Fertilizer Management and Nutrient Budgeting

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Objectives

1. **Predict July leaf N % using an April sampling.**
2. **Develop a leaf sampling protocol representative of CA almond orchards.**
3. **Develop fertilizer response curves to relate nutrient demand with fertilizer rate and nutrient use efficiency.**
4. **Develop a phenology and yield based nutrient model for almond.**
5. **Deploy model in online system**

Results

Can we sample leaves in April and Predict July?

Overall, great fit between predicted and observed.

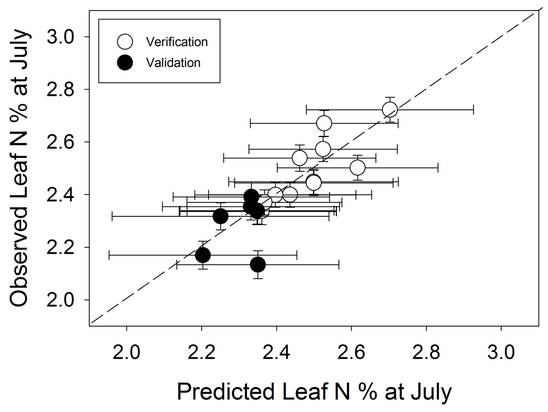
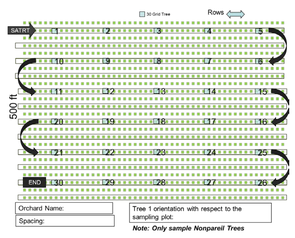


Figure 1. Verification (orchards and years used to develop the model) and validation (additional set of orchards) of the model performance. Dashed line is the 1:1 concurrence between predicted and observed values. Bars show the 95% confidence intervals. Circles represents average N % observed in July (y axis) and predicted by the model (x axis) with a sample of 30 pooled trees for the 18 site-year combinations in the study

The proper way to sample in April



1. Sample at 43+/-6 days after full bloom when the majority of leaves on non-fruiting spurs have reached full size
2. Identify six non fruiting spurs around the canopy
3. Use your hand and your thump nail to clamp all the leaves from each spur (picture below).
4. Collect leaves from 18-28 trees per orchard
5. Each sample tree must be at least 30 yards apart
6. Use a grid design if possible (left picture).
7. Send the samples to the lab and ask for a FULL NUTRIENT ANALYSIS (N, P, K, B, Ca, Zn, Cu, Fe, Mg, Mn, S) and application of UCD-ESP program.

Total Nutrient Demand

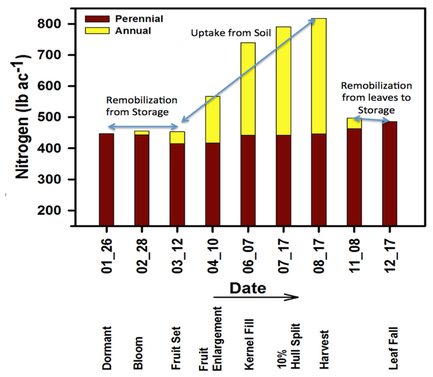


Figure 2. Changes in nitrogen accumulation in fruit and perennial organs of mature almond trees

How much is exported for every 1000 lb of Kernels produced?

Table 2. Nutrient Removal per 1000 lb of Kernel produced.

Nutrient removal Per 1,000 lb (Almond =Kernel equivalent)

Nonpareil
- N removal 68 lb per 1,000
- K removal 80 lb per 1,000
- P removal 8 lb per 1,000

Monterey
- N removal 65 lb per 1,000
- K removal 76 lb per 1,000
- P removal 7 lb per 1,000

Growth Requirement
- Yield 2,000 to 4,000 = 0 lb N
- Yield 1,000 to 2,000 = 20 lb N
- Yield <1,000 = 30 lb N

Timing of the Fertilization and Nitrogen Use Efficiency

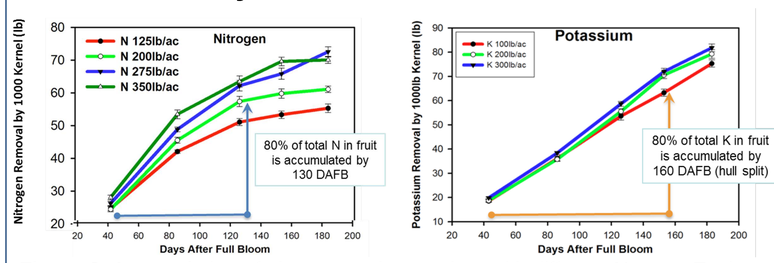


Figure 3. Accumulation of nitrogen and potassium with different N rates. Each point shows mean and std error

Nitrogen Use efficiency 2008 – 2010 under optimum treatment (275lbs of N/ac) was >80%

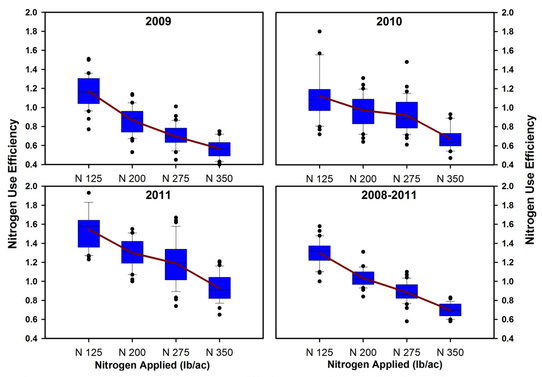
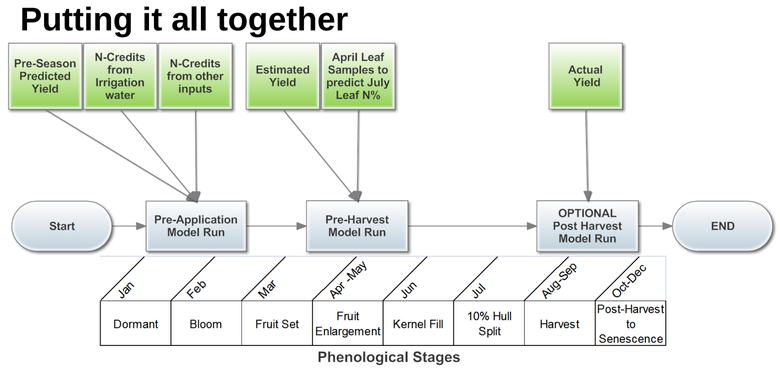


Figure 4. Nitrogen Use Efficiency (NUE) of various N rates. NUE calculated as N exported in fruits/N applied

Base your fertilization rate on realistic, orchard specific yield, account for all N inputs and adjust in response to spring nutrient and yield estimates.

- **<u>Every field, every year, is a unique decision</u>**

Putting it all together



Right Rate:

Match tree and crop demand with supply, taking into consideration the contribution of nutrients from all sources, including fertilizer, organic nitrogen, water and soil.

Assess plant nitrogen demand based on yield

Every 1000 lb of kernels harvested removes 68 lb N, 8 lb P and 80 lb K. Accurate yield estimates better reflect nitrogen demand. Revise yield estimates as conditions change.
- Pre-season predicted kernel yield
- Post-bloom estimated kernel yield
- Post-harvest actual kernel yield

Assess nitrogen contributions from all sources
- Nitrogen in irrigation water.
- Credits from soil amendments.

Assess tree nitrogen status to determine if OK or less than adequate.
- Post-bloom leaf samples can predict July leaf N%, an indicator of tree nitrogen status.

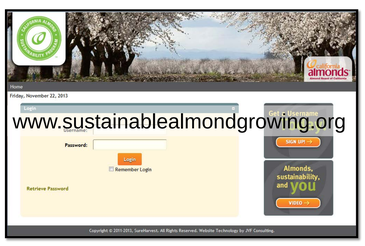
Right Time:

Spoon-feed applications during the growing season to maximize uptake and minimize loss potential.
- Most (~80%) N uptake between full leaf out and kernel fill.
- The remaining N uptake (~20%) between hull split and immediately post harvest.

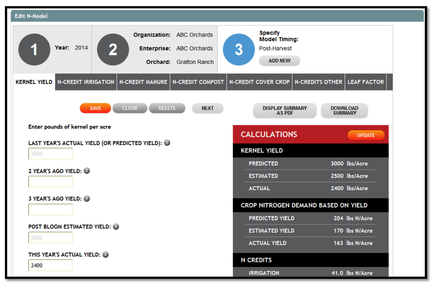
Right Place:

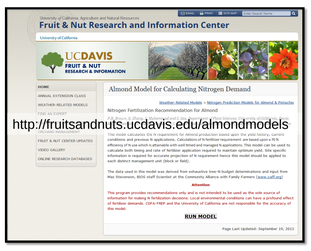
Ensure delivery to the active root zone.
- Fertigation often ensures highest nutrient use efficiency.
- If nitrogen is likely to be soil lost from the soil, consider applying nitrogen foliarly.

Web Resources for More Information and Models



Online Model Available for 2014 in CASP





California almonds AlmondBoard.com
cdfa California Department of Food and Agriculture
USDA United States Department of Agriculture | National Institute of Food and Agriculture | Specialty Crop Research Initiative Project
SureHarvest Sustainability from the Ground Up
Paramount Farming Company
Tessenderlo Kerley
YARA