of 3 to 5 inches.
- ∞ A grower will need to shred 5 to 10 times annually to maintain the sod in a non-competitive condition.

Cultivation

- ∞ Weed control by clean cultivation has to be shallow or no deeper than 5 inches.
- ∞ 2" to 3" is ideal
- ∞ A disk harrow is the common implement used in cultivation.
- ∞ Some growers are using a Lely Roterra or a Howard Rototiller to shallow cultivate.
- ∞ Shallow "V" blades and harrows are used in the irrigated far west Texas for clean cultivation.

Pecan Orchard Weed Management

Horticulture in IPM



Chemical Weed Control

Some growers use Round-Up® herbicide to replace clean cultivation in east, south and central Texas. It is applied at a rate of 1-quart per 50 gallons of water to one acre in April, June and August.

Round-Up® has been recently implicated in nickel deficiencies being found in some pecan orchards and producers should be aware of scientific studies underway and alert for symptoms turning up in their own trees.

A sod tractor path is often maintained down the tree row to facilitate equipment entry into the orchard during rainy weather.

Tree Thinning

Horticulture in IPM



Native Orchard Tree Thinning

Pecans Need Space

Tree spacing has a fundamental impact on pecan production, Pecan trees require adequate space for both roots and foliage to function properly.

Soil and Light

Soil resources of moisture and nutrients become limiting under crowded conditions. When tree canopies overlap, foliage is shaded from energy-rich sunlight and the lower limbs begin to lose vigor and soon die. The pecan crop moves to the top where the sunlight remains adequate.

Native Groves Crowd

Trees are planted at a high-density spacing with the knowledge that, as the trees mature, many of the trees will have to be removed. Due to the pre-set spacing employed in planted orchards, all the trees start to crowd at the same time and the opportunities for tree thinning occur in intervals of many years. Trees in native orchards mature and crowd at different rates throughout the orchard. Consequently, native groves can be thinned, in part, every year.

Tree Thinning

Horticulture in IPM



Maintain 30 Square Feet Per Acre

A constant watch must be kept over the trees to continually upgrade the tree stand. Pecans trees produce the best crops at approximately 30 square feet of cross-sectional trunk area per acre. The larger the trees, the fewer the number of trees required to obtain this trunk area. By carefully evaluating tree stands, pecan producers select the least productive trees for removal.

Each Tree Is Unique

Pecan trees should be selected on the basis of nut production, nut quality, pecan scab resistance and susceptibility to phylloxera. Some trees remain in the orchard for years without producing. Other trees consistently harbor pecan scab and the pecans never fill well. The strength of the foliage is important but does not always indicate the productivity of the trees. Certain trees within an orchard are infested with phylloxera year after year. A special spray program may be required to make them productive. If other trees will fill the spaces, phylloxera-infested trees should be selected for removal over otherwise comparable trees.

Tree Thinning

Horticulture in IPM



Qualities of a Good Pecan Tree

Trees cannot be judged on the basis of a single factor. The ideal tree:

- ∞ consistently produces high quality pecans in large volumes
- ∞ displays strong branching and an ability to heal wounds quickly
- ∞ has strong foliage that resists insect and disease attacks
- ∞ responds vigorously to good culture

The initial thinning should reflect obvious differences among trees. After the trees respond to the improved soil and light conditions of the initial thinning, more critical judgments can be made on tree performance.

Tree Thinning Reduces Disease Pressure

Thinning reduces pressure in the pecan orchard. Not only are scab-susceptible trees removed, reducing the inocula, but air circulation is improved, which increases the drying rate after rain showers and morning dew. The frequency and rates of fungicide use can often be reduced after thinning.

Tree Thinning

Horticulture in IPM



Reduced Costs

Other spraying costs are also reduced. By removing unproductive trees through thinning, you no longer spray the trees that provide only shade.

Tree Thinning Increases Spraying Efficiency

Crowded trees often produce only at the top where adequate sunlight reaches the bearing shoots. Mist blowers, in order to spray the top of the tree, must displace the air with a fine mist from the sprayer nozzle to the top of the tree. When low branches are present, the foliage holds all the pesticide. If there are no low branches, the lower portion of the spray column falls to the ground instead of on foliage. By opening the trees to light and soil, tree canopies fill out and lower branches develop so spray applications are more efficient.

Pecan Tree Thinning Yields a Grazing Bonus

Finally, improved spacing provides sunlight to the orchard floor, improving sod conditions for harvesting. For producers grazing their native groves, this is a real bonus in terms of stocking rates.

Tree Thinning

Horticulture in IPM



Exercise Good Judgment

- ∞ Tree thinning is a labor-consuming operation, and tree selection is only the first step.
- ∞ Several years judgments may be desirable before cutting begins.
- ∞ Mark the trees for cutting this year and observe them closely.
- ∞ Follow up the next year with a different colored paint to determine if the same trees are marked two years in a row.

Tree Thinning

Horticulture in IPM



Be Selective

Texas has a future in the hardwood timber industry. The first step in marketing timber is marking the trees for sale. Regardless of the future for timber sales, though, it will be important for native pecan producers to select the trees that will be the most productive under the management they receive.

Cover Crops

Horticulture in IPM



Many producers establish a cover crop between rows of trees and combine it with herbicide treatment to remove vegetation leaving a bare circle beneath each tree.

A variety of clover is the typical choice of cover crops. Many varieties are available and the best one (or mixtures) for your area depends on soil type and climate. Tibbee Crimson, Bigbee Berseem, and Hairy Vetch have been used effectively in some areas but there are dozens of others to consider as well.

Advantages of a legume cover crop:

- ⌘ Provides vegetative cover to reduce erosion especially through the spring
- ⌘ Providing habitat for natural enemies during the spring
- ⌘ Returning nitrogen to the soil where legumes are used
- ⌘ Reducing competition for nutrients and water during summer months when the legume cover crop goes dormant

Disadvantages of a legume cover crop:

- ⌘ Investment to identify the best cover crop
- ⌘ Establish and maintain the orchard floor
- ⌘ Grazing is still possible but precautions must be taken to prevent bloat
- ⌘ Cycling of cattle on and off the orchard varies compared to grass cover

Related

[Use of Legumes in Pecan Orchards](#), Oklahoma Cooperative Extension, OSU Publication