



Nitrogen Management and Budgeting

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Almond Board of California





Workshop: Management of Nitrogen in Almonds

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Agenda

- Section 1: 25 minutes talk
- Section 2: 35 minutes hands-on work/discussion
- Section 3: 25 minutes CASP-SureHarvest model
- Section 4: 5 minutes evaluation form



Section one



New Nutrient Budgets and Leaf Sampling for Almond



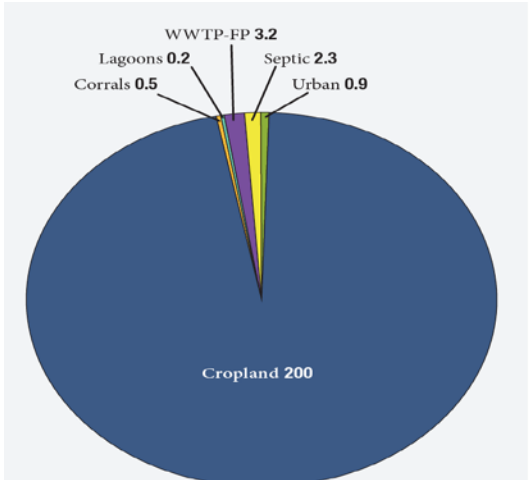


Nitrogen is essential for productivity but when managed poorly N results in environmental problems.

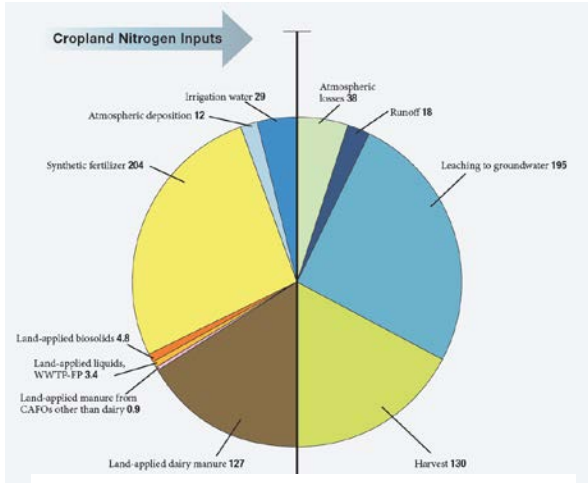


Nitrogen and Phosphorus have 'Escaped' from Farms and Contaminated Water Resources

Environmental Legislation is Forcing a Change in Farming Practices.

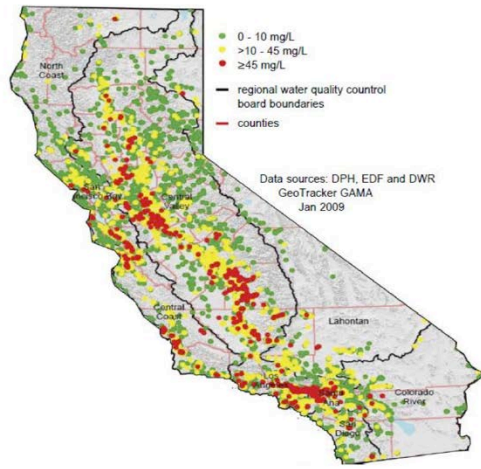


94% due to Crop Agriculture



Application = >200% of Need

>55% of Wells in SJV and Salinas are Contaminated and 250,000 People do Not Have Access to Clean Drinking Water



(Ekdahl and others, 2009; Harter Report, 2012)

Lakes, Streams and Estuaries Suffer When Nutrient and Sediment Load is too High.



Legislative Response: Mandated Nitrogen Management Planning



- Application rates will be based upon field specific crop N budget estimations, accounting for all applied N x 'efficiency factor' (60-80%).
 - New techniques for N monitoring and budgeting
 - Adoption of 'in-season' decision making and N management
- Certified Crop Advisor sign off required.
 - Training and certification process under development
 - Post season verification and reporting.
- In the short term this will be a self-reporting industry driven activity.
 - However, if improvements in ground water resources are not realized then a tightening of these regulations can be expected.
- Will require enhanced efficiency of N use. Site (orchard) specific management. In season monitoring and adjustment.
 - New online tools for management

Whenever there is a challenge, there
is also an opportunity...



...Improving the Efficiency of Nitrogen use
will Reduce Production Costs and Reduce
Environmental Impact



Efficient Nitrogen Management

-the 4 R's-

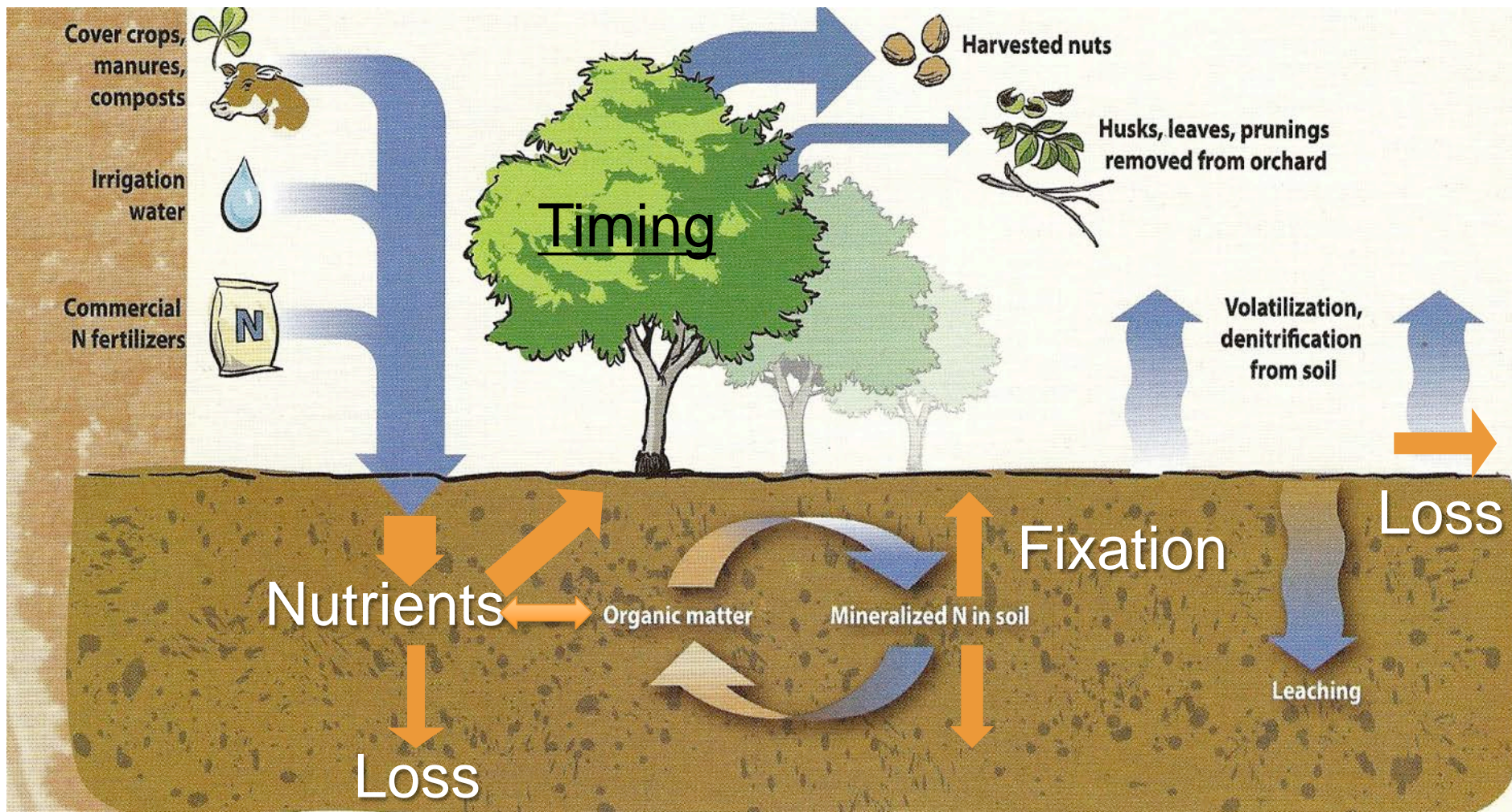


- Apply the **Right Rate**
 - Match supply with tree demand (all inputs- fertilizer, organic N, water, soil).
- Apply at the **Right Time**
 - Apply coincident with tree demand and root uptake.
- Apply in the **Right Place**
 - Ensure delivery to the active roots.
 - Minimize movement below root zone
- Using the **Right Source and Monitoring**
 - Maximize uptake, maximize response and minimize loss.

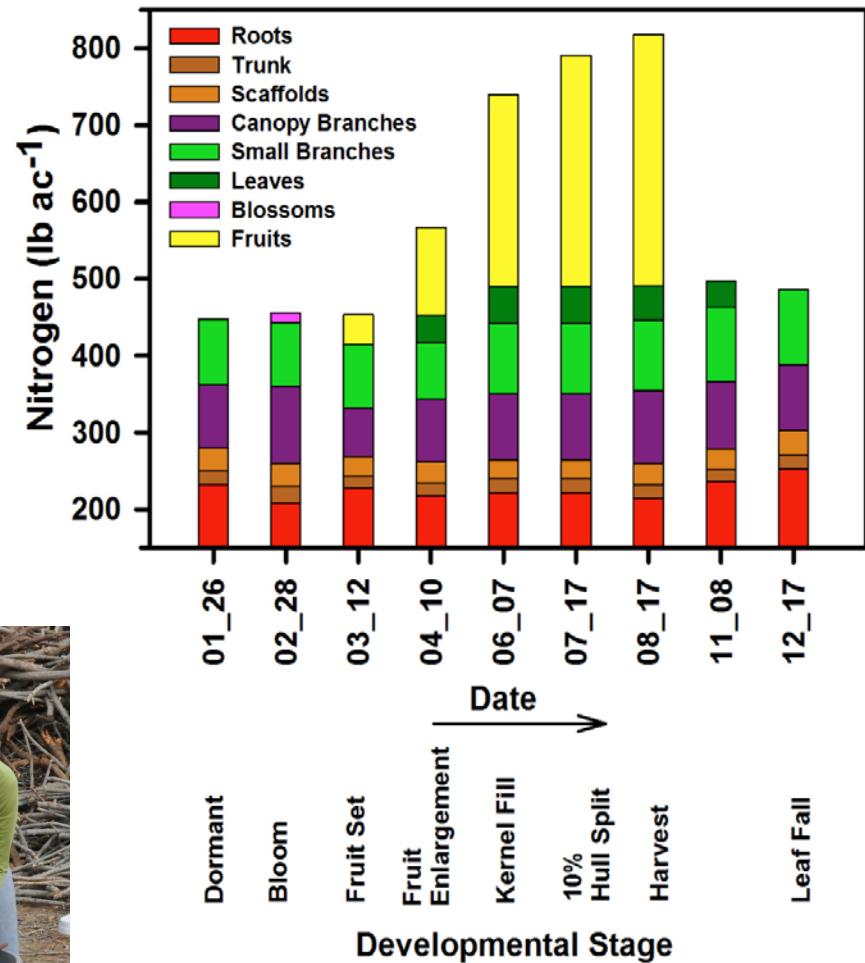
The 4 R's are specific to every orchard each year.

Optimizing N Use in CA Tree Crops.

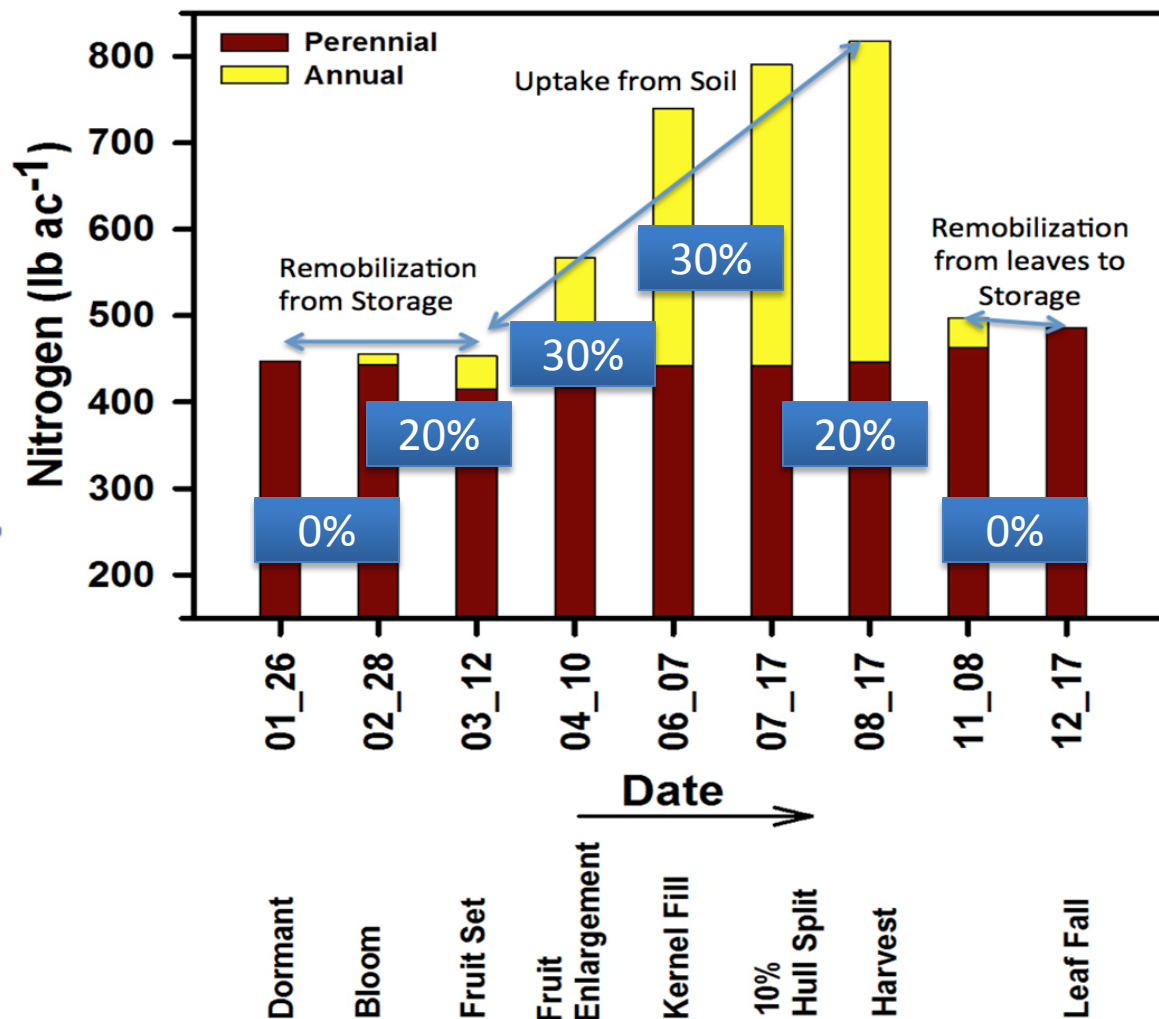
$$\text{Supply (Rate)} = \text{Demand (Amount and Timing)}$$



Right Rate and Right Timing



Total and Annual Dynamics of N in Mature Almond Tree (data from 12 year old trees)



Annual accumulation (Yield: 4,700 lbs)

2011: (320 lb N total)

Nuts = 90%
 Leaves = 2%
 Bloom = 4%
 Perennial = 5%

Around 20 lbs/acre of N were needed to support growth in this 12 year old 85% canopy cover orchard. In younger orchards and in low yield years the demand for N for growth may reach 40 lbs/acre.



Tree Nutrient Demand is Determined by Yield

Nutrient removal Per 1000 lb Kernels

Nonpareil

- N removal 68 lb per 1000
- K removal 80 lb per 1000

Right Rate:

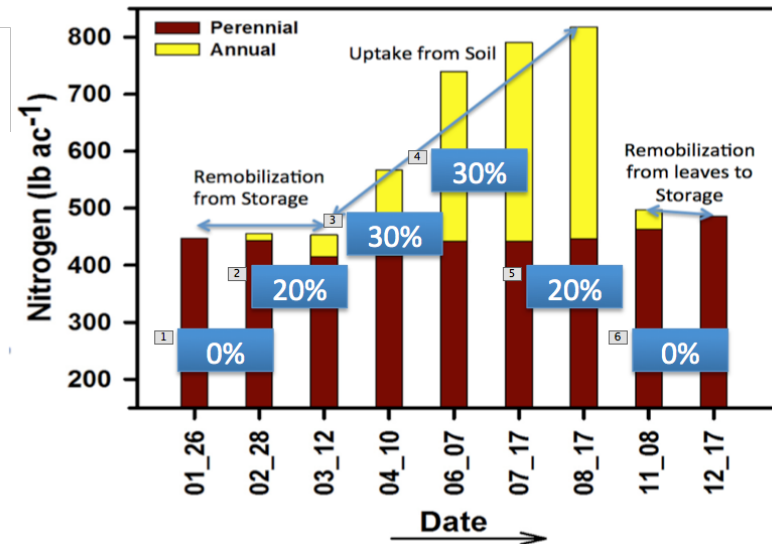
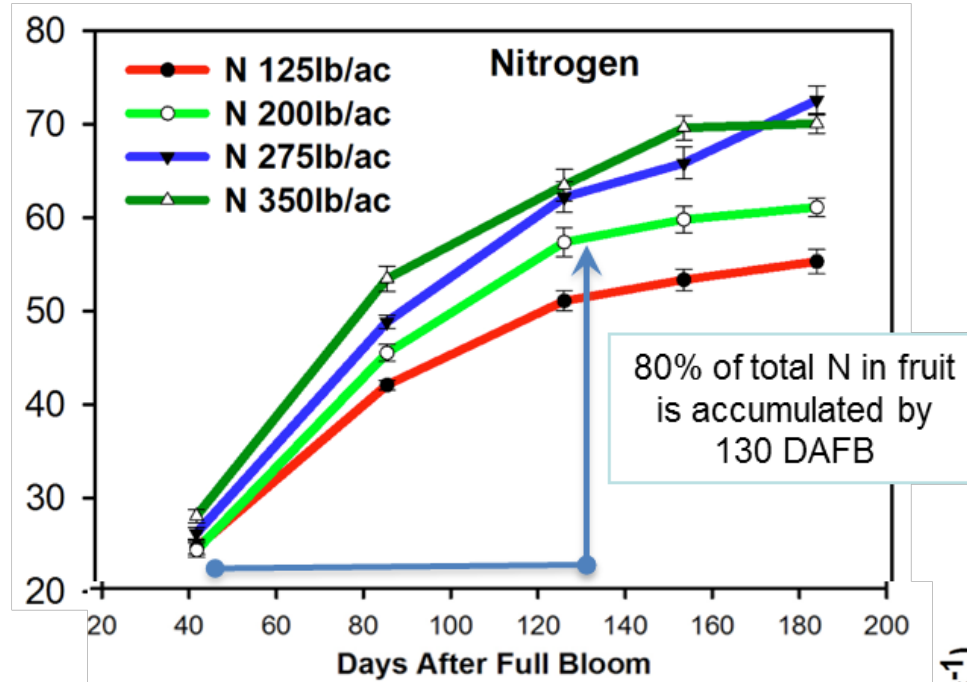
(Tree Nutrient Demand – N inputs)

**N inputs = N in Fertilizers, N in water,
N in soil**

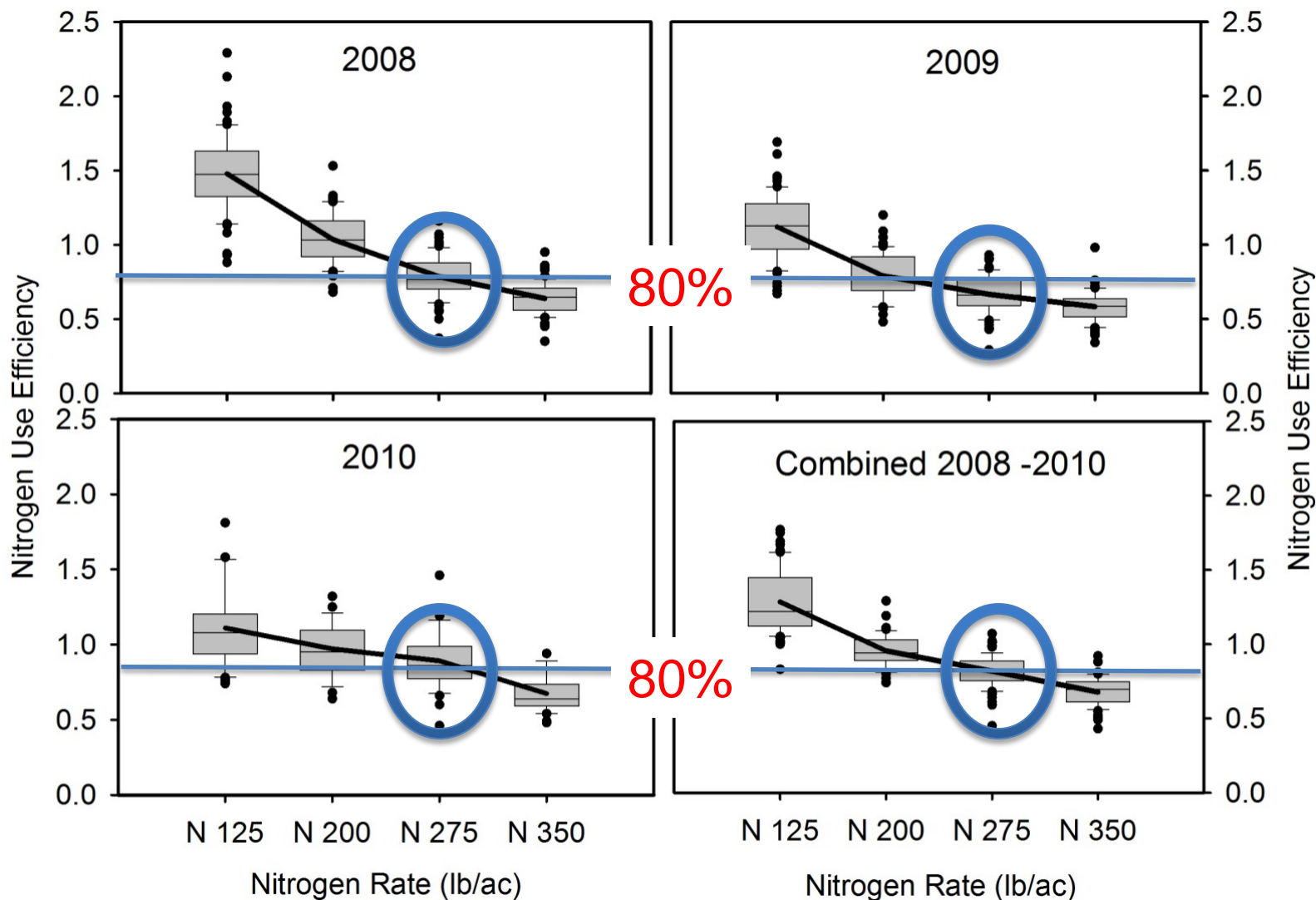
- Yield 2,000 to 4,000 = 0 lb N
- Yield 1,000 to 2,000 = 20 lb N
- Yield <1,000 = 30 lb N

What is the shape of N demand through the season?

Nitrogen Removal by 1000 Kernel (lb)



Nitrogen Use efficiency 2008 – 2010 under optimum treatment (N 275) was >80%.



NUE = N Export in Fruit/N Applied



Tree Demand, When to Apply, How efficient.

Tree Demand? = 68lbs of N for 1000lbs of kernel produced plus growth requirement (0-30 lbs)

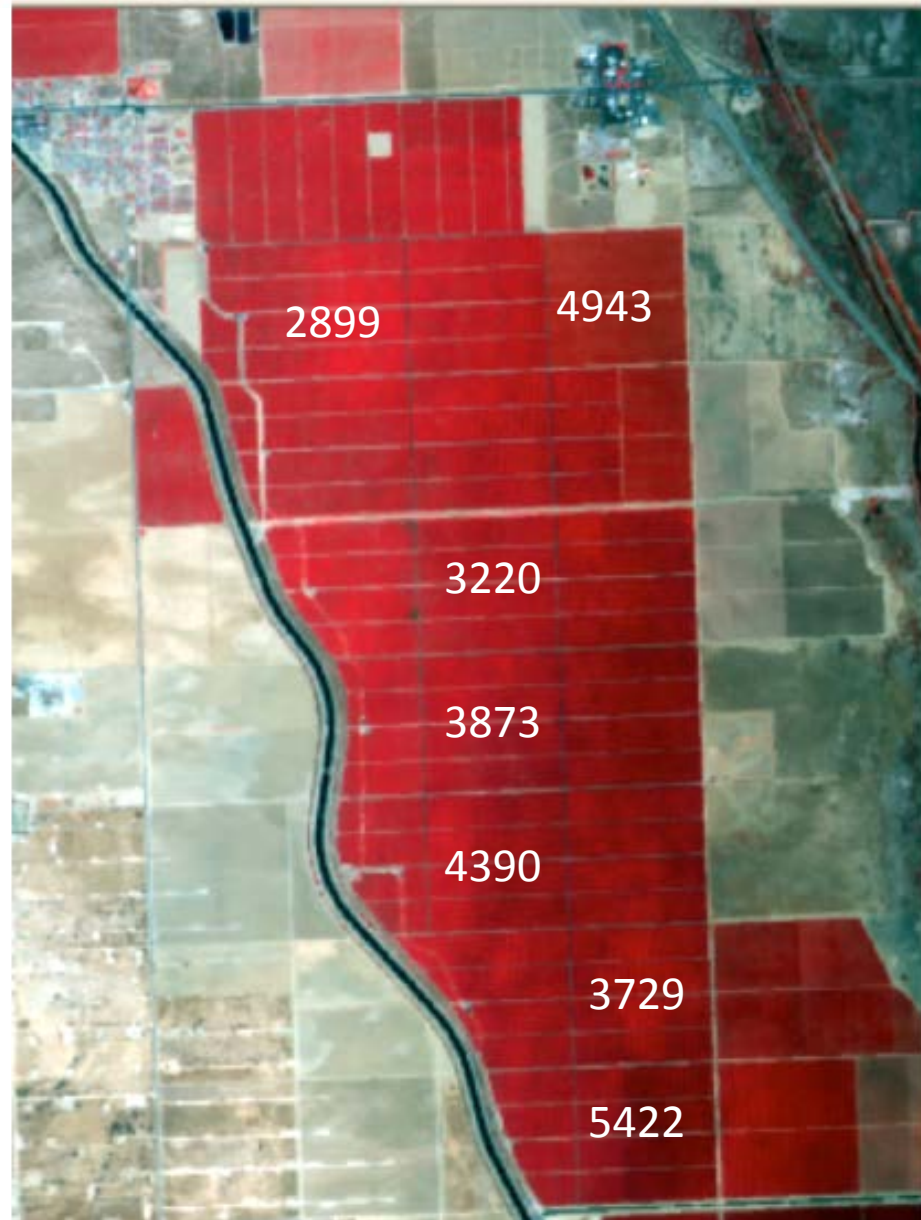
When to apply? = 80% during the first 4 months of growth, 20% post hull split – pre leaf senescence.

How efficient can we be if we do everything well? = 70% NUE

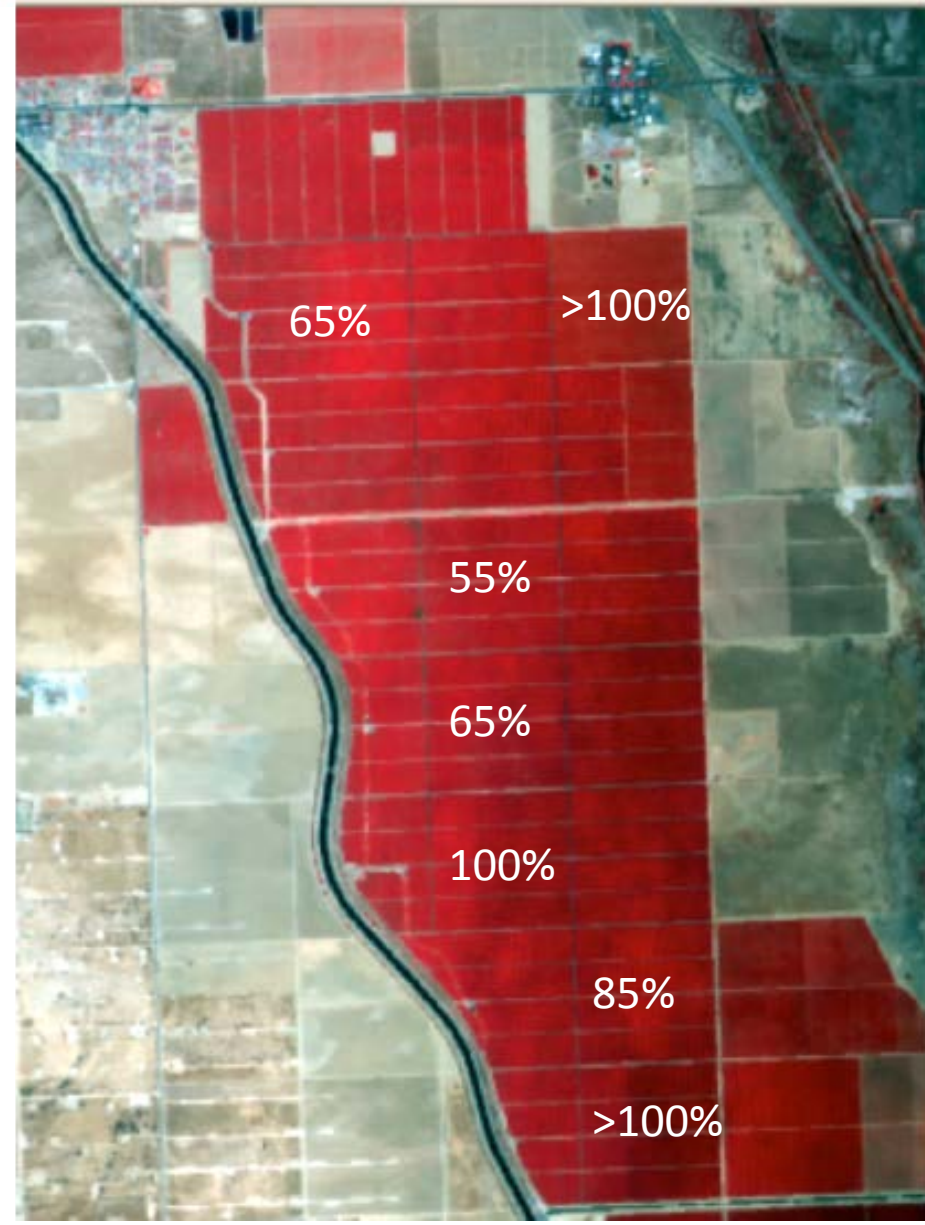


MANAGING MULTIPLE ORCHARDS:

Hypothetical Yield and Final Nutrient Use Efficiency: 275 Lbs N Applied



MAKING ONE FERTILIZATION DECISION FOR MULTIPLE ORCHARDS IS A RECIPE FOR LOST YIELD AND WASTED NITROGEN

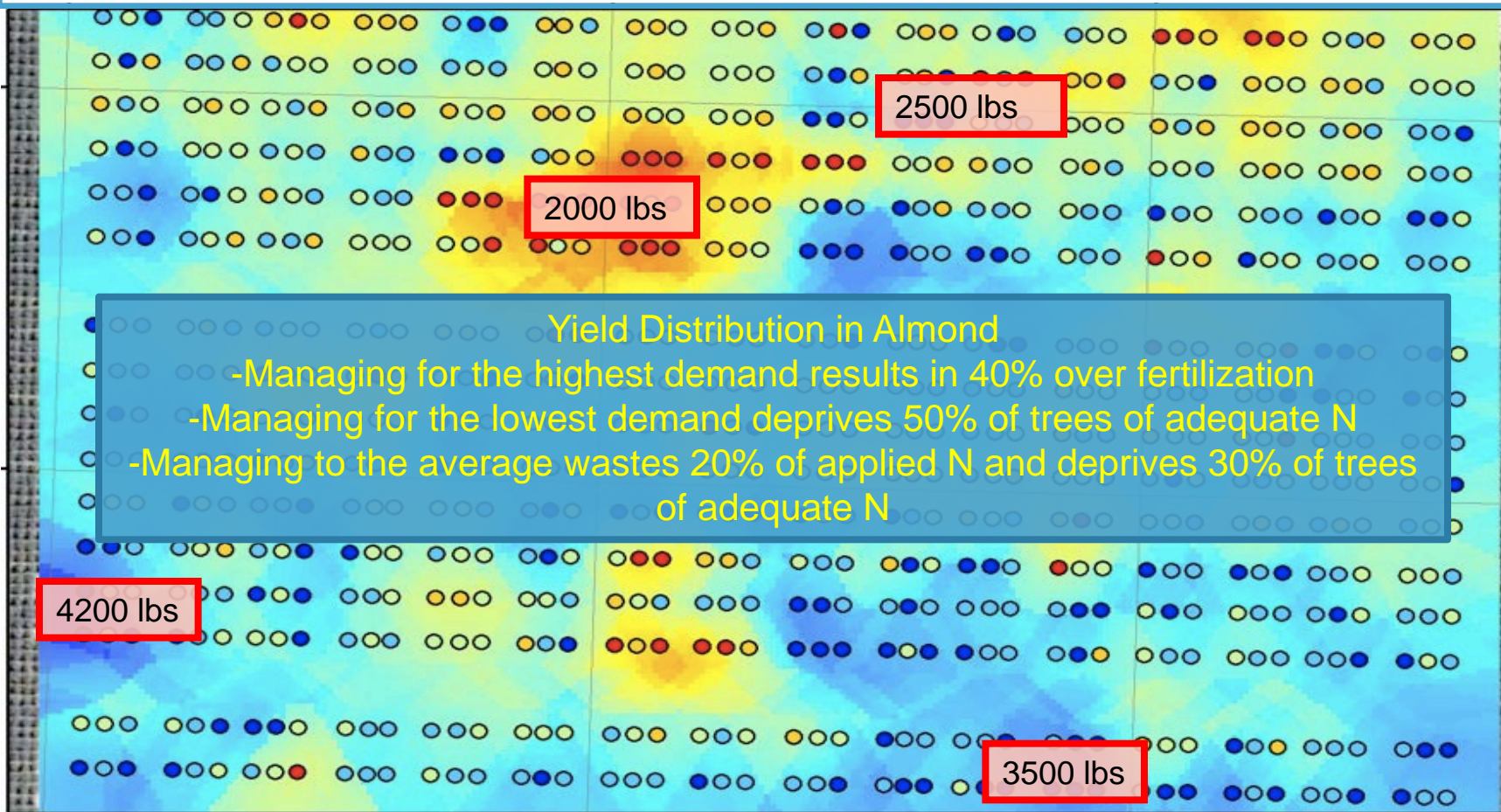


Right Place: Field Variability

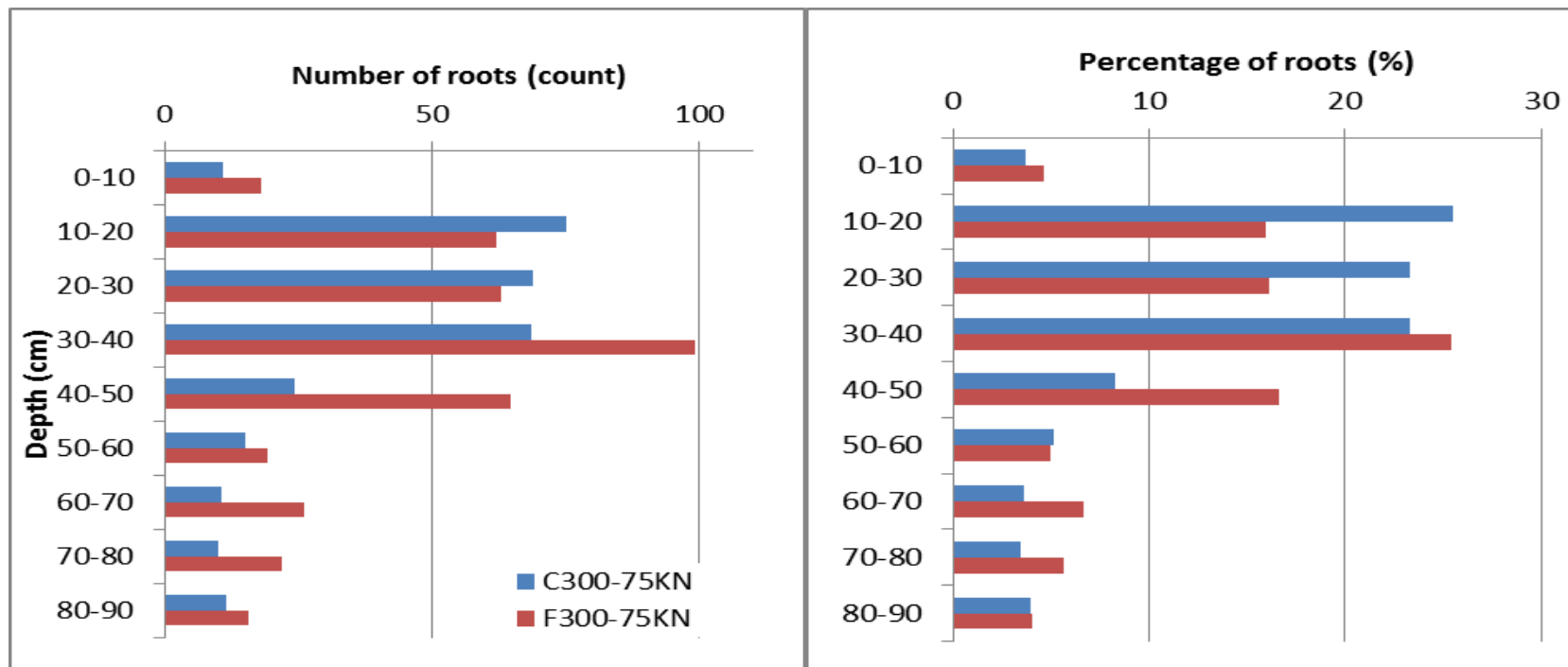
Compromises Efficiency:

If managed as a single plot– larger fields will always be less nutrient efficient than smaller fields.

Opportunity: Controlled release fertilizers – Improved fertigation systems
Precision Applications.



Right Place: Where does N uptake occur?



→ The majority of the roots are in the first 18 inches of soil.



Right Place: Irrigation Rapidly Moves N into Soil Surface applied N Followed by Irrigation (90 minutes)

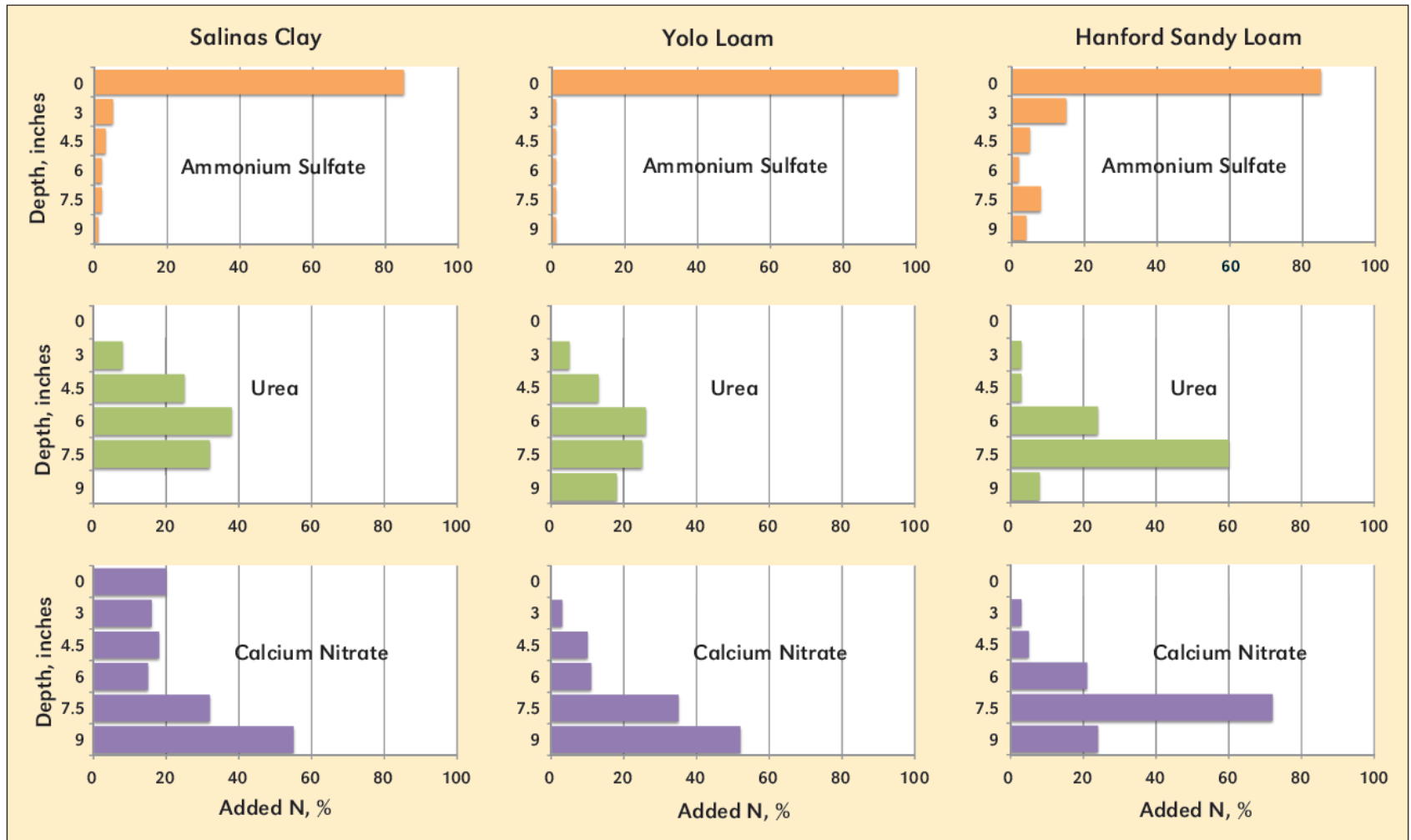


Figure 2. The movement of ammonium, urea, or nitrate in the surface 9 in. of three soils. The urea and calcium nitrate were applied to the soil surface and irrigated with a uniform amount of water. The ammonium sulfate was added as a solution. The soils were sampled 90 minutes after fertilizer and water application. (Broadbent et al., 1958).



Tree Demand, When to Apply, How efficient.

Tree Demand? = 68lbs of N for 1000lbs of kernel produced plus growth requirement (0-30 lbs)



When to apply? = 80% during the first 4 months of growth, 20% post hull split – pre leaf senescence.

How to Apply: Manage application/irrigation to keep N in the root zone.

How efficient can we be if we do everything well? = 70% NUE



**How do we monitor
our trees?**

**How do we predict
and adjust to ensure
optimal efficiency?**

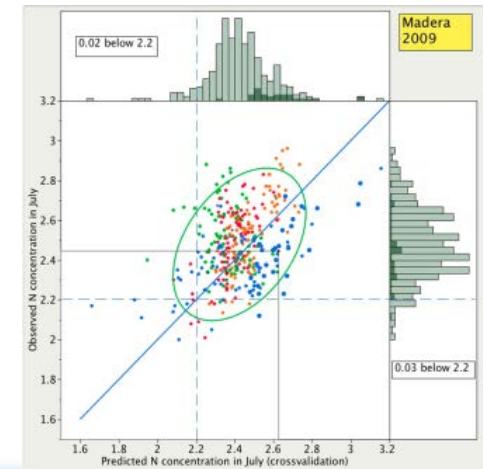


Early Leaf Sampling



Can we sample in April and Predict July?

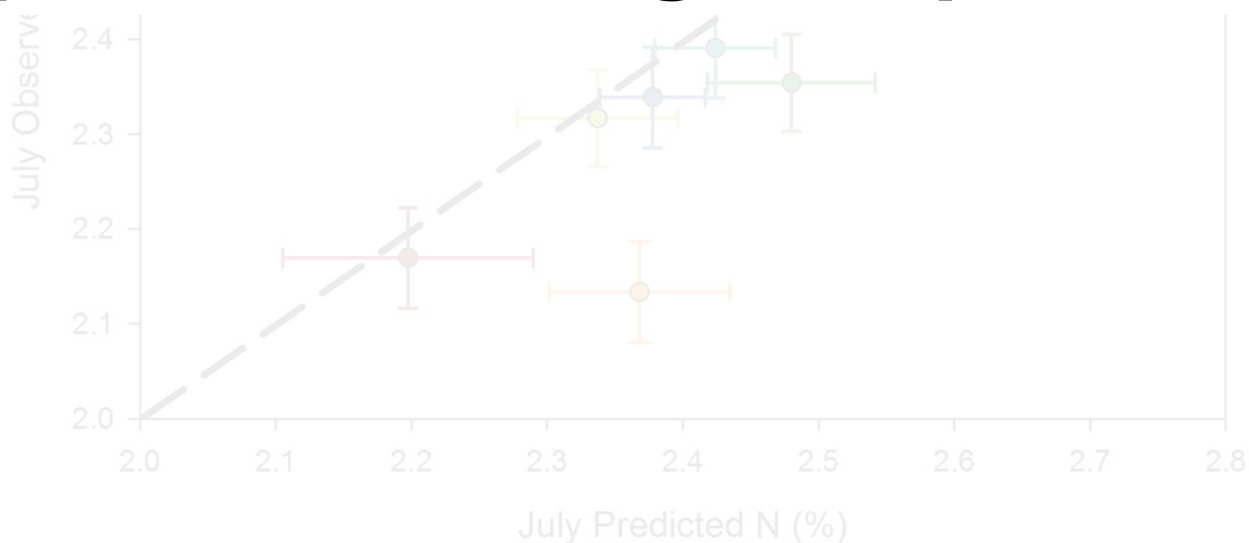
- To answer this question we collected data from different types of leaves, in multiple years and in multiple locations.
- Then, we developed 6 models in 2011.
- In 2012 we sampled 6 different orchards to check which one of the 6 models was the best one.



Results showed that one of the six models was very good at predicting July N concentration.



Validation data confirms that July N can be predicted using an April Sample.



This model requires to collect NF leaves in April.

Sampling Criteria



- Collect leaves from 18 to 28 trees in one bag (depending of the confidence level and on the number of acres).
- Each tree sampled at least 30 yards apart.
- In each tree collect leaves around the canopy from at least 8 well exposed spurs located between 5-7 feet from the ground.
- In April, collect samples at 8121 GDH +/- 1403 (43 days after full bloom (DAFB) +/- 6 days).
- If you would like to collect samples in July, then collect samples at 143 DAFB +/- 4 days. SAME RULES!

Conclusions: Managing Nitrogen in Almond



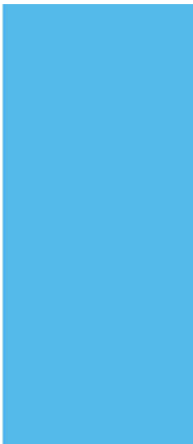
Base your fertilization rate on realistic, orchard specific yield, account for all N inputs and adjust in response to spring nutrient and yield estimates.

- **Make a preseason fertilizer plan based on expected yield LESS the N in irrigation and other inputs.**
 - 1000lb kernel removes from 68lb N, 8lb P and 80lb K.
- **Conduct (properly!) a leaf analysis following full leaf out.**
- **In May, review your leaf analysis results and your updated yield estimate, then adjust fertilization for remainder of season.**
- **At harvest review yields and adjust post harvest fertilization accordingly**
- **Time application to match demand in as many split applications as feasible**
 - 80% N uptake occurs from full leaf out to kernel fill.
 - Apply up to 20% hull split to immediately post harvest, corrected for actual yield - but only if trees are healthy. Use foliars if N loss is possible.
 - Optimize everything!
- **Every field, every year, is a unique decision**



Section two

35 minutes hands-on
work/ discussion



1. What do the 4Rs stand for? Circle four of the following options:



- a) Right Rate
- b) Right Source
- c) Right Weather
- d) Right Place
- e) Right Cultivar
- f) Right Time

2. How do you calculate the right rate?



- First, you need to know the tree nitrogen demand based on predicted yield.
- Second, you need to calculate all the N credits.
- Third, you calculate the amount of fertilizer needed.

3. If you know that for every 1,000 lbs. of kernel produced the tree demands 68 lbs of N, then how much N does the tree demand if your predicted yield is 3,000 lbs? Circle one:

a) 68 b) 124 **c) 204** d) 300 e) 400

Formula: Yield (lbs) x 0.068

A: $3000 \times 0.068 = 204$

4. Now, you need to account for all the N credits. Which of the following would be considered as N credit? Circle all that apply.

a) N in the Irrigation Water

b) N in Manure

c) N in the Compost

d) N in the Cover Crops

e) N in the soil below the rooting zone

5. Calculate your N credits for the following scenario in 2014:



a) Your Irrigation Water Contains Nitrate.

Lab reports 10 ppm Nitrate or 2.27 ppm Nitrate-N and you apply 48 inches of water

To convert Nitrate in water to lbs of N

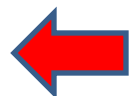
- Formula for Nitrate: Nitrate concentration (ppm) x inches irrigation applied x 0.052
- Formula for Nitrate-N: Nitrate-N concentration (ppm) x inches irrigation applied x 0.23

Answer = 25 lbs (10 x 48 x 0.052)



An estimated 70% of the N in the irrigation water will be available.

N Credit from Irrigation = 25 x 0.7 = 17.5 lbs N Credit



5. Calculate your N credits for the following scenario in 2014:



b) You use no manures

Answer= 0 lbs

5. Calculate your N credits for the following scenario in 2014:



d) You use no legume cover crop

Answer= 0 lbs

Summarizing:

a = Calculated N in the water → 17.5 lbs

b = Calculated N in the manures → 0 lbs

c = Calculated N in the compost → 40 lbs

d = Calculated N in the cover crop → 0 lbs

Total N Credits = a + b + c + d = 57.5 lbs of N credits.

6. Let's subtract "N credits" from the "N Tree Demand", which will give us the remaining amount of N needed to support 3,000 lbs yield.



(204 N Tree Demand) – (57.5 N credits) =

147 lbs N/Acre are still needed.

7. If managed properly (correct timing and placement) then an efficiency of 70% can be achieved. To convert this crop N demand into units of fertilizer N required, divide by 0.70.



147 / **0.70** = 210 lbs of N is the

recommended fertilizer application for a predicted production of 3,000lbs/acre and given the above N credits.

**8. Right Time: When during the growing season should I apply the 210 lbs of N fertilizer?
(Given 4 fertigation periods through year).**



Date	% of Total	lbs of N
Early Spring	20	
Fruit Growth	30	
Kernel Fill	30	
Fruit Maturity or Early Post-Harvest	20	

+ 210 lbs of N

8. Now let's suppose the following scenarios:

a) It is May 1st and you have already applied half of your planned fertilizer (Early Spring and Fruit Growth). You collected leaves in April and the prediction for July was that your trees were going to have “adequate N”. You also re-estimate your yield and it is still 3,000 lbs.

Do you need to change your original fertigation plan?

Answer: NO

8. Now let's suppose the following scenarios:

a) It is May 1st and you have already applied half of your planned fertilizer (Early Spring and Fruit Growth). You collected leaves in April and the prediction for July was that your trees were going to have “adequate N”. You also re-estimate your yield and it is still 3,000 lbs.

b) Same as case a), but your leaf N prediction says your trees are going to be “deficient in N”.

Answer: Increase remaining N fertilization by 20 lbs.

8. Now let's suppose the following scenarios:

a) It is May 1st and you have already applied half of your planned fertilizer (Early Spring and Fruit Growth). You collected leaves in April and the prediction for July was that your trees were going to have “adequate N”. You also re-estimate your yield and it is still 3,000 lbs.

c) Same as case a, but now your expected yield is actually 2,000 lbs (1,000 lbs less than originally predicted). What do you do?

Because you have already applied Early Spring and Fruit Growth you can only reduce fertilization in Kernel Fill and Fruit Maturity/Post-Harvest period.

Reduce original fertilization by $1000 \text{ lbs} * 0.068 / 0.70 = 97.2$

-You planned for 3000 lbs but only achieved 2000 lbs (June Drop)

Your Original Fertilization total for Kernel Fill and Fruit Maturity/Post-Harvest was = 105 lbs. N

This needs to be reduced by 97 due to reduced yield estimate:

$105 - 97 = 8 \text{ lbs}$

8 lbs should be applied 60% and 40% in the remaining two fertigations. (Note: In a case such as this with very low application rates you may choose a foliar fertilization or to combine fertilizations.)

Kernel Fill = $0.60 * 8 = 4.8$ (round to 5)

Fruit Maturity/Post-Harvest = $0.40 * 8 = 3.2$ (round to 3)

Your new fertilization plan...



Date	% of Total	Ibs of N Original Estimation	Ibs of N New Estimation
Early Spring	20	42	42
Fruit Growth	30	63	63
Kernel Fill	30	63	5
Fruit Maturity or Early Post-Harvest	20	42	3

If this adjustment is not made your final efficiency will be < 50%!!

8. Now let's suppose the following scenarios:

d) It is September 15th (right after harvest) and you have already applied 80% of your fertilization plan (Early Spring and Fruit Growth and Kernel Fill). You collected leaves in April and the leaf N prediction for July was that your trees were going to have “adequate N”. You predicted 3,000 lbs, however yields were actually 3,500 lbs. You have already applied 168 lbs of N fertilizer. What do you do?

You need to provide additional N for $500 \text{ lbs} * 0.068 / 0.70 = 49 \text{ lbs}$ in addition to the planned 42 lbs. $42 + 49 = 91 \text{ lbs N}$.

BEWARE: We do not recommend soil applications in excess of 75 lbs per acre Post Harvest. AND 75 lbs. fertigated N can ONLY be applied if trees are healthy. You may consider foliar application.

Date	% of Total	lbs of N Original Estimation	lbs of N New Estimation
Early Spring	20	42	42
Fruit Growth	30	63	63
Kernel Fill	30	63	63
Fruit Maturity or Early Post-Harvest	20	42	75

e) It is September 15th (right after harvest) and you have already applied 80% of your fertilization plan (Early Spring and Fruit Growth and Kernel Fill). You collected leaves in April and the leaf N prediction for July was that your trees were going to have “adequate N”. However, **your actual yields were 500 less than originally predicted (actual yield = 2,500).** What do you do?

You need to reduce the final fertilization by – 500 lbs*0.068/0.70 = 49 lbs. The planned Post-Harvest fertilization was 42 lbs.

Then, : 42-49= -7.

Thus, this application may be eliminated (Cost Savings!).

Your new fertilization plan...



Date	% of Total	lbs of N Original Estimation	lbs of N New Estimation
Early Spring	20	42	42
Fruit Growth	30	63	63
Kernel Fill	30	63	63
Fruit Maturity or Early Post- Harvest	20	42	0

10. Take Home Messages:



- Always consider your N credits since they can be an important source of N.
- Good yield estimates are essential.
- The more times you re-estimate your N budget during the season, the more chances you will have to apply what is needed.
- Postharvest applications are limited to tree uptake capacity. You should never apply more than 75 lbs, even if your calculations tell you to do so and ONLY if trees are healthy. Foliar N may be useful at this time.
- Your flexibility to correctly adjust your in-season fertilizer plan decreases as the season progresses.
- This type of exercise should be run in every individual orchard that you manage. Each orchard is unique with a unique history and nitrogen need.



Section three: 25 minutes CASP-SureHarvest model



Edit N-Model

1 Year: 2014 **2** Organization: ABC Orchards
Enterprise: ABC Orchards
Orchard: Gratton Ranch **3** Specify Model Timing: Post-Harvest
ADD NEW

KERNEL YIELD N-CREDIT IRRIGATION N-CREDIT MANURE N-CREDIT COMPOST N-CREDIT COVER CROP N-CREDITS OTHER LEAF FACTOR

SAVE CLOSE DELETE NEXT DISPLAY SUMMARY AS PDF DOWNLOAD SUMMARY

Enter pounds of kernel per acre

LAST YEAR'S ACTUAL YIELD (OR PREDICTED YIELD): ?

2 YEAR'S AGO YIELD: ?

3 YEAR'S AGO YIELD: ?

POST BLOOM ESTIMATED YIELD: ?

THIS YEAR'S ACTUAL YIELD: ?

CALCULATIONS UPDATE

KERNEL YIELD	
PREDICTED	3000 lbs/Acre
ESTIMATED	2500 lbs/Acre
ACTUAL	2400 lbs/Acre

CROP NITROGEN DEMAND BASED ON YIELD

PREDICTED YIELD	204 lbs N/Acre
ESTIMATED YIELD	170 lbs N/Acre
ACTUAL YIELD	163 lbs N/Acre

N CREDITS

IRRIGATION	41.0 lbs N/Acre
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California Almond Sustainability Program



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Monday, December 02, 2013

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Almonds,
sustainability,
and **you**



1 Year: 2014 2 Organization: ABC Orchards Enterprise: ABC Orchards Orchard: UC DAVIS TEST block 3 Specify Model Timing: Pre-Application ADD NEW

KERNEL YIELD N-CREDIT IRRIGATION N-CREDIT MANURE N-CREDIT COMPOST N-CREDIT COVER CROP N-CREDITS OTHER LEAF FACTOR

SAVE CLOSE DELETE NEXT DISPLAY SUMMARY A&PDF DOWNLOAD SUMMARY

Enter pounds of kernel per acre

LAST YEAR'S ACTUAL YIELD (OR THIS YEAR'S PREDICTED YIELD): 3000

2 YEAR'S AGO YIELD:

3 YEAR'S AGO YIELD:

POST BLOOM ESTIMATED YIELD:

THIS YEAR'S ACTUAL YIELD:

CALCULATIONS UPDATE

KERNEL YIELD	
PREDICTED	3000 lbs/Acre
ESTIMATED	lbs/Acre
ACTUAL	lbs/Acre

CROP NITROGEN DEMAND BASED ON YIELD	
PREDICTED YIELD	204 lbs N/Acre
ESTIMATED YIELD	lbs N/Acre
ACTUAL YIELD	lbs N/Acre

N CREDITS	
IRRIGATION	25.0 lbs N/Acre
MANURE	lbs N/Acre
COMPOST	40.0 lbs N/Acre
COVER CROP	lbs N/Acre
OTHER N-CREDITS	lbs N/Acre
SUM OF N-CREDITS	65.0 lbs N/Acre

PREDICTED JULY LEAF N%

RECOMMENDED APPLICATIONS	
ASSUMES 70% NUTRIENT USE EFFICIENCY. YOUR RESULTS MAY VARY.	
EARLY SPRING (ES)	42 lbs N/Acre
FRUIT GROWTH (FG)	63 lbs N/Acre
KERNEL FILL (KF)	63 lbs N/Acre
FRUIT MATURITY OR EARLY POST-HARVEST (FM/PH)	42 lbs N/Acre
TOTAL RECOMMENDED N	210 lbs N/Acre

This recommendation is not intended to be used as the sole source of information for making fertilization decisions. Local environmental conditions can have a profound effect on fertilizer demands. The Almond Board of California, the University of California, and the California State University are not responsible for the accuracy of this model.

California Almond Sustainability Program

sustainablealmondgrowing.org

4Rs Framework



Yield-based crop demand, N-Credits & UC research



Home Events ▾ Assessments ▾ N Modeling Reports ▾ Web Resources ABC Admin ▾

Monday, December 02, 2013

Welcome back Administrator! (v1.5.7) Need Help? | Logout

Edit N-Model

[N Modeling Help](#)

1

Year: 2014

2

Organization: ABC Orchards
Enterprise: ABC Orchards
Orchard: UC DAVIS TEST block

3

Specify Model Timing:
Pre-Application

[ADD NEW](#)

KERNEL YIELD

N-CREDIT IRRIGATION

N-CREDIT MANURE

N-CREDIT COMPOST

N-CREDIT COVER CROP

N-CREDITS OTHER

LEAF FACTOR

[SAVE](#)

[CLOSE](#)

[DELETE](#)

[NEXT](#)

[DISPLAY SUMMARY AS PDF](#)

[DOWNLOAD SUMMARY](#)

4Rs Framework



Yield-based crop demand

KERNEL YIELD | N-CREDIT IRRIGATION | N-CREDIT MANURE | N-CREDIT COMPOST

SAVE | **CLOSE** | **DELETE** | **NEXT**

Enter pounds of kernel per acre

LAST YEAR'S ACTUAL YIELD (OR THIS YEAR'S PREDICTED YIELD): ?

2 YEAR'S AGO YIELD: ?

3 YEAR'S AGO YIELD: ?

POST BLOOM ESTIMATED YIELD: ?

THIS YEAR'S ACTUAL YIELD: ?

CALCULATIONS

UPDATE

KERNEL YIELD

PREDICTED	3000 lbs/Acre
ESTIMATED	lbs/Acre
ACTUAL	lbs/Acre

CROP NITROGEN DEMAND BASED ON YIELD

PREDICTED YIELD	204 lbs N/Acre
ESTIMATED YIELD	lbs N/Acre
ACTUAL YIELD	lbs N/Acre

4Rs Framework



N-Credits

N-CREDIT IRRIGATION

N-CREDIT MANURE

N-CREDIT COMPOST

N-CREDIT COVER CROP

N-CREDITS OTHER

4Rs Framework



UC research

LEAF FACTOR

SPECIFY PREDICTION METHOD: ?

DIRECT ENTRY UNPROCESSED LAB RESULTS

PREDICTED JULY N %: ?

APRIL LEAF VALUES ?

N %:

K %:

B (PPM):

CA %:

MG %:

Does the math for you



KERNEL YIELD

N-CREDIT IRRIGATION

N-CREDIT MANURE

N-CREDIT COMPOST

N-CREDIT COVER CROP

N-CREDITS OTHER

LEAF FACTOR

SAVE

CLOSE

DELETE

NEXT

DISPLAY SUMMARY
AS PDF

DOWNLOAD
SUMMARY

Enter pounds of kernel per acre

LAST YEAR'S ACTUAL YIELD (OR THIS YEAR'S PREDICTED YIELD): ?

3000

2 YEAR'S AGO YIELD: ?

3 YEAR'S AGO YIELD: ?

POST BLOOM ESTIMATED YIELD: ?

THIS YEAR'S ACTUAL YIELD: ?

CALCULATIONS

UPDATE

KERNEL YIELD

PREDICTED	3000 lbs/Acre
ESTIMATED	lbs/Acre
ACTUAL	lbs/Acre

CROP NITROGEN DEMAND BASED ON YIELD

PREDICTED YIELD	204 lbs N/Acre
ESTIMATED YIELD	lbs N/Acre
ACTUAL YIELD	lbs N/Acre

Does the math for you



KERNEL YIELD **N-CREDIT IRRIGATION** **N-CREDIT MANURE** **N-CREDIT COMPOST**

PREVIOUS **SAVE** **CLOSE** **DELETE** **NEXT**

ESTIMATE OF PREDICTED SEASON'S IRRIGATION WATER: ?

Acre-in

UNIT OF MEASURE USED BY LAB: ?

NO3 NO3-N

LAB MEASUREMENT: ?

PPM

N CREDITS	
IRRIGATION	25.0 lbs N/Acre
MANURE	lbs N/Acre
COMPOST	40.0 lbs N/Acre
COVER CROP	lbs N/Acre
OTHER N-CREDITS	lbs N/Acre
SUM OF N-CREDITS	65.0 lbs N/Acre

Does the math for you



KERNEL YIELD

N-CREDIT IRRIGATION

N-CREDIT MANURE

N-CREDIT COMPOST

PREVIOUS

SAVE

CLOSE

DELETE

NEXT

COMPOST TYPE: ?

Medium Composted



COMPOST TONS/ACRE: ?

5

COMPOST ANALYSIS (%N): ?

1

N CREDITS

IRRIGATION

25.0 lbs N/Acre

MANURE

lbs N/Acre

COMPOST

40.0 lbs N/Acre

COVER CROP

lbs N/Acre

OTHER N-CREDITS

lbs N/Acre

SUM OF N-CREDITS

65.0 lbs N/Acre

Does the math for you



RECOMMENDED APPLICATIONS

ASSUMES 70% NUTRIENT USE EFFICIENCY.
YOUR RESULTS MAY VARY.

EARLY SPRING (ES)	42 lbs N/Acre
FRUIT GROWTH (FG)	63 lbs N/Acre
KERNEL FILL (KF)	63 lbs N/Acre
FRUIT MATURITY OR EARLY POST-HARVEST (FM/PH)	42 lbs N/Acre
TOTAL RECOMMENDED N	210 lbs N/Acre

The fine print

This recommendation is not intended to be used as the sole source of information for making fertilization decisions. Local environmental conditions can have a profound effect on fertilizer demands. The Almond Board of California, the University of California, and the California State University are not responsible for the accuracy of this model.

Scenario – Harvested yield 500 lbs higher



Enter pounds of kernel per acre

LAST YEAR'S ACTUAL YIELD (OR THIS YEAR'S PREDICTED YIELD): ?

3000

2 YEAR'S AGO YIELD: ?

3 YEAR'S AGO YIELD: ?

POST BLOOM ESTIMATED YIELD: ?

3000

THIS YEAR'S ACTUAL YIELD: ?

3500

CROP NITROGEN DEMAND BASED ON YIELD

PREDICTED YIELD	204 lbs N/Acre
ESTIMATED YIELD	204 lbs N/Acre
ACTUAL YIELD	238 lbs N/Acre

RECOMMENDED APPLICATIONS

ASSUMES 70% NUTRIENT USE EFFICIENCY.
YOUR RESULTS MAY VARY.

EARLY SPRING (ES)	42 lbs N/Acre
FRUIT GROWTH (FG)	63 lbs N/Acre
KERNEL FILL (KF)	63 lbs N/Acre
FRUIT MATURITY OR EARLY POST-HARVEST (FM/PH)	85 lbs N/Acre
TOTAL RECOMMENDED N	253 lbs N/Acre

Scenario – Harvested yield 500 lbs lower



Enter pounds of kernel per acre

LAST YEAR'S ACTUAL YIELD (OR THIS YEAR'S PREDICTED YIELD): ?

3000

2 YEAR'S AGO YIELD: ?

3 YEAR'S AGO YIELD: ?

POST BLOOM ESTIMATED YIELD: ?

3000

THIS YEAR'S ACTUAL YIELD: ?

2500

CROP NITROGEN DEMAND BASED ON YIELD

PREDICTED YIELD	204 lbs N/Acre
ESTIMATED YIELD	204 lbs N/Acre
ACTUAL YIELD	170 lbs N/Acre

RECOMMENDED APPLICATIONS

ASSUMES 70% NUTRIENT USE EFFICIENCY.
YOUR RESULTS MAY VARY.

EARLY SPRING (ES)	42 lbs N/Acre
FRUIT GROWTH (FG)	63 lbs N/Acre
KERNEL FILL (KF)	63 lbs N/Acre
FRUIT MATURITY OR EARLY POST-HARVEST (FM/PH)	-10 lbs N/Acre
TOTAL RECOMMENDED N	158 lbs N/Acre

California Almond Sustainability Program



Home Events ▾ Assessments ▾ N Modeling Reports ▾ Web Resources ABC Admin ▾

Monday, December 02, 2013

Welcome back Administrator! (v1.5.7) Need Help? | Logout

NModeling

[N Modeling Help](#)

Year: ▾

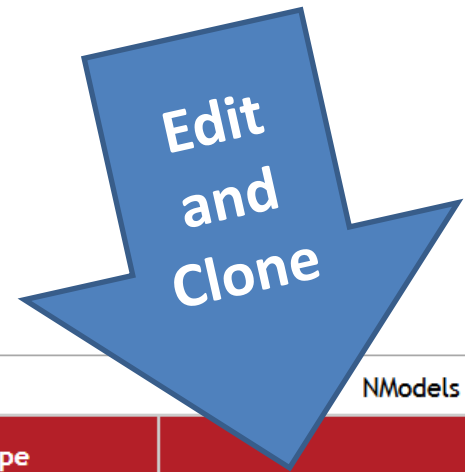
Organization: ▾

Enterprise: ▾

Ochard: ▾

Model Timing: ▾

ADD N MODEL



View By Pages Export

NModels 1-3 of 3

Year	Organization	Enterprise	Facility	Type	
2014	ABC Orchards	ABC Orchards	UC DAVIS TEST block	Pre-Application	<input type="button" value="EDIT"/> <input type="button" value="CLONE"/>
2014	ABC Orchards	ABC Orchards	UC DAVIS TEST block	Pre-Harvest	<input type="button" value="EDIT"/> <input type="button" value="CLONE"/>
2014	ABC Orchards	ABC Orchards	UC DAVIS TEST block	Post-Harvest	<input type="button" value="EDIT"/> <input type="button" value="CLONE"/>

California Almond Sustainability Program



Display
PDF or
export
data

Edit N-Model

N Modeling Help

1 Year: 2014

2 Organization: ABC Orchards
Enterprise: ABC Orchards
Orchard: UC DAVIS TEST block

3 Special Mode

KERNEL YIELD N-CREDIT IRRIGATION N-CREDIT MANURE N-CREDIT COMPOST N-CREDIT COVER CROP N-C... LEAF FACTOR

SAVE CLOSE DELETE NEXT DISPLAY SUMMARY AS PDF DOWNLOAD SUMMARY

N MODEL

CALCULATIONS

CRITERIA

KERNEL YIELD

YEAR 2014
ORGANIZATION ABC ORCHARDS

PREDICTED 3000 LBS/ACRE

ENTERPRISE
ORCHARD

TIMING

RECOMMENDED APPLICATIONS

ASSUMES 70% NUTRIENT USE EFFICIENCY.
YOUR RESULTS MAY VARY.

KERNEL YIELD

PREDICTED
ESTIMATED
ACTUAL YIELD

EARLY SPRING (ES) 42 LBS N/ACRE

FRUIT GROWTH (FG) 63 LBS N/ACRE

N-CREDIT IRRIGATION

AMOUNT (ACRE)
METHOD
PPM

KERNEL FILL (KF) 63 LBS N/ACRE

FRUIT MATURITY OR EARLY
POST-HARVEST (FM/PH) 42 LBS N/ACRE

N-CREDIT MANURE

LAST YEAR
TYPE

TOTAL RECOMMENDED N 210 LBS N/ACRE

LAST YEAR
TONS/ACRE
TWO YEARS
MANURE TYPE
TWO YEARS
MANURE TONNAGE

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N-CREDIT COMPOST

COMPOST TYPE
COMPOST TONNAGE
COMPOST APPLICATION RATE

N-CREDIT COVER CROPS

LEGUME COVER CROP TYPE
COVER CROP INCORPORATION METHOD

N-CREDIT OTHERS

OTHER N-CREDIT CARRY OVER LBS
N/ACRE
OTHER N-CREDIT DESCRIPTION

This recommendation is not intended to be used as the sole source of information for making fertilization decisions. Local environmental conditions can have a profound effect on fertilizer demands. The Almond Board of California, the University of California, and the California State University are not responsible for the accuracy of this model.



Section four

Evaluation



Evaluation: (ALL ANSWERS ARE ANONYMOUS)



A) Are You (Circle all that apply):

- 1) A grower who makes his or her own fertilization recommendations
- 2) A grower who works collaboratively with a CCA/PCA or Agronomist to make fertilization recommendations
- 3) A grower who predominantly relies (>80%) on the fertilization recommendations made by a CCA/PCA or Agronomist
- 4) A PCA/CCA or Agronomist who makes recommendations for growers

A) In January (pre-bloom) can you estimate your MAXIMUM potential yield within:

- 1) 2,000
- 2) 1,000
- 3) 500
- 4) No idea

Evaluation: (ALL ANSWERS ARE ANONYMOUS)



C) In late-April, early May (after full leaf out and after fruit set), I can estimate my yield within:

- 1) 2,000 lbs.
- 2) 1,000 lbs.
- 3) 500 lbs.
- 4) No idea

D) At what date are you confident within 750 lbs. of your final yield?

- 1) After it is harvested
- 2) In June
- 3) In July
- 4) At Hull Split

E) I currently manage each individual orchard block according to its yield potential:

- 1) Yes
- 2) No
- 3) I have not in the past but I will now.

Evaluation: (ALL ANSWERS ARE ANONYMOUS)



F) Will you, or the person who manages your fertilizer program, use the new N Model that was shown today?

- 1) Yes
- 2) No

If not, why not.....

.....

.....

.....

G) What is the minimum amount of N that you would apply to an orchard (>7 years old)?

- 1) Whatever the program tells me is needed even if it is zero lbs. N (This can happen in a low yield year if you have N in your irrigation water.)
- 2) Never less than 100 lbs. N
- 3) Never less than 200 lbs. N

Evaluation: (ALL ANSWERS ARE ANONYMOUS)



H) Would you like to have a smartphone/tablet version of this online model?

1. Yes Smart-Phone
2. Yes Tablet
3. No

H) Please comment:

How can this program be improved, what additional information or training would you like, what aspects did not make sense, anything else we should be aware of.

.....

.....

.....

.....



Additional Information in Poster # 49, 50, 51



Fertilizer Management and Nutrient Budgeting

Sebastian Saa, Saiful Muhammad, Blake Sanden, Patrick Brown*

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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). Dotted line is the 1:1 concordance between predicted and observed values. Bars show the 95% confidence intervals. Circles represent average N % observed in July in areas and predicted by the model (n=area) with a sample of 30 pruned trees for the 18 site year combinations in the study.

The proper way to sample in April

1. Sample at 43±4 days after full bloom when the majority of leaves on non-fruitlet spurs have reached full size
2. Identify six non-fruitlet spurs around the canopy
3. Use your hand and your thumb nail to clamp all the leaves from each spur (picture below)
4. Collect leaves from 18-25 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, Si) and application of AGD-ESIP program

Total Nutrient Demand

Figure 2: Changes in nitrogen accumulation in fruit and parthenal organs of mature almond trees

How much is required for every 1000 lb of kernels produced?
 Note: 2. Nutrient removal per 1000 lb of kernel produced.
 *Nutrient removal Per 1,000 lb (kernel removal assumed)

Nutrient	Removal per 1,000 lb
N	~68 lb per 1,000
P	~8 lb per 1,000
K	~8 lb per 1,000
Magnesium	~8 lb per 1,000
Zinc	~1.8 lb per 1,000
Copper	~0.8 lb per 1,000
Iron	~1.8 lb per 1,000
Manganese	~1.8 lb per 1,000
Boron	~0.2 lb per 1,000
Sulfur	~1.8 lb per 1,000
Calcium	~1.8 lb per 1,000
Silicon	~1.8 lb per 1,000

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

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. Revised 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 full spat and immediately post harvest

Right Place: Ensure delivery to the active root zone.

- Fertilization 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

- www.almondboard.com
- www.sustainablealmondgrowing.org
- <http://ucanr.edu/sites/csr>

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.

- Every field, every year, is a unique decision



Thank you!

- **Historical Contributions:
Weinbaum, Rosecrance, Uriu,
Farm Advisors.**
- **Andres Olivos**
- **Saiful Muhammad**
- **Blake Sanden**
- **Roger Duncan**
- **John Edstrom**
- **David Doll**
- **Bruce Lampinen**
- **Ken Shackel**
- **Emilio Laca**
- **Grower Cooperators**
- **Paramount Farming**
- **Almond Board of California**
- **USDA, CDFA**
- **SureHarvest**