4Rs and Walnut Nitrogen Management

Walnuts and Nitrogen Fertilization

Is there a "right way" to grow walnuts to achieve consistent, bountiful harvests? Top agronomists in private industry and universities are saying "Yes!" especially when it comes to managing the very important tree nutrient, nitrogen.

Walnut tree nutrition is complex and involves more than just nitrogen fertilization: phosphorus, potassium, calcium, boron, zinc and other essential nutrients are also needed for top production.

State water regulators today are focusing on nitrogen applied to crops because all forms of nitrogen can transform to nitrate, which can leach into groundwater. Many groundwater basins in the Central Valley are contaminated with nitrate at levels exceeding drinking water standards.

Water testing is finding that some portion of the contamination is attributable to nitrogen fertilizers, composts and animal manures applied to irrigated crop land.

Agronomists have devised a management approach for optimizing crop applications of nitrogen while minimizing leaching of excess nitrates. The approach is called the 4Rs: Right Rate, Right Time, Right Place and Right Source. This translates into:

- applying the right amount to the orchard
- when the tree needs it
- where the tree can most effectively absorb the nutrient and
- the right product to meet the nutrient needs.

4Rs of Walnut Nitrogen Management

The University of California, with support from the California Department of Food and Agriculture and the California Walnut Board, has identified key steps to include in the 4Rs for nitrogen management in walnuts.

RIGHT RATE

Goal: *Match nitrogen applications with nitrogen tree demand.*

Demand = all the nutrients a tree needs for harvested nuts, husks, hulls, tree woody growth and twigs.

Nitrogen sources:

- Synthetic nitrogen fertilizers
- Nitrate in irrigation water
- Animal manure/compost
- Cover crops

Studies have shown that nitrogen demand for Central Valley walnuts is approximately 29 lbs/ac of nitrogen for every ton of inshell walnuts at harvest.

As a guideline, most growers can achieve a nitrogen use efficiency (NUE) for walnuts of 70%.

Steps to calculate a nitrogen application rate*:

- Projected yield: 3** tons per acre
- 29 lbs/ac acre nitrogen per ton (Total N removed per acre)
- Divide by 70% efficiency factor
- 124 lbs/ac nitrogen applied during the growing season to meet tree demand.

*Right rate calculations given here are for trees in full production. Demand calculations differ in years 3-4 when trees are growing rapidly with light crop.

**Yield amount used as example

Management Considerations: Factors to consider when determining nitrogen application rate:

- Yield history of each orchard
- Current year growing conditions
- Conditions at leaf out
- Realistic yield potential for each orchard
- Tree age and size (high yielding trees need higher rates than smaller, mature trees)
- Young trees can produce excessive growth, have delayed dormancy if rates are too high
- Early applications (April) or late (post harvest) of nitrogen have not shown to benefit the crop and can lead to excess nitrogen available for leaching by irrigation or rain storms

Amount of N Needed to Satisfy Tree Demand at 70% NUE

Inefficient N Use Costs Money and Poses Environmental Risk

Nut Yield	N Removal	Fertilization N Required (lbs N/A)
Tons/Ac	lbs/Ac	70% NUE
1	48	68
1.5	72	101
2	96	135
2.5	120	169

Source: CDFA FREP California Fertilization Guidelines - Walnut

RIGHT TIME

Goal: *Match timing of nitrogen applications with active root uptake.*

Active nitrogen demand/root uptake occurs in May, June, July and August. Nitrogen uptake is uniform across the growing season.

Best approach: split nitrogen applications during growing season. Also known as spoon feeding or applying smaller amounts over multiple applications; the more split applications the better.

Using example above, divide 124 lbs/ac by 4 which equals 31 lbs/ac each month.

- 31 lbs/ac/month should include all nitrogen sources: nitrate in groundwater, nitrogen from compost and synthetic nitrogen fertilizer.

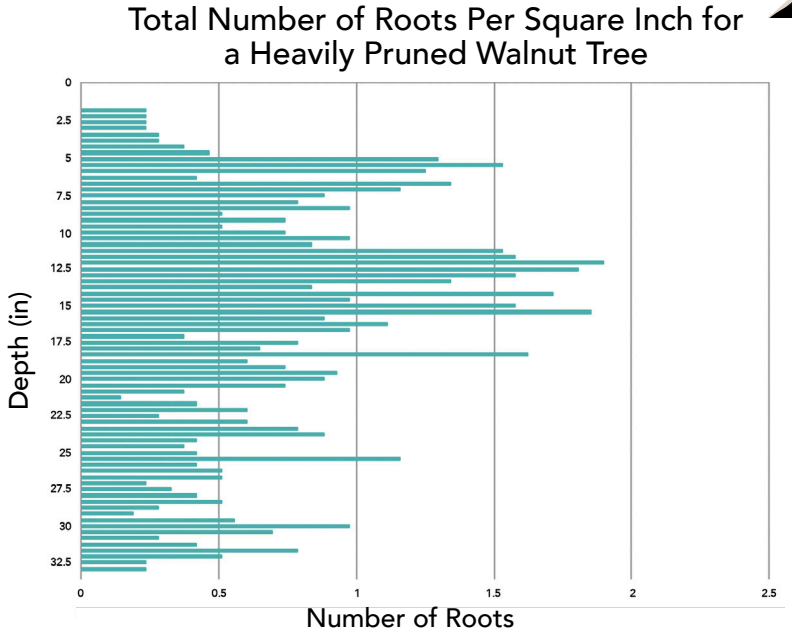
Management Considerations:

- Nitrogen used by trees in April comes from storage in the tree structure.
- Trees do not efficiently take up nitrogen post-harvest; late applications can lead to delayed dormancy or risk of leaching.

RIGHT PLACE

Goal: *Apply nitrogen where majority of roots are located.*

Vast majority of important feeder roots are in top 2-3 feet of soil. Deeper roots anchor tree and also can absorb water.



Source: Lampinen et al, University of California Cooperative Extension

Management Considerations:

- Nitrogen moves with water so keep nitrogen in the root zone by managing in-season irrigation applications to keep irrigation water in the root zone, using such tools as ET and soil moisture sensors.
- Root distribution depends on irrigation system type
- Tree-to-tree sprinklers and flood irrigation creates expansive root systems
  - Place nitrogen near tree row where roots are concentrated.
- Micro sprinklers or double line drip irrigation encourages root development in smaller area.
  - Fertigation – injecting fertilizer during irrigations – is the most efficient method.

Fertigation best practice: always inject the fertilizer in the last half or quarter of an irrigation set, stopping the injection 10-15 minutes before the set is finished to ensure the system is adequately flushed.

RIGHT SOURCE

Goal: *Select best nitrogen fertilizer source for efficient uptake under growing conditions while minimizing excess nitrogen movement past the root zone.*

Management Considerations:

- Choose nitrogen fertilizer that will not move rapidly beyond the root zone
- High nitrate fertilizer sources will move rapidly through the soil with irrigation water and should be avoided if soils are light textured, if water percolates beyond root zone quickly or if the fertilizer application system does not allow application at the end of the irrigation event
- Fertigation through sprinklers or drip necessitates liquid formulation

Fertilizer	Nitrogen (%)	Urea	Ammonium	Nitrate	Leaching Potential	Soil Acidifier	Comments
Ammonium Nitrate	34%		X	X	Medium	Medium	Nitrate N immediately available. Ammonium N half delayed.
Ammonium Sulfate	21%		X		Low	High	Source of sulfur
Calcium Ammonium nitrate (CAN-17)	17%		X	X	Medium	Medium	
Calcium Nitrate	16%			X	High	No	Source of calcium
Urea	45%	X		X	Low	Low	
Urea Ammonium Nitrate (UN-32)	32%	X	X	X	Medium	Medium	Nitrate N immediately available. Remainder of N delayed.

MAY LEAF SAMPLING PROVIDES VITAL NUTRIENT STATUS

Leaf sampling results can provide valuable information to help you design a rational, plant-based fertilization regime. The results can guide your decisions on the right amount and right time.

New critical nitrogen values for May leaf sampling are now available* so results allow for adjustments to nitrogen applications June-August.

May leaf sampling steps:

- When nutlets are about 25% of normal size, select a healthy shoot that does not have any nutlets (non-fruiting spur).
- Select leaf that is in the sunlight at least part of the day.
- Remove terminal leaflet: not the full walnut leaf but just the terminal end.
- Collect 1 terminal leaf per quarter section of tree for a total of 4 terminal leaflets per tree (think of tree as a pie split into four quarters).
- Select trees at least 30 yards apart for total of 29 trees per orchard (if similar soil type throughout field).
- For dramatically different soil types, subdivide orchard into blocks based on the soil type; take 29 leaf samples from each area.
- Put all your leaflets in a paper bag, label the bag with an orchard identification and send them to your nutrient analysis lab of choice.
- If temperatures are warm, keep leaf samples in an ice chest.
- Analyze leaves for N, P, K, Ca, Mg and B and request Walnut Early Season Sampling

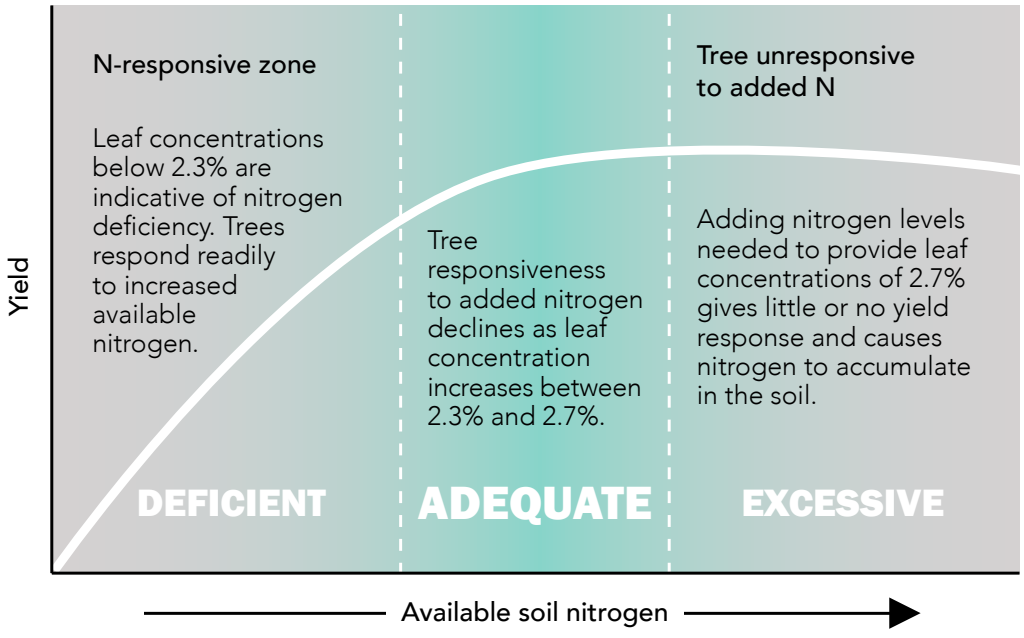
July Critical nitrogen values*

- Ideal range is 2.3% and 2.7% leaf nitrogen
- Beyond 2.3% generally no improvement in yields or tree health
- Above 2.7% potentially negative impacts such as excessive vegetative growth

Once you receive the leaf sample results, the nitrogen values can be input into CropManage. Most labs provide analysis for other nutrients as well which can also be added to your CropManage worksheet.

* See CropManage for May nitrogen values at www.cropmanage.ucanr.edu

Leaf Nitrate Levels and Available Soil Nitrogen



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