



Pecan Tree Nutrition & Fertilization

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TEXAS A&M
AGRILIFE
EXTENSION

Terminology

Nutritional Program

Needs-Based Assessment

VS.

Fertilizer Program

Product-Driven Decisions

Goals of Nutritional Program

- Identify needs for growth/canopy health
- Maximize Nut Yield
- Produce High Quality Kernels
- Minimize Waste and Environmental Impact



Assessment

Subjective

Yield, Nut Quality, Growth

Pecan Tree Needs

Quantitative

Leaf & Soil Analysis

Subjective Assessment

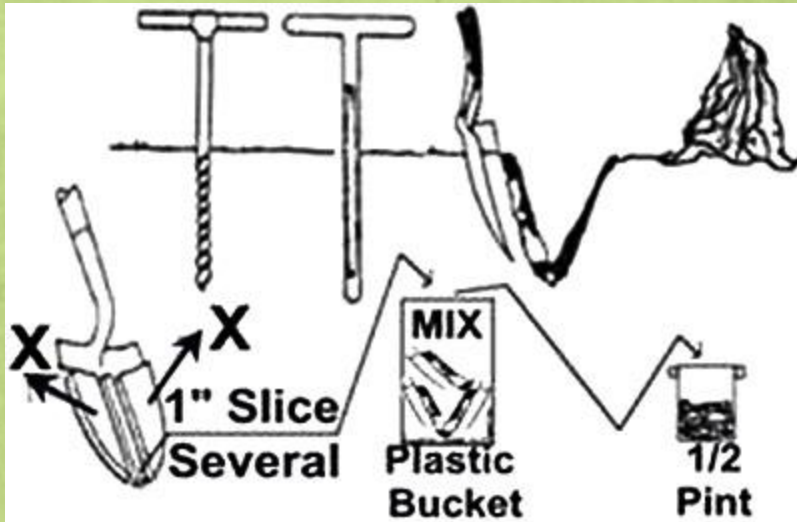
Are you satisfied with yields & quality?

If yes, keep doing what you're doing.



But can you do

Quantitative Assessments: Soil Testing



How have past and present farming practices impacted soil chemistry?

pH

Nutrient availability

Salinity

<http://soiltesting.tamu.edu>



Real World Example

Analysis	Critical Level	Orchard	Description	Recommendation
pH	6.2	7.8	Mod. Alkaline	None
Nitrate-N		3 ppm	Extremely Low	140 lbs/Ac
Phosphorus	50	8	Very Low	65 lbs/Ac P ₂ O ₅
Potassium	100	563	Very High	None
Calcium	180	13,580	Very High	None
Magnesium	50	619	Very High	None
Sulfur	13	16	High	None

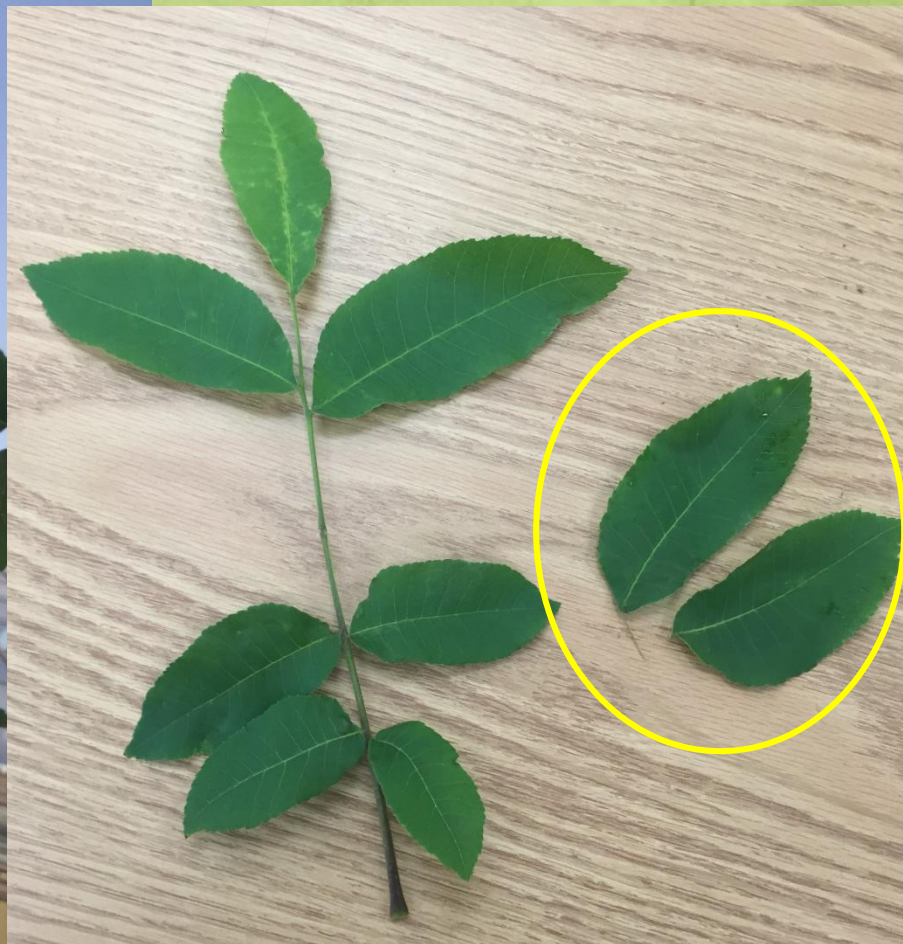
Purpose of a leaf sample

- Assess how current year fertilizer (or lack thereof) ***directly*** influences trees in the orchard to either meet or exceed comparable benchmarks.
- Provides little help if not used as a comparison to known standards sampled at the same time (July).



Find leaf at midpoint of branch in July

How to Sample



Collect 50 leaflet pairs

Compare Dry Weight Results to Standards

Element	Dry Wt. Concentration Texas
N-Nitrogen	2.5 to 4.0%
P-Phosphorus	0.15 to 0.30
K-Potassium	0.75 to 1.25
Calcium	0.70 to 3.00
Mg-Magnesium	0.30 to 0.60
Fe-Iron	50 to 300 ppm
Mn-Manganese	40 to 300
Zn-Zinc	80 to 500
B-Boron	20 to 45
Cu-Copper	10 to 30

Tips on Leaf Sampling

- Be consistent in sampling month, sample trees, keeping varieties separate, sampling from nut-bearing or non nut-bearing terminals, sun exposed, canopy position, mid-point of growth...



Should leaves be washed at the time of collection?

- TAMU STUDY_Lombardini (2013): Leaves sprayed with ZnSO_4 and not washed before analysis had up to 33X times higher Zn concentration than unwashed leaves.
- Three types of wash (Distilled water, drest laundry detergent, and 1% HCl) were effective in removing between 64% and 79% of the applied Zn. Only HCl, however, reduced Zn concentration to an expected baseline level for sprayed leaves.
- Grower washing practices need to incorporate an acid wash to improve understanding of true leaf Zn levels.

Leaf Washing Procedures

- 1. Send leaves directly to laboratory and request acid wash. **OR**
- 2. Wash leaflets in a 1% hydrochloric acid solution (Although it depends on the concentration of the muriatic acid, usually 2 TBSP /gallon of water will approximate a 1% hydrochloric acid solution.),
- Rinse in five separate distilled water baths and air dry before shipping.”



<http://soiltesting.tamu.edu/>

Nitrogen-Essential for growth & crop production

- Not stable in soil
 - Leached by irrigation & rainfall
- Trees are depleted early in spring, so uptake is great at this time.
- Needs vary with tree age, soil type, orchard floor management practices, and crop load.
- Recommended rate is 80-200 lbs N/Acre



Leaf Sample Critical Level=2.5 to 4.0%

- **Anhydrous Ammonia**
 - Most cost efficient
 - Gaseous form must be injected into the soil
- **Urea (46%)**
 - Dry form converts to volatile ammonia
 - Must water-in timely manner (very water soluble)
 - Incorporate by knifing or dribbling to stabilize
 - Sulfur and other polymer coatings extend delivery
- **UAN (28-32%)**
 - Urea ammonium nitrate—liquid
 - Drench into soil or inject through drip system
- **Ammonium Sulfate (21%)**
 - Delivers sulfur and acidifies soil
 - Volatility when applied to wet soils
- **Ammonium Nitrate (33%)**
 - Low volatility risk
 - Delivers nitrate form---quick availability, leachable
 - Not Available!

Phosphorus

- Macronutrient involved in energy/storage (bloom production) and vegetative growth.
- Transported in significant quantities into developing pecan kernels
- Related to late season leaf scorch and winter cold damage.



Latest thinking is to band P_2O_5 when leaf levels are less than 0.14%

Band applications of up to 100 lbs P_2O_5 /Acre recommended when leaf or soil tests indicate deficiency

Photo: Noble Foundation

Potassium (K)

- Regulates water movement, stomatal conductance, **utilization of N**
- Pecan fruit elemental content is 58% K (85% in shucks)
- Imbalances from over application of N can be a problem.
- Fall leaf levels correlate with return bloom (Smith, 2010)
- Tree Response to soil K can be slow.
 - 5 years on clay soils
 - 1 year on sandy soil
- Rates for Correction: 100 lbs/A if leaf levels=deficient. (0.75%)
- Banded Applications more effective in some soils.
- Foliar app. not effective (except for kernel oil %)



Micronutrients of concern in pecan orchards:

- Zinc
- Boron
- Nickel
- Iron

Zinc (Zn): Mild to moderate deficiency symptoms



Target Leaf Levels (Texas): 80-500 ppm

Severe Zn deficiency symptoms



Small leaves, lateral bud breaking,
dwarfy-appearing trees.



06/30/2010

Highly calcareous soils in the west region have worst problem

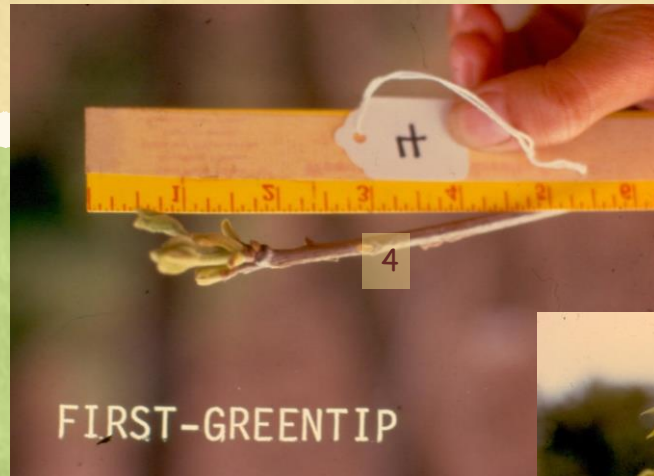


Foliar spraying is effective approach for annual Zn fertilization in calcareous soils.



On mature, bearing trees, foliar sprays in early Spring are effective.

Zinc Timing Chart



Fourth—Casebearer time



Third—4 weeks after



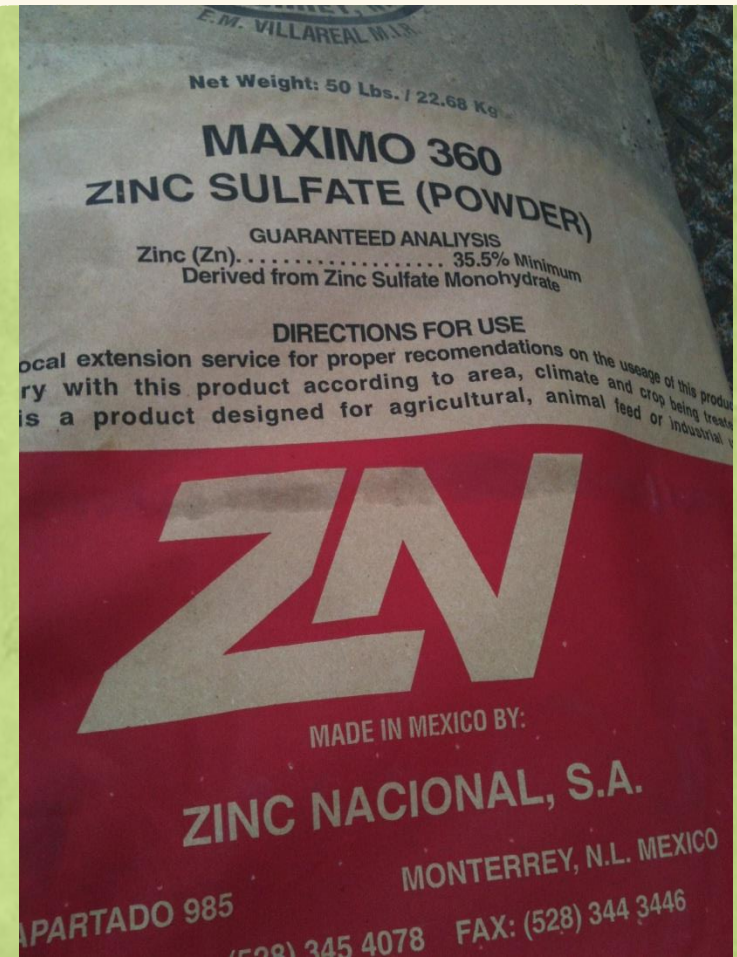
Second-1 or 2 weeks after



Fifth—12 weeks after

Misconception: Any product with Zn in it can do some good as a foliar spray.

- Zinc Sulfate wettable powder has been proven effective.
- Zinc Nitrate liquid (ZnNO_3) 17% has been proven effective.
- Zinc Oxide has been proven effective.
- Zinc chelates (foliar) have variable track record.



Foliar Rates

- **Zinc Sulfate: Mature trees--2 lbs per 100 gallons of water/Acre to target 10 lbs of 36% zinc sulfate /acre each season (3-6 lbs/year)**
 - Young trees: 1 lb/100 gallons + 2 pts Uan (32% N)
 - Can burn some other plants (peaches, other)
- **Zinc Nitrate (17%): 1 Pt -1 Qt per 100 gallons of water.**
 - Far West Texas needs the higher rate
 - Less phytotoxic to peaches, other plants
- **Zinc Oxide: 1.4 lbs/Acre**
 - Less effective product choice in some trials.
 - Equally effective in some trials.
 - Price may be +/-

Product confusion—not all “zinc nitrates” are equal

ZINC NITRATE SOLUTION

GENERAL USE INFORMATION – READ ENTIRE LABEL BEFORE USING THIS PRODUCT

13-0-0+5 Zn GUARANTEED ANALYSIS:

Total Nitrogen (N).....	13.0%
2.4% Ammoniacal Nitrogen	
5.2% Nitrate Nitrogen	
5.4% Urea Nitrogen	
Zinc (Zn).....	5.0%
5% Soluble Zinc	

TYPICAL PROPERTIES:

Specific Gravity, 60°F.....	1.316
pH.....	3.9

PHYTOTOXICITY: Plant and leaf injury may occur on some crops when certain weather and growing conditions are present. The user assumes all risks of use and handling.

CAUTION
KEEP OUT OF REACH OF CHILDREN
HARMFUL IF SWALLOWED

EMERGENCY AND FIRST AID PROCEDURES

EYES: Wear chemical dust/splash goggles or full-face shield to prevent eye contact. As a general rule, do not wear contact lens when handling. If contact occurs, flush eyes immediately with water for at least 15 minutes. Call a physician if irritation persists.

SKIN: Wear impervious gloves and clothes. If contact occurs, wash thoroughly with soap and

GENERAL INFORMATION

ZINC NITRATE SOLUTION is an easily adsorbed liquid fertilizer with zinc and nitrogen compounds which further increase absorption efficiency. **ZINC NITRATE SOLUTION** stimulates cell formation, increasing leaf size and encouraging good root development and plant growth. Disease and stress tolerance is enhanced. With higher zinc levels in the plant, there is greater uptake and utilization of fertilizer and soil nutrients for significantly higher yields and crop quality.

5% zinc, no disclosure of source material

For best results 1 qt. should be applied after petal fall, 2 qts. in sprays thereafter. Post-harvest, dormant, and delayed dormant: 4 qts.

Black Walnuts: 1–1½ qts. per 100 gals. water spray to cover. *Aerial Application:* ½ qt. per acre with a minimum of 20 gals. of water. *Max Rate:* 4 qts. per acre conc. application. *Time of Application:* For best results 1 to 3 applications at bud break to end of shoot elongation.

English Walnuts: 1–1½ qts. per 100 gals. water spray to cover. *Aerial Application:* ½ qt. per acre with a minimum of 20 gals. of water. *Max Rate:* 4 qts. per acre conc. application. *Time of Application:* For best results apply at tender pink to early feather. Repeat 1 qt. rate with first insect spray. May also be applied with copper bactericide.

Filberts: 1–2 qts. per 100 gals. water spray to cover. *Aerial Application:* ½ qt. per acre with a minimum of 20 gals. of water. *Max Rate:* 4 qts. per acre conc. application. *Time of Application:* For best results apply at ½ to full leaf. Repeat post-harvest to pre-dormant.

Pecans: 1¼–2½ qts. per 100 gals. water spray to cover. *Aerial Application:* ½ – 1qt. per acre with a minimum of 20 gals. of water. *Max Rate:* 4 qts. per acre conc. application. *Time of Application:* For best results apply at bud break to end of shoot elongation. Apply 3 to 5 applications. Post-harvest, dormant, and delayed dormant.

BLACKJACK Zn™

4-0-0 6.5% Zinc

GUARANTEED ANALYSIS

Total Nitrogen (N)
4.00% Ammoniacal Nitrogen
Zinc (Zn)
6.50% Water Soluble Zinc (Zn)

Derived from: Anhydrous Ammonia and Zinc Sulfate

ALSO CONTAINS NON-PLANT FOOD INGREDIENT:

5.0% Humic Acids derived from Leonardite

KEEP OUT OF REACH OF CHILDREN

CAUTION

NET WEIGHT: 29.5 LBS (13.38 Kg) DENSITY: 11.80
U.S. PATENT Nos. 4,698,000 and 4,786,000

Information regarding the contents and levels of metals in this product
<http://www.regulatory-info-uap.com>

WARNING: This product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

FOR COMMERCIAL OR PROFESSIONAL USE ONLY

F1548

NET CONTENTS:

265 GALLONS

GENERAL INFORMATION

BLACKJACK Zn™ contains Humic Acids that are combined with zinc to help improve the prevention or correction of zinc deficiencies in plants and may be used in both foliar and soil applications.

BLACKJACK Zn can be used on all crops either as a foliar or soil application. BLACKJACK Zn is non-phototoxic when used as directed and is compatible with pesticides and fertilizers.

BLACKJACK Zn rates should be reduced by half when compared to rates for other zinc complexes.

BLACKJACK Zn, when used as a foliar, should be applied under conditions of optimum plant growth.

APPLY ONLY AS DIRECTED

Soil Application Rates

VEGETABLE, CUCURBITS, FIELD AND ROW CROPS: Apply through a drip system or inject into the soil 3 to 6 inches deep either below or off to the side of the seed placement area. May be applied with preplant or sidedress fertilizers. Use 1 to 4 quarts per acre.

DECIDUOUS FRUIT AND NUT TREES, GRAPES, OLIVES AND CITRUS: Apply through a drip system or inject at the drip line 3 to 5 inches deep. Use 1 to 4 quarts per acre.

Foliar Application Rates

VEGETABLE, CUCURBITS, FIELD AND ROW CROPS: Apply 1 to 3 quarts per acre in 15 to 25 gallons of water when plants are 8 to 12 inches in height. For trees, apply 1 to 4 quarts per acre in 15 to 25 gallons of water per acre. May be applied through center

OLIVES AND CITRUS: Apply 1 to 4 quarts per acre in 15 to 25 gallons of water per acre. In dilute or concentrated solutions, use a fine mist nozzle for thorough coverage and a small droplet size.

MIXING INSTRUCTIONS

BLACKJACK Zn disperses well in water with a minimum of agitation. For best results, mix as follows:

1. Partially fill tank with water or fertilizer and start agitation.

DISCLAIMER AND NOTICE

THESE PRODUCTS ARE BELIEVED TO BE ADEQUATE AND EFFECTIVE UNDER NORMAL CONDITIONS OF USE. IT IS IMPOSSIBLE TO ELIMINATE ALL RISKS ASSOCIATED WITH THE USE OF THIS PRODUCT. CROP INJURY, CROP LOSS AND CONSEQUENCES MAY RESULT DUE TO MISUSE, MISAPPLICATION, PRESENCE OR ABSENCE OF OTHER MATERIALS, OR THE MANNER OF USE OR APPLICATION, ALL OF WHICH ARE BEYOND THE CONTROL OF LOVELAND PRODUCTS, INC., THE MANUFACTURER OR SELLER. ALL SUCH RISKS SHALL BE ASSUMED BY THE USER OR BUYER.

TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, THE PRODUCTS SOLD TO YOU ARE

THE MANUFACTURER OR SELLER'S WARRANTIES, IF ANY, WHICH ARE LIMITED TO THE MANUFACTURER OR SELLER MAKES NO WARRANTY OF ANY KIND TO BUYER OR USER, EXPRESS OR IMPLIED, IN CONNECTION WITH THE SALE OF THIS PRODUCT, INCLUDING, BUT NOT LIMITED TO, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR USE, OR MERCHANTABILITY. TO THE EXTENT PERMITTED BY LAW, THE BUYER'S EXCLUSIVE REMEDY, AND THE MANUFACTURER'S OR SELLER'S TOTAL LIABILITY TO BUYER OR USER SHALL BE LIMITED TO DAMAGES NOT EXCEEDING THE COST OF THE

Derived from zinc sulfate
(6.5%)

Label recommends 1-4 qts
per acre in a minimum of 15
gallons.

Manufactured by:



PO Box 1286 • Greeley, CO 80632-1286

Requires 11 quarts per acre to
equal 2 pounds of 36% zinc
sulfate

Improve Zn uptake and reaction by tank mixing with N

- Zinc sulfate or Zinc nitrate alone will be absorbed by pecan leaves.
- **BUT!**
- 32% Urea Ammonium nitrate (UAN) added at 2-3 pts per 100 gal of water can increase the Zn absorption rate or lower the amount of Zn product needed to get equivalent uptake.

Treatment	Leaf Zn ppm	Leaflet size	Yield (lbs/A)
Control	23	20	103
ZnSO ₄ alone	84	30	442
ZnSO ₄ + uan	195	31	589

Other MicroNutrients

- Iron—50 ppm min.
- Problematic on high pH soils.
- Correct with foliar and soil applications of Iron Chelate
 - Example:
Sequestrene 138
 - EDDHA Chelate



Other Micronutrients of Concern

- Nickel Deficiency
- Mouse-Ear Symptoms
- Exhibited by some container-grown nursery stock
- Correct with foliar nickel sprays.
 - 2 applications per year for orchards with symptoms
 - Nickel lignosulfate (Nickel Plus, Nipan LLC)



Other Micronutrients of Concern

- Boron---Sprayed post-pollination in Southeast to improve nut set.
- Less frequently deficient in Texas, due to presence in soil and irrigation water.
- 20-45 ppm critical range

Contact

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