Fertilizing Pecan Trees

MISSISSIPPI STATE UNIVERSITY EXTENSION

Pecans are large trees that have significant nutrient requirements. Often, when trees go long periods of time without fertilizer applications, growth becomes poor and leads to a reduction in nut production. Lack of adequate nutrient availability can also weaken the tree and predispose it to diseases and other disorders. Therefore, in order to ensure tree health and to produce consistent and high-quality nuts, it is imperative to fertilize annually.

Soil Testing

A soil test should be the first step to begin a fertilizer regimen. These tests are inexpensive and easy to perform. Contact your local county Extension office for details. A soil test is most useful when done pre-plant because it will allow for modification of soil pH and addition of nutrients. **Table 1** describes desired levels of soil nutrients for a pecan orchard site.

Table 1. Recommended nutrient levels in soils for pecan production.[1]

Element	Recommended Range[2]
Phosphorus	30–60
Potassium	60–150
Sulfur	10–50
Calcium	400–900
Magnesium	90–100
Boron	0.5–1.0
Copper	0.5–1.5
Iron	12–25
Manganese	15–40
Zinc	15–20
Soil pH	6.0–6.5

[1]Table based on Wells (2009)
[2]pounds per acre

After planting, a soil test is most useful for keeping track of soil pH and monitoring the levels of nutrients present in the soil; however, foliar (leaflet) analysis is a better barometer of overall plant nutrient needs. Pecans can grow on a wide range of soil pHs. The recommended range is about 6.5, but, in most cases, soil pH from 6.0 to 7.0 will be sufficient.

Foliar Analysis

Foliar analysis is the most accurate representation of a pecan tree's nutrient needs. Taking a leaf sample can be done easily in just a few steps:

Figure 1. Many symptoms can mimic nutritional deficiencies or toxicities. The photo above is of pecan bacterial leaf scorch (*Xylella fastidiosa* subsp. *multiplex*), a disease that displays symptoms similar to drought stress, excessive chloride (salt), nitrogen scorch, boron toxicity, potassium deficiency, and phosphorus deficiency. Photo credit: Rebecca A. Melanson, Mississippi State University Extension, Bugwood.org.

1. Contact your local county Extension office for detailed instructions of how to collect and where to send samples, or see Extension Publication 1224 *Plant Analysis Sampling Instructions* (http://extension.msstate.edu/publications/publications/plant-analysis-sampling-instructions).
2. Collect leaf samples in July.
3. Mark trees that were sampled for future reference.
4. The sample should be random within a tree and within a cultivar. Collect two leaflets from a few leaves per tree—up to 100 total leaflets.
5. Take the leaflets from halfway up the leaf, halfway up the tree, and from all sides of the tree.
6. Make sure to sample each cultivar separately.
7. If the orchard is not uniform, sample different areas separately.

Establishment Years (1 to 5)

Regardless of whether a newly planted tree is in a commercial orchard or in a homeowner's yard, weed control is absolutely essential for good growth and establishment. Other pests should also be controlled if they are problematic. First-year trees likely do not need a fertilizer application as the tree will live off nutrients obtained in the nursery. The tree may grow slowly aboveground in the first year, but the root system will grow abundantly.

In year two, the tree should start growing faster, with anywhere from 12 to 36 inches of growth per year. Start applying fertilizer in a band along the dripline, but not next to the trunk. As the tree gets older, apply fertilizer in a band at a distance of 12 inches from the trunk. Fertilizer can also be applied by broadcasting, but this is usually not as efficient as band applications.

Mature Years (6+)

Commercial

Annual fertilizer applications based on leaflet analysis are necessary to maintain a commercial-level pecan orchard (**Table 2**). The amount of fertilizer to apply can vary based on cultivar, management, site, and environment. Improved cultivars generally need more fertilizer than native/seedling pecan trees because they often produce larger nuts and have greater overall yields (**Tables 3 and 4**). Nitrogen-based fertilizer applications can be applied at one time just before budbreak (March) or as a split application with half being applied in March and the other half in May.

Homeowner

If the lawn surrounding the pecan tree is being fertilized, this could add some nutrition to the tree; however, it may not be enough to satisfy the nutritional needs of the tree because most of the fertilizer will be taken up by the grass. One-half pound of ammonium nitrate (or similar) per 100 square feet can be applied under the drip line of the tree. This should be done starting around the time of budbreak (March/April) and again in late spring or early summer (May/June). Roughly 6 to 12 inches of new growth is desired every year.

Table 2. Sufficiency ranges for elements essential to pecan nutrition in both low–input and high–input orchards. These ranges are based on leaflet analysis when leaves are fully expanded.[1]

Element	Low Input	High Input
Nitrogen (N)	2.3–3.0 %	2.4–3.0 %
Phosphorus (P)	0.12–0.30 %	0.14–0.30 %
Potassium (K)	0.85–2.50 %	1.00–2.50 %
Sulfur (S)	0.20–0.35 %	0.20–0.35 %
Calcium (Ca)	0.70–1.75 %	0.70–1.75 %
Magnesium (Mg)	0.30–0.60 %	0.30–0.60 %
Boron (B)	15–50 ppm[2]	15–50 ppm
Copper (Cu)	6–30 ppm	6–30 ppm
Iron (Fe)	50–300 ppm	50–300 ppm
Manganese (Mn)	100–2000 ppm	100–2000 ppm
Zinc (Zn)	60–150 ppm	60–150 ppm
Nickel (Ni)	>2.5 ppm	>2.5 ppm

[1]Table based on Smith et al. (2012)
[2]ppm=parts per million (equal to milligrams per gram)

Nutritional Elements

Macronutrients and Micronutrients

Proper and balanced fertilization is important because pecan yields are proportional to the amount of the most limiting nutrient. This means if only one nutrient is below normal and all others are sufficient, yields can still suffer. Nutrients that a pecan tree requires are in two categories: macronutrients and micronutrients. Macronutrients are needed in larger amounts by pecan trees. Those elements are nitrogen (N), phosphorus (P), potassium (K), sulfur (S), calcium (Ca), and magnesium (Mg). Essential plant functions performed by macronutrients include the production of proteins, nucleic acids, and chlorophyll; the activation of enzymes; photosynthesis; and sugar transport.

Micronutrients are essential for plant growth and development but are needed in minute amounts. They include boron (B), chloride (Cl), copper (Cu), iron (Fe), nickel (Ni), manganese (Mn), molybdenum (Mo), and zinc (Zn). Although the plant needs only small amounts of these nutrients, they play critical roles in many plant functions such as translocation of sugar and carbohydrates, cell wall formation, carbohydrate and protein metabolism, chlorophyll development, electron transport, and many others.

Interactions can occur among these elements. For instance, when P is at very high levels, both Zn and Cu may become unavailable (or less available) to the tree. Therefore, it is very important to keep each element within the recommended sufficiency range, but also optimize soil pH and provide sufficient water to the tree.

Nitrogen

The single-most required nutrient is nitrogen. Pecan trees grow quickly and need a good amount of nitrogen for best production. High-input, improved cultivars may re-

Table 3. Recommendations for managing nitrogen (N) in low-input and high-input pecan orchards.[1]

Low-Input			High-Input		
Range	Concentration	Recommendation	Range	Concentration	Recommendation
Low	<2.3 %	Double last year's application or add 150 lb/acre N.	Very Low	>2.3 %	Double last year's application or add 150 lb/acre N.
Normal	2.3–2.5 %	Continue with present application rates.	Low	2.3–2.4 %	Increase N by 30% or 125 lb/acre N.
Normal	2.5–2.7 %	Decrease N by 20%.	Normal	2.4–2.7 %	Continue with present application rates.
Normal	2.7–3.0 %	Decrease N by 50%.	Normal	2.7–3.0 %	Decrease N by 30%.
Above Normal	>3.0 %	Do not add N.	Above Normal	>3.0 %	Decrease N by 50%.

[1]Table based on Smith et al. (2012)

Table 4. Recommendations for managing macro- and micronutrients in low-input and high-input pecan orchards based on leaf analysis results.[1]

		Low-Input		High-Input	
Nutrient	**Range**	**Concentration**	**Recommendation**	**Concentration**	**Recommendation**
Phosphorus (P)	Low	<0.12 %	Apply 100 lb/acre phosphate.	<0.14 %	Apply 100 lb/acre phosphate.
	Normal	>0.14 %	None needed.	>0.14 %	None needed.
Potassium (K)	Low	<0.85 %	Apply 100 lb/acre potassium oxide.	<1.0 %	Apply 100 lb/acre potassium oxide.
	Normal	>0.85 %	None needed.	>1.0 %	None needed.
Sulfur (S)	Low	<0.20 %	Use ammonium sulfate as nitrogen source and/or zinc sulfate as foliar spray.	<0.20 %	Use ammonium sulfate as nitrogen source and/or zinc sulfate as foliar spray.
	Normal	>0.20 %	None needed.	>0.20 %	None needed.
Calcium (Ca)	Low	<0.70 %	Apply lime to increase soil pH to 6.8.	<0.70 %	Apply lime to increase soil pH to 6.8.
	Normal	>0.70 %	None needed.	>0.70 %	None needed.
Magnesium (Mg)	Low	<0.30 %	Test soil pH and use lime if needed to raise pH or use magnesium sulfate.	<0.30 %	Test soil pH and use lime if needed to raise pH or use magnesium sulfate.
	Normal	>0.30 %	None needed.	>0.30 %	
Boron (B)	Low	<15 ppm[2]	Apply soluble boron at 0.5–1 lb/acre as first leaf unfurls, then twice at 2-week intervals.	<15 ppm	Apply soluble boron at 0.5–1 lb/acre as first leaf unfurls, then twice at 2-week intervals.
	Normal	>15 ppm	None needed.	>15 ppm	None needed.
	Above Normal	>300 ppm	Check water source for high B.	>300 ppm	Check water source for high B.
Manganese (Mn)	Low	<100 ppm	Apply manganese sulfate at 6 lb/acre beginning as first leaf unfurls, then twice later in season.	<100 ppm	Apply manganese sulfate at 6 lb/acre beginning as first leaf unfurls, then twice later in season.
	Normal	>100 ppm	None needed.	>100 ppm	None needed.
Zinc (Zn)	Low	<60 ppm	Apply 3–6 lb/acre of zinc sulfate on bearing trees, 1–2 lb/100 gal water on nonbearing trees. Apply at least 3 times during spring and summer. Soil applications may be used in acidic soils.	<60 ppm	Apply 3–6 lb/acre of zinc sulfate on bearing trees, 1–2 lb/100 gal water on nonbearing trees. Apply at least 3 times during spring and summer. Soil applications may be used in acidic soils.
	Normal	>60 ppm	Continue Zn spray program as is.	>60 ppm	Continue Zn spray program as is.
Iron (Fe)	Low	<50 ppm	Usually induced by environmental conditions and will resolve itself when conditions improve. If not, use iron chelate.	<50 ppm	Usually induced by environmental conditions and will resolve itself when conditions improve. If not, use iron chelate.
	Normal	>50 ppm	None needed.	>50 ppm	None needed.
Copper (Cu)	Low	<6 ppm	Apply copper sulfate or copper chelate.	<6 ppm	Apply copper sulfate or copper chelate.
	Normal	6 to 20 ppm	None needed.	6 to 20 ppm	None needed.
	Above Normal	>20 ppm	Determine source of Cu and adjust.	>20 ppm	Determine source of Cu and adjust.
Nickel (Ni)	Low	<2.5 ppm	Apply Ni as a foliar application.	<2.5 ppm	Apply Ni as a foliar application.
	Normal	>2.5 ppm	None needed.	>2.5 ppm	None needed.

[1]Table based on Smith et al. (2012)
[2]ppm=parts per million (equal to milligrams per gram)

quire more than 250 pounds of actual nitrogen per acre per year for best production. Low-input orchards (those without irrigation and few spray applications) and native pecan trees do not require as much nitrogen and can perform with around 150 pounds of actual nitrogen per acre per year. See **Table 3** for details on recommendations based on foliar analysis.

Zinc

Pecan trees are heavy users of zinc, and it is an essential nutrient for good growth and nut production. Zinc is commonly applied to improved cultivar pecan trees as a foliar spray. This ensures quick uptake by the tree. Young trees and fast-growing trees need applications of zinc on new growth during the spring starting at budbreak and continuing for three sprays at 2- to 3-week intervals. Zinc sulfate is the primary source of zinc and can be mixed at 2 to 3 pounds per 100 gallons of water.

Soil applications of zinc are less effective than foliar applications and are only useful when the soil pH is below 6.0. If soil pH is below 6.0, then one-half pound of zinc sulfate per year age of the tree can be soil- applied under the tree up to 10 pounds per tree total. Even so, foliar applications are the highly preferred method. See **Table 4** for more information.

Others

Phosphorus and potassium are also required for pecan production. Any deficit with these nutrients should be rectified before planting. If done pre-plant, subsequent applications will likely be infrequent. Nutrient deficiencies from Mn, Ni, B, and others are rarely observed to cause problems in pecan trees; however, they can occur. See **Table 4** for recommendations regarding these nutrients.

Abnormalities in a plant's appearance, development, function, or growth may be caused by various factors. These abnormalities are often visualized as symptoms. Abnormalities may be classified as *diseases* or *disorders* depending on the nature of the causal agent. Diseases are caused by biotic (living) organisms such as bacteria, fungi, nematodes, and viruses. These disease-causing organisms are called plant pathogens. Pathogens that cause disease can be spread from plant to plant under favorable conditions. Disorders are caused by abiotic (nonliving) factors such as nutritional deficiencies, herbicides, and environmental conditions (e.g., drought, freezing temperatures). Unlike diseases, disorders are not infectious.

When plants are not performing as expected, it is important to correctly identify the cause of the problem so that appropriate management actions may be taken. Unfortunately, abiotic and biotic factors can produce similar symptoms, which can make it difficult to quickly discern the cause of a problem (**Figure 1**). These are some examples of nutritional disorders and diseases in pecan trees that can cause confusion:

- Mouse-ear (nutritional disorder). Symptom: leaflets with rounded, blunt ends. Mouse-ear is caused by a nickel deficiency.
- Nitrogen scorch (nutritional disorder) and pecan bacterial leaf scorch (disease). Common symptom: leaflets appear "scorched," and portions of the leaflet are brown and necrotic (dead). Nitrogen scorch is caused by an excess of nitrogen combined with a shortage of potassium. Pecan bacterial leaf scorch is caused by a bacterium that lives in the water-conducting tissues (xylem) of the tree and is graft- and insect-transmitted.
- Zinc deficiency (nutritional disorder) and bunch disease (disease). Common symptom: "bunching" (shortening of internodes). Bunch disease is caused by a type of plant pathogen called a phytoplasma that is graft-transmitted. The method of natural spread of this pathogen is unknown.

As a final reminder, applying fertilizer to pecan trees is not a cure-all. Other factors such as site, soil moisture, and pest management are as important as—if not more important than—fertilizer applications for production of a successful crop. These recommendations are to be used as guidelines for application. Each site is different and may require modification from these guidelines based on owner/operator observation and experience.

References

Garcia, M.E. and D. Chapman. 2007. Fertilizer and cultural recommendations for pecan trees. University of Arkansas Cooperative Extension Service. FSA6131.

Smith, M.W., C.T. Rohla, and W.D. Goff. 2012. Pecan leaf elemental sufficiency ranges and fertilizer recommendations. HortTechnology 22:594-599.

Wells, M.L. 2009. Pecan nutrient element status and orchard soil fertility in the Southeastern Coastal Plain of the United States. HortTechnology 19:432-438.

Online Resources

MSU Extension Plant Disease and Nematode Diagnostic Services — ***http://extension.msstate.edu/lab***

MSU Extension Soil Testing — ***http://extension.msstate.edu/lawn-and-garden/soil-testing***

MSU Extension Soil Testing Form — ***http://extension.msstate.edu/publications/information-sheets/soil-testing-for-the-farmer***

MSU Extension Plant Analysis Sampling Instructions — ***http://extension.msstate.edu/publications/publications/plant-analysis-sampling-instructions***

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