



Nitrogen, Early Leaf Sampling, and Orchard Variability

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Why Are We Discussing Nitrogen

Essential nutrient, Expensive, Environmental Regulations

Optimizing Yields

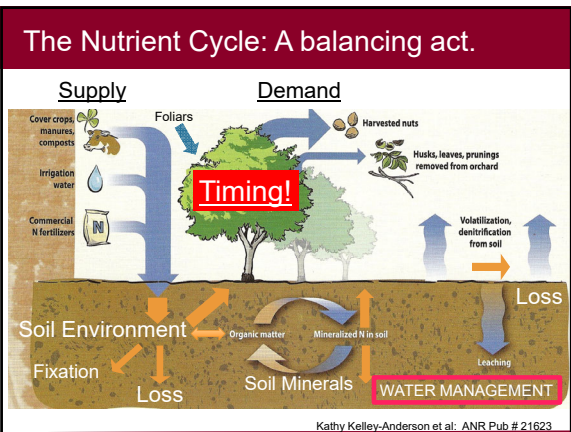
Pistachio Yield

Meeting Regulatory Requirements

NMP Management Unit			
1. Crop Year (Fiscal Year)	4. APN(s)	5. Field ID(s)	Address
2. Monitor Size			
3. Name			

GDP NITROGEN MANAGEMENT PLAN (NMP)		16. Approved	18. Approved
17. NITROGEN FERTILIZERS APPLIED		17.1	17.2
1. Crop	2. Fertilizer Type		
3. Application Rate	4. Application Date		
5. Application Method	6. Application Location		
7. Application Rate	8. Application Rate		
9. Application Rate	10. Application Rate		
11. Application Rate	12. Application Rate		
13. Application Rate	14. Application Rate		
15. Application Rate	16. Application Rate		

9th Advances in PISTACHIO PRODUCTION



Efficient Nutrient Management

The 4 R's + 1.

Nutrients are used most efficiently when you:

Apply the **Right Rate**

- Match tree demand with fertilizer supply.

At **Right Time**

- Apply nutrients when root uptake is most active.

In the **Right Place**

- Ensure delivery of nutrients to the active roots and not past the root zone.

Using the **Right Source**

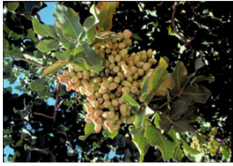

- Choose fertilizers sources that maximize uptake and minimize loss.

Management can be fine tuned by using:

- Soil testing (pH, salts, soil physical conditions, problem elements)
- Leaf analysis (critical values and orchard sampling)
- Nutrient Budgeting

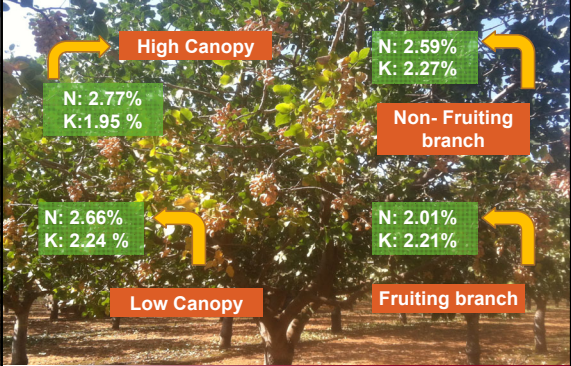
What do we know and how do we manage?

Leaf Sampling and Critical Value Analysis

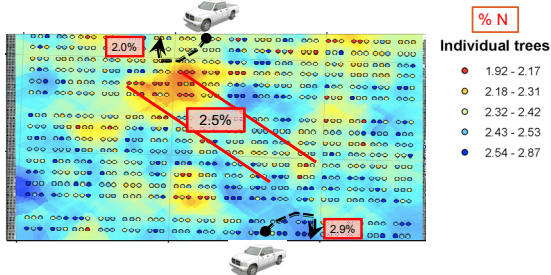
Element	Critical value	WARNING
		Adequate range
nitrogen (N)	1.8%	2.2-2.5%
phosphorus (P)	0.14%	0.14-0.17%
potassium (K)	1.6%	1.8-2.2%
calcium (Ca)	2.0%	2.1-4.0%
magnesium (Mg)	0.45%	0.5-1.2%
sodium (Na)	—	—
chlorine (Cl)	—	0.1-0.3%
manganese (Mn)	30 ppm	30-80 ppm
boron (B)	90 ppm	150-250 ppm
zinc (Zn)	7 ppm	10-15 ppm
copper (Cu)	4 ppm	6-10 ppm

Problem 1: Challenges of leaf sampling- Canopy variability



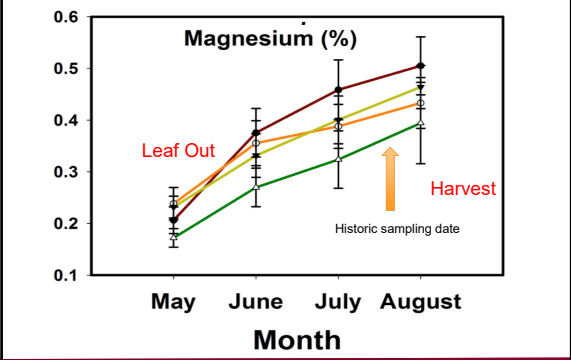
Problem 2: Field Variability

Common Sampling Practices are Inadequate:



What is the average nutrient concentration and how much variability is there?

Problem 3: Samples collected in July are too late in the season to influence management





Leaf Sampling And Interpretation Methods For CA Orchards.

Ismail Siddiqui, Sebastian Saa, Patrick Brown. UC Davis

Recommended Sampling Criteria



Sub-terminal Leaf on non-fruiting branch.



In non-uniform orchards, sample each soil or productivity zone separately.



13 trees at least 30 yards apart.
10 leaves per tree. Pooled

Ismail Siddiqui, Sebastian Saa, Patrick Brown. UC Davis

Recommended Sampling Criteria

Average Orchard (10-200 acre block. Spring or Summer Sampling)

- Collect sub terminal leaves from non-fruiting branches.
- Minimum of 13 trees each tree sampled at least 25-30 yards apart.
- In each tree collect 10 leaves around the canopy from well exposed branches located between 5-7 feet from the ground.
 - If cost is a constraint, samples can be pooled into a single sample for analysis to guide an individual orchards management
 - Analyze for the N, P, K, S, Ca, Mg, Cu, Zn, Fe, B
- In spring, collect samples soon after full leaf expansion (approx. 30-50 days after full bloom (DAFB), for standard sample collect in late July.

Non-Uniform Orchard:

- Repeat this process in each orchard zone of similar performance.

YES: Spring samples can effectively predict summer tissue values: UCD-PPM program

Site	Year	Summer predicted leaf N from spring sample	Summer measured leaf N.
Arbuckle	8	2.4	2.3
Belridge	8	2.4	2.4
Madera	8	2.5	2.4
Modesto	8	2.4	2.4
Arbuckle	9	2.4	2.5
Belridge	9	2.4	2.4
Madera	9	2.6	2.4
Modesto	9	2.6	2.7
Arbuckle	10	2.4	2.5
Belridge	10	2.3	2.7
Madera	10	2.3	2.3
Modesto	10	2.4	2.5

UCD-PPM
 Model for interpreting Spring Analysis can be found at:
 Google: FNRIC Pistachio early leaf sampling
 Or:
 Fruit Growers Lab currently uses the program.

Or Google "UCD PPM Pistachio"

<http://ucanr.edu/b/41860>

Collect samples properly approximately 40 days after bloom, submit to lab and request UCD-PPM

Efficient Nutrient Management Approach -the 4 R's-

Applying the **Right Rate**

- Match demand with supply (all inputs- fertilizer, organic N, water, soil).

At **Right Time**

- Maximize uptake minimize loss potential.

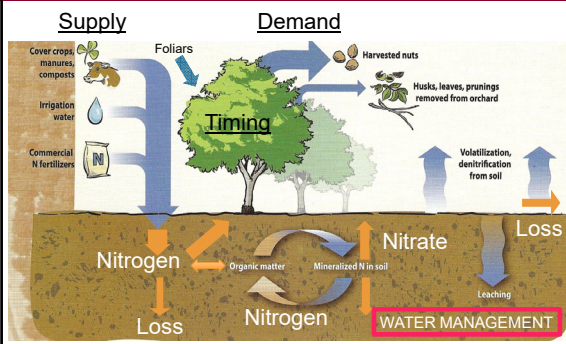
In the **Right Place**

- Ensure delivery to the active roots.

Using the **Right Source**

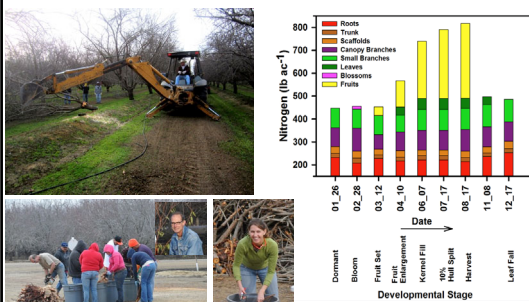
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The Nitrogen Cycle: A balancing act.

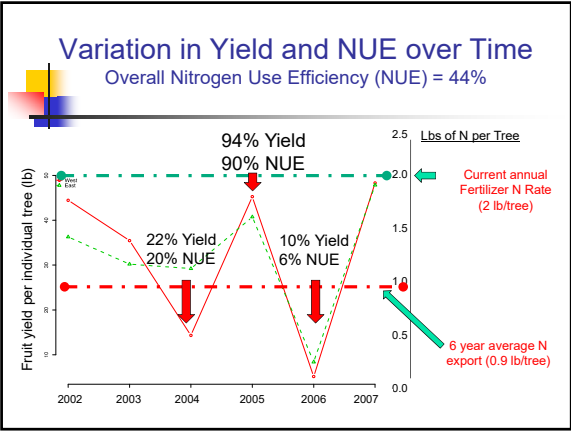


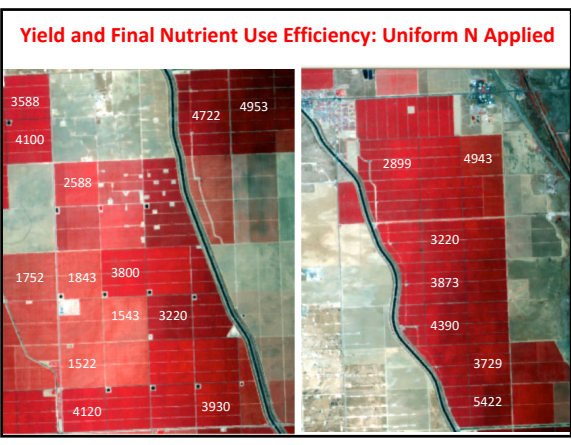
Kathy Kelley-Anderson et al. ANR Pub # 21623

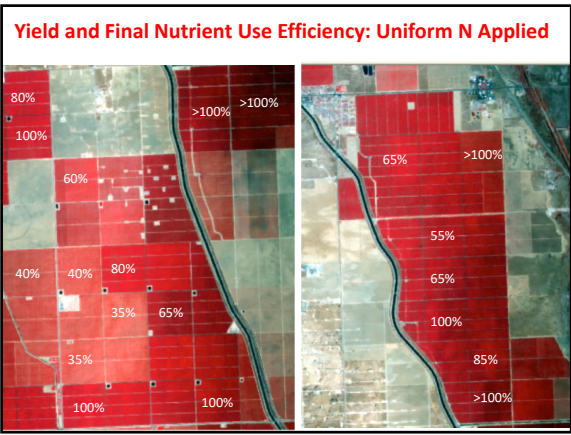
Right Rate: Plant Nutrient Demand



Muhammad, PhD Dissertation. 2013







Factors that Affect Nutrient Uptake

- Poor irrigation system design and scheduling
- Drought or flooded soils
- Weed competition
- Poor root growth: presence of hardpans, poor water infiltration, perched water tables, alkali spots
- Salinity (soil or water), pH, nutrient fixation
- Low soil temperature (microbial activity, root activity)
- Weather/climate, limitations of tree uptake and transport
- Nutrient imbalance and toxic elements
- Low or high native soil fertility for one or more nutrients
- Root disease (i.e. Verticillium wilt affects K uptake)



Environment Interacts with Nutrition.

Conclusions: Managing Nitrogen

Base your fertilization rate on realistic, orchard specific yield and adjust in response to spring nutrient and yield estimates.

- Make a pre-season fertilizer plan based on expected yield.
 - Pistachio 1000 lb CPC yield removes 28 lb N, 25 lb K and 3 lb P.
- Conduct leaf analysis following full leaf out.
- Using leaf analysis and updated yield estimate, adjust fertilization for remainder of season.
 - Uptake of N, K, P occurs uniformly from leaf out to harvest.
 - Apply up to 20% immediately post harvest, corrected for actual yield - but only if trees are healthy.
- Every field and every year is a unique decision, adjust fertilization accordingly.
