THE ALMOND CONFERENCE

50 YEARS

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We Want to Hear from You!

The Almond Board is conducting research to understand your experiences, perceptions and needs/wants of The Almond Conference. This information will improve future conferences. During the conference, we'll conduct several focus group sessions and short individual interviews.

Focus Group Sessions

These will be in Room 15 (Level 2–across from Ballroom B-5) during the following times:

Wednesday, December 7, 2022

- 9:30–10:30 a.m.
- 11:45 a.m.–12:45 p.m.
- 4:00–5:00 p.m.

Thursday, December 8, 2022

- 10:30–11:30 a.m.

If you are interested in being a part of the focus group, please use this QR code to select a time!

Short Individual Interviews

Throughout the conference, Vivayic, the research organization, will also ask select attendees about their conference experiences.

Vivayic will have a neon yellow ribbon on their name badges that says, **"Tell me more."**

Please take a few moments to provide your insights if asked.

THE ALMOND CONFERENCE
50 YEARS

Fertigation When Times Are Tight

December 7, 2022

Moderator: Sebastian Saa (ABC)
Speakers: Patrick Brown (UC Davis)
Tommy Bottoms (Timothy and Viguie Farming & El Molino Farms)

california almonds
Almond Board of California

Session Details

Fertigation When Times Are Tight

Moderator

Sebastian Saa, ABC, Session Moderator

Speakers

Patrick Brown, Distinguished Professor, University of California, Davis

Almond Nutrition: Doing More with Less

Tom Bottoms, Manager and Partner, Timothy and Viguie Farming & El Molino Farms

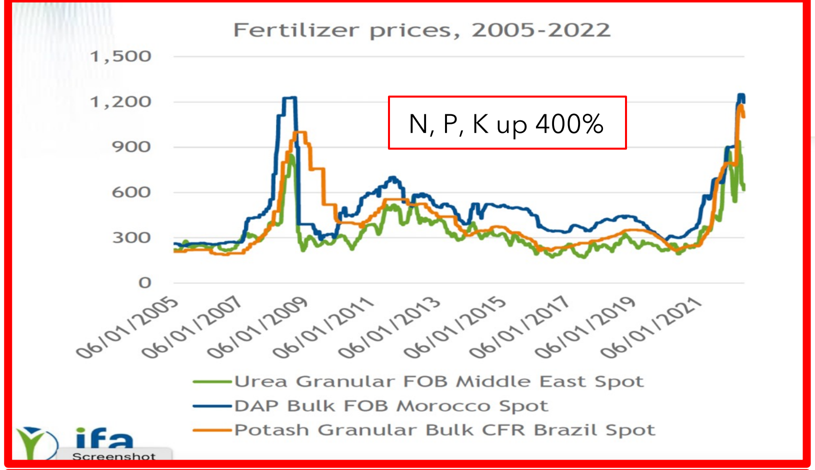
Farm Level Fertigation: How do You Ensure a Successful Fertigation?

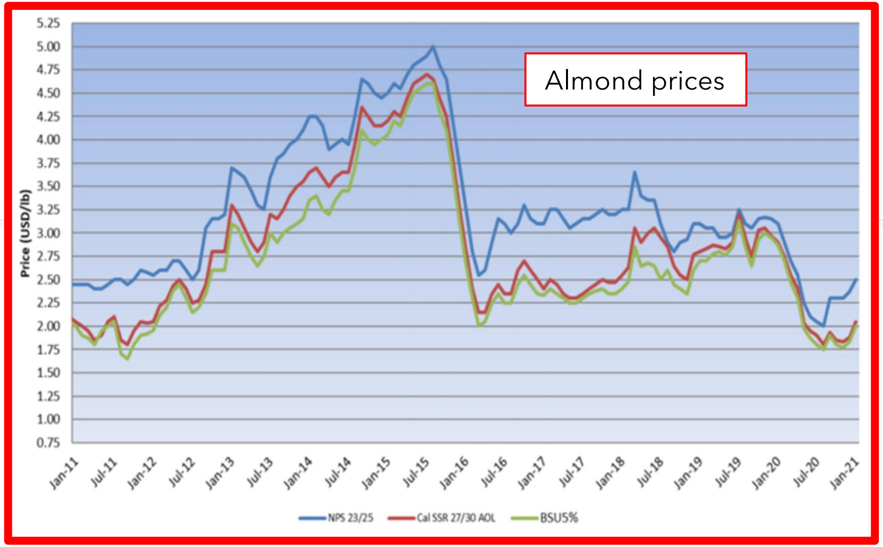
Almond Nutrition

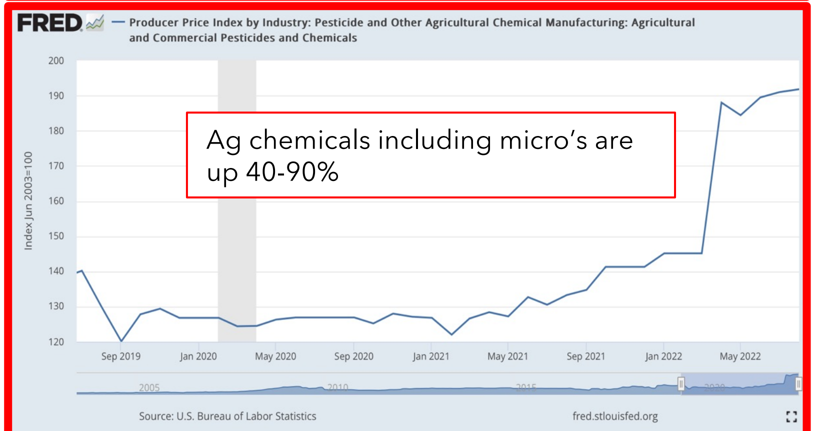
Doing More with Less

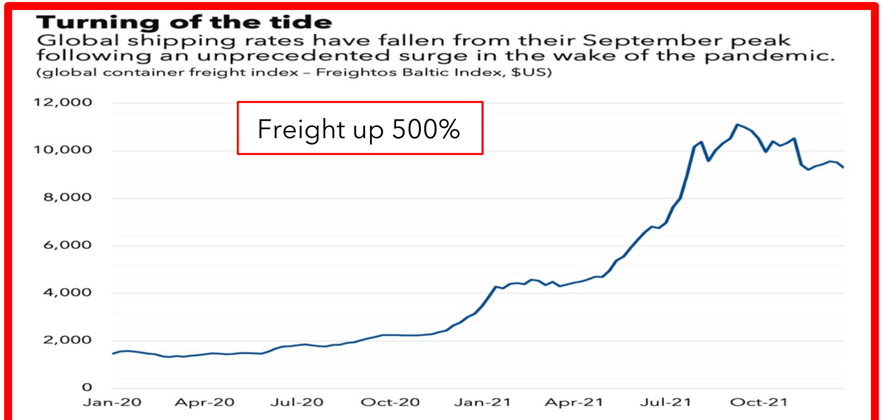
Patrick H Brown, Department of Plant Sciences, University of California, Davis

Rising Costs
Low Prices









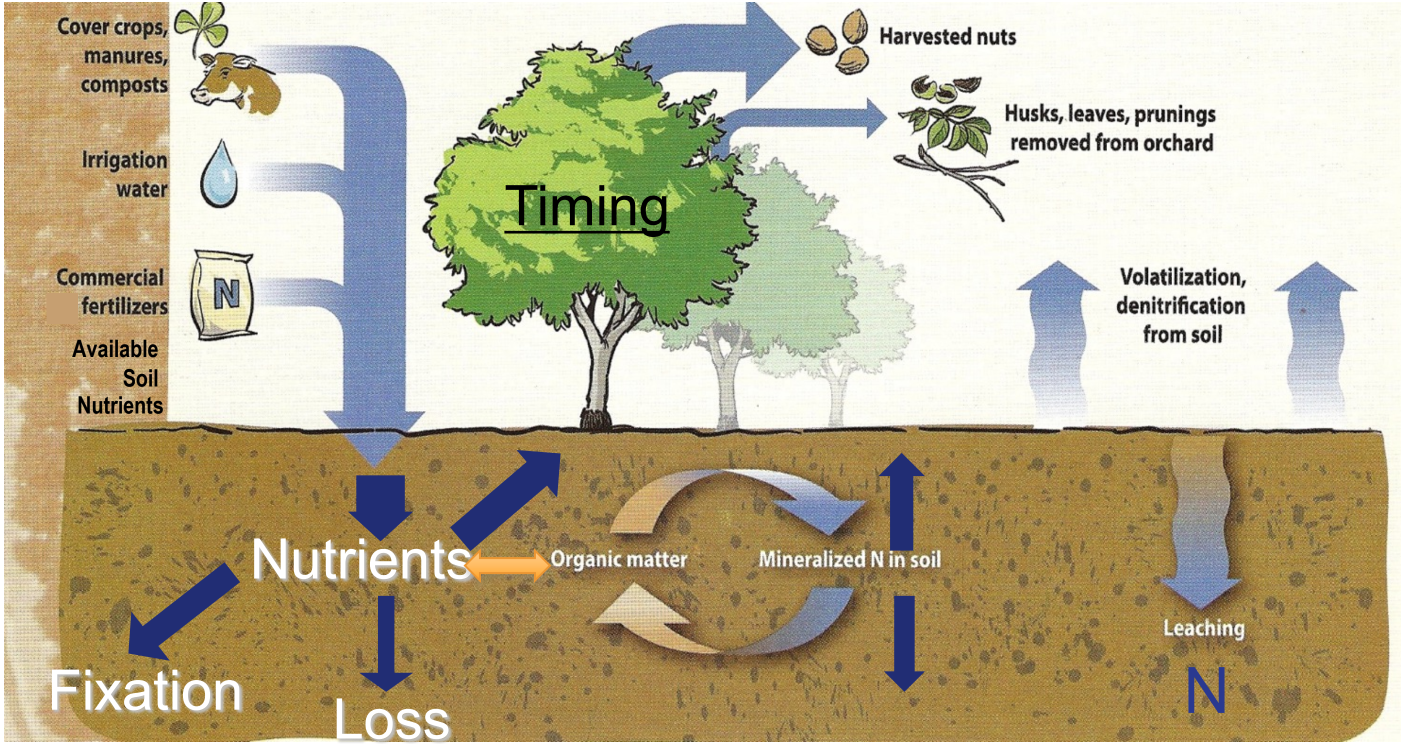
Managing Nutrients For Almonds In Tough Times

Macro Nutrients	Micro Nutrients
Nitrogen	Zinc
Phosphorus	Iron
Potassium	Boron
Calcium	Manganese
Magnesium	Copper
Sulfur	Chlorine
	Nickel
	Molybdenum

- Always Manage
- Monitor and Manage, Prevent/React
- Isolated occurrence (Monitor)
- Unknown

Optimizing Nitrogen and Potassium in Almond. Nutrient Budget Approach

Supply (Rate) = Demand (Amount and Timing)



N= 68 lbs/1000 lb yield
K = 80 lbs/1000 lb yield
+ tree growth demand

Kathy Kelley-Anderson et al: ANR Pub # 21623

Efficient Nutrient Management Approach
-the 4 R's- IPNI

Applying the **Right Rate**

- Match supply with tree demand
  - Determine tree demand
  - Consider all inputs- fertilizer, organic N, water, residual soil N.

At **Right Time**

- Apply coincident with root uptake.
- Apply coincident with demand

In the **Right Place**

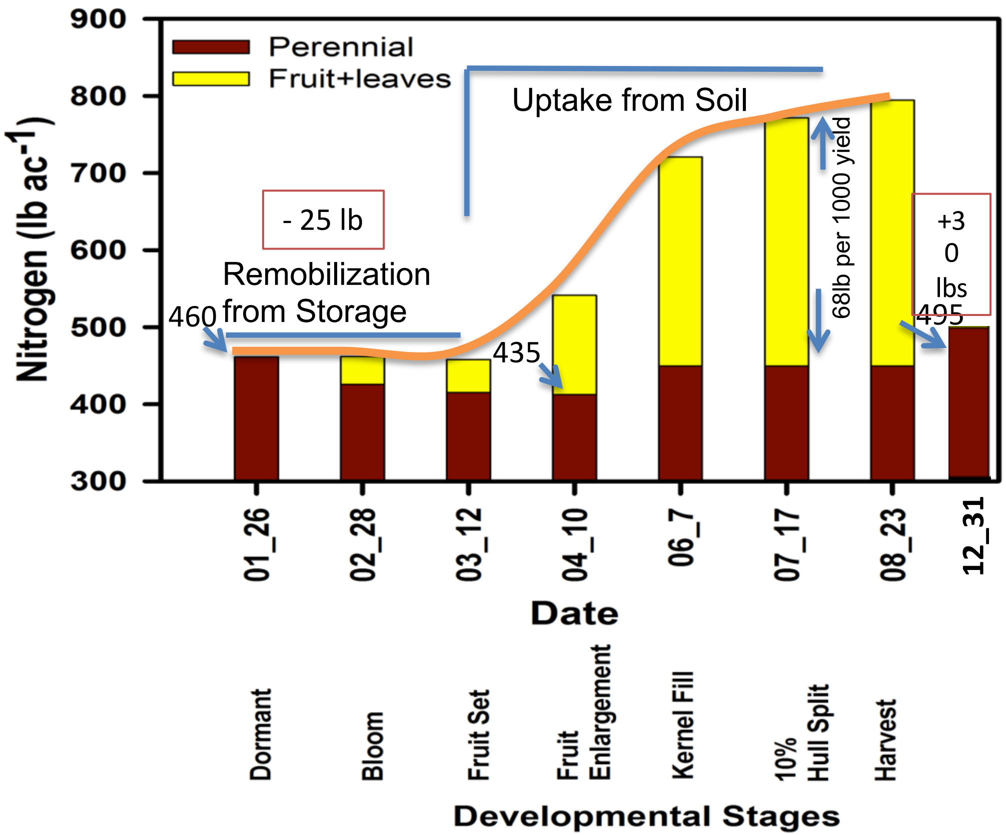
- Ensure delivery to the active roots
- Integrate with irrigation/fertigation practice
- Consider orchard variability.

Using the **Right Source/Right Balance**

- Eliminate limiting nutrients, minimize leaching potential, stabilize N in root profile….

http://www.ipni.net/4r

Total and Annual Dynamics of N in Mature Almond (data from 11-12 year old trees 4,200 lbs.)



Key Principles

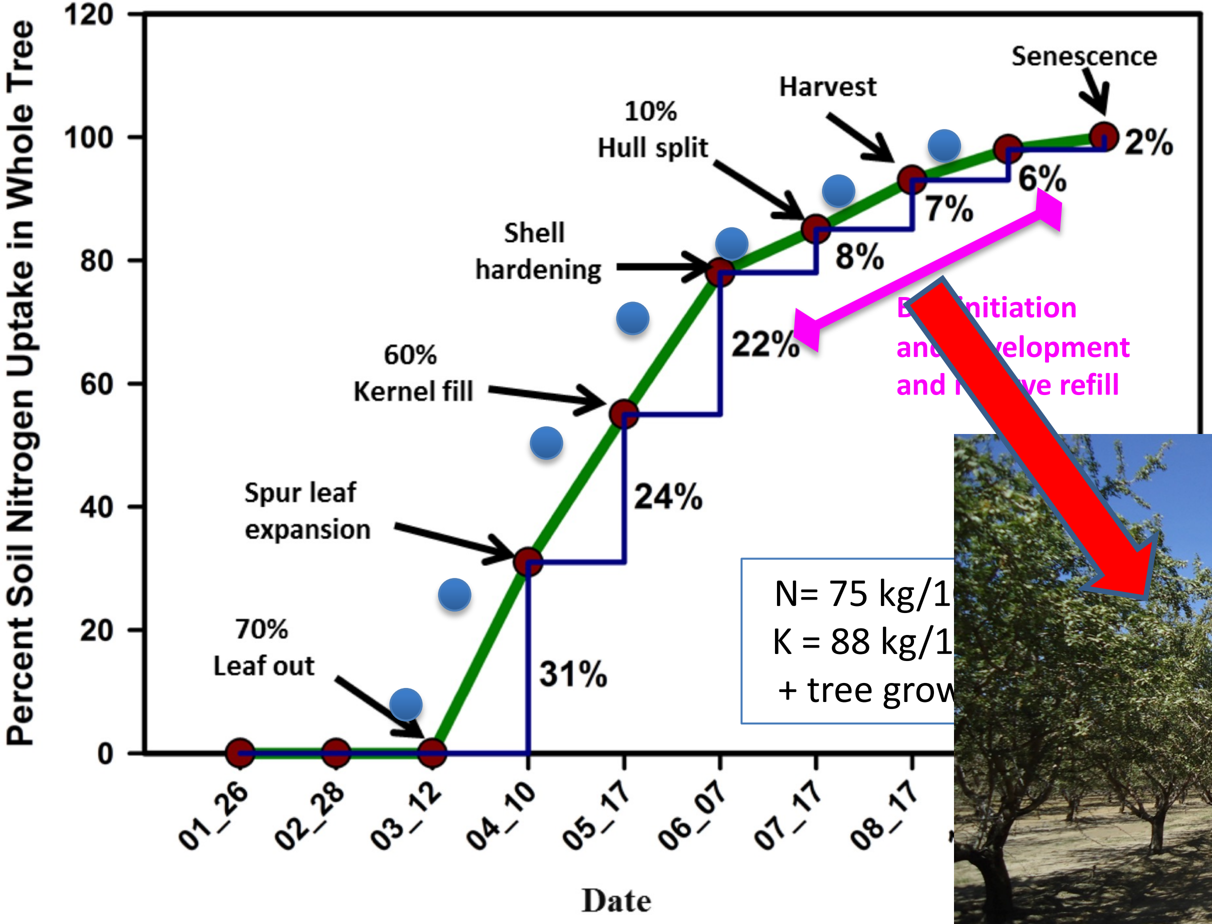
From dormancy to mid-leafout there is very little N uptake. Uptake commences at mid-leaf out and is essentially complete by hull split.

Perennial N:
25 lbs N remobilized to flowers, early fruits and leaves (bud break till 50% leaf out).

30 lbs acre accumulated in perennial N over the year.

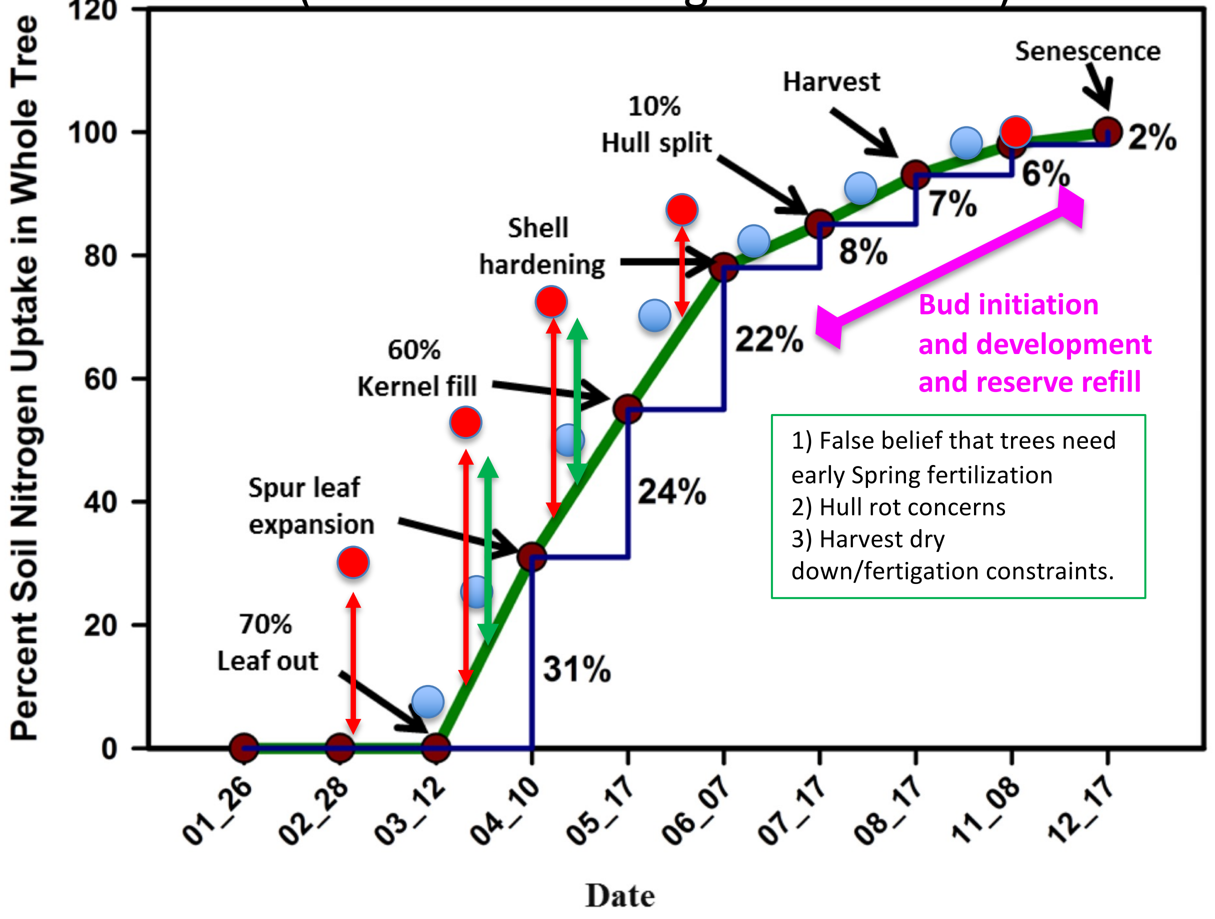
Exported N in harvest averages 75 kgs N per 1000 kgs of harvested kernels.

Seasonal Almond Nitrogen Uptake



- Ideal Fertilization: Multiple Applications in season timed with demand
- Demand driven by yield (every orchard and cultivar may be different)
- No significant uptake prior to leaf out

Seasonal Almond Nitrogen Uptake
(2008-2012 Belridge Excavations)



Ideal Fertilization: Multiple Applications in season timed with demand

Common Fertilization: 3-4 applications 80-90% complete by June 1 (added complexity in wet years)

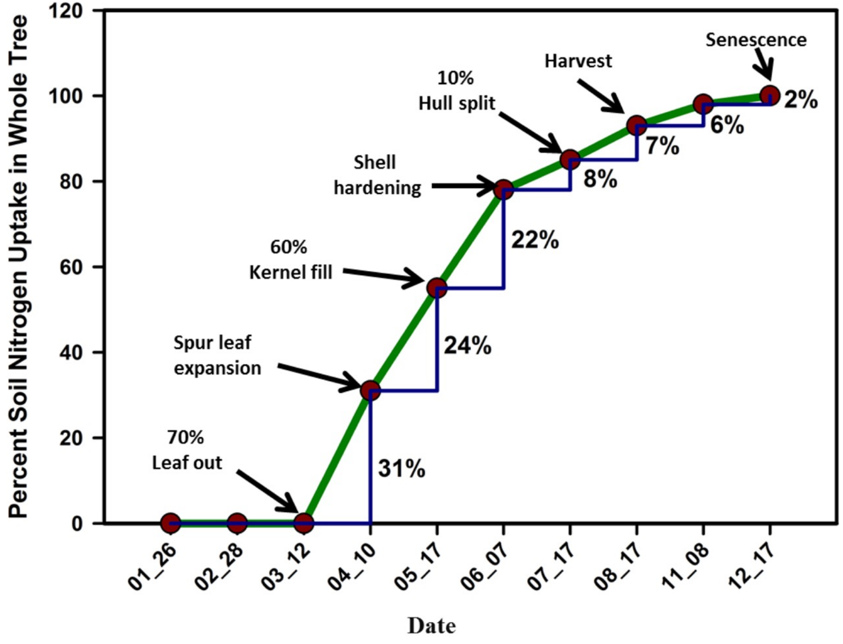
Potential for loss of N
-Nitrate in soil/irrigation

Potential for excess canopy vigor
-N uptake in excess of fruit demand

CA Almond Board Nitrogen: New Numbers

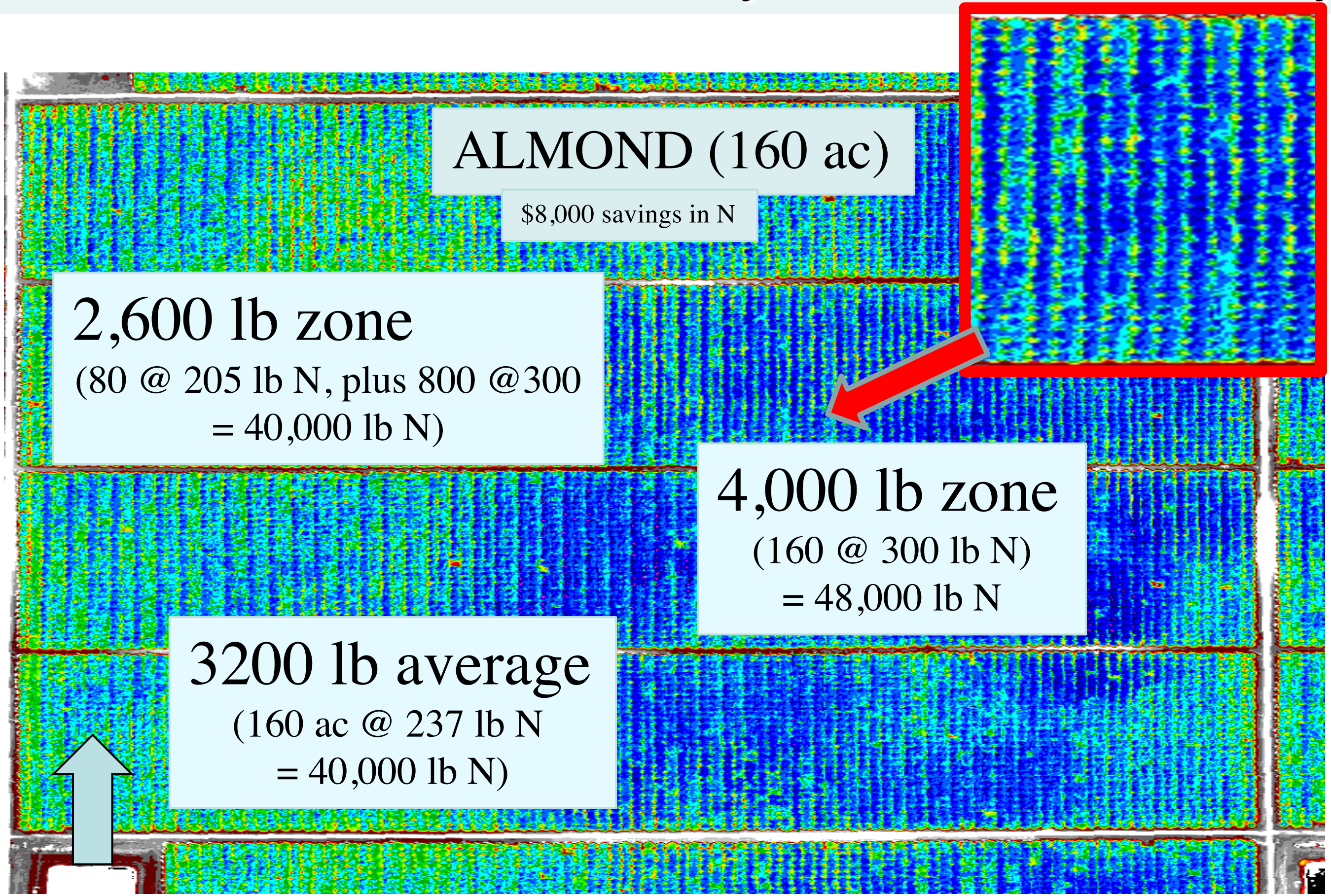
Tree and Yield Progression with Orchard Age

Age years	Total Non-Yield Nitrogen Demand leaf + woody biomass	Nitrogen Demand for Yield kernel lbs.
1	30	0
2***	55	0
3	65	Expected yield x 0.068
4	55	Expected yield x 0.068
5	45	Expected yield x 0.068
6	40	Expected yield x 0.068
7 – 15	40	Expected yield x 0.068
16 – 25	30	Expected yield x 0.068



40 lb = 44 kg 0.068 lb = 0.075 kg

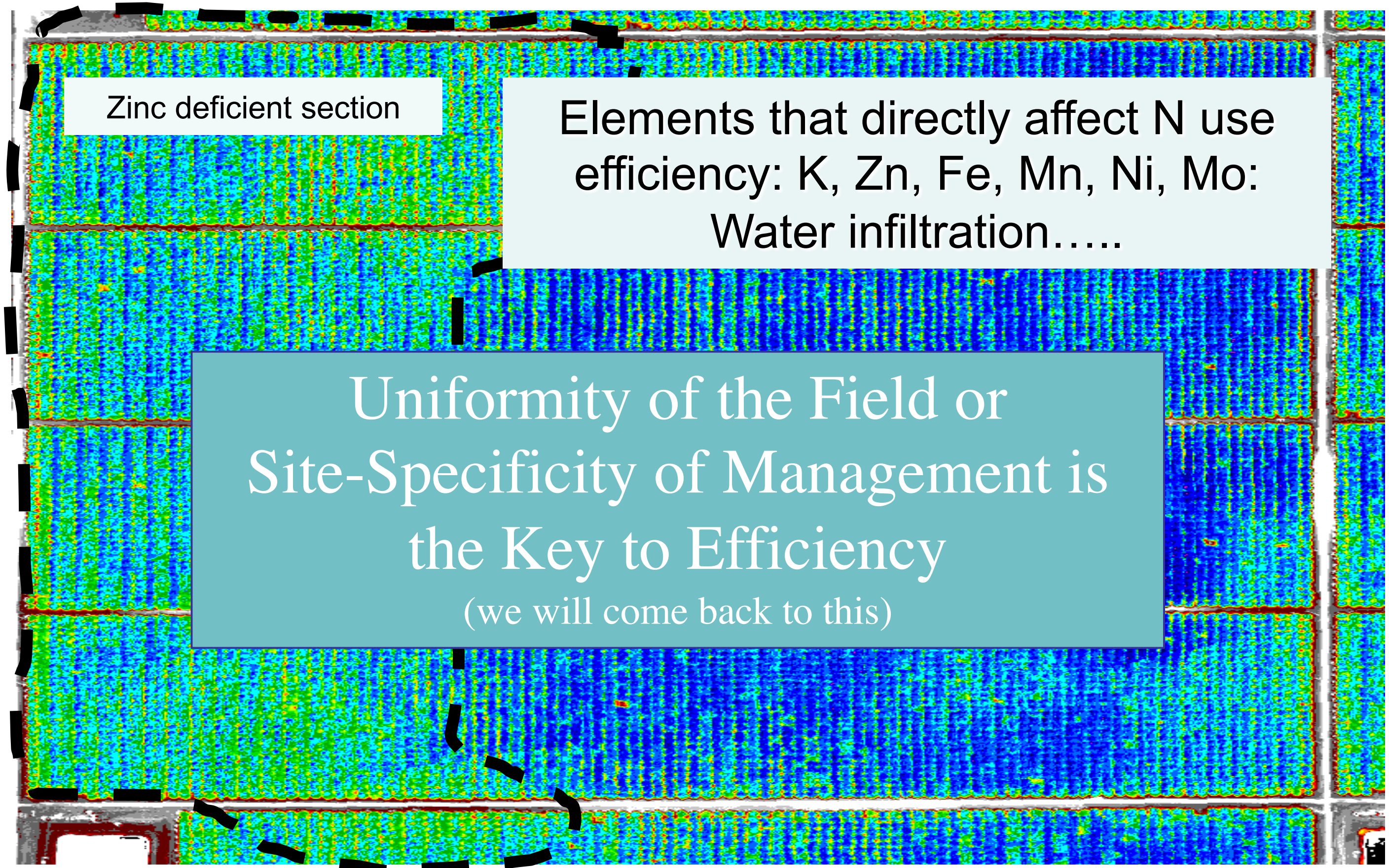
Fields are variable, how do you choose the correct yield based N rate?



GNDVI 29 April 2009: SmartImage (B,G, NIR only)1 m pixel (Britz Fert. Com.)

- Years differ in productivity
- Zones differ in productivity
- Cultivars differ in productivity.
- But…one fertigation system per field (or cultivar specific) and… foliars are applied uniformly to all as a consequence of tank mixing products.

Optimizing N use efficiency requires Optimal Management of all Inputs: e.g. Zinc deficiency can limit crop response to N



Elements that directly affect N use efficiency: K, Zn, Fe, Mn, Ni, Mo: Water infiltration…..

Uniformity of the Field or Site-Specificity of Management is the Key to Efficiency
(we will come back to this)

GNDVI 29 April 2009: SmartImage (B,G, NIR only)1 m pixel (Britz Fert. Com.)

Strategies for Nitrogen Decision Making

1. Always have a cultivar specific yield driven fertilization strategy
    1. requires prediction and in-season adaptation
2. In-field yield variability should be identified and corrected.
    1. Investment in correcting local nutrient deficiencies
    2. Fertigation system optimization
3. Nitrogen is not retained well between seasons in low OM soils
4. A uniform field N rate cannot be efficient.

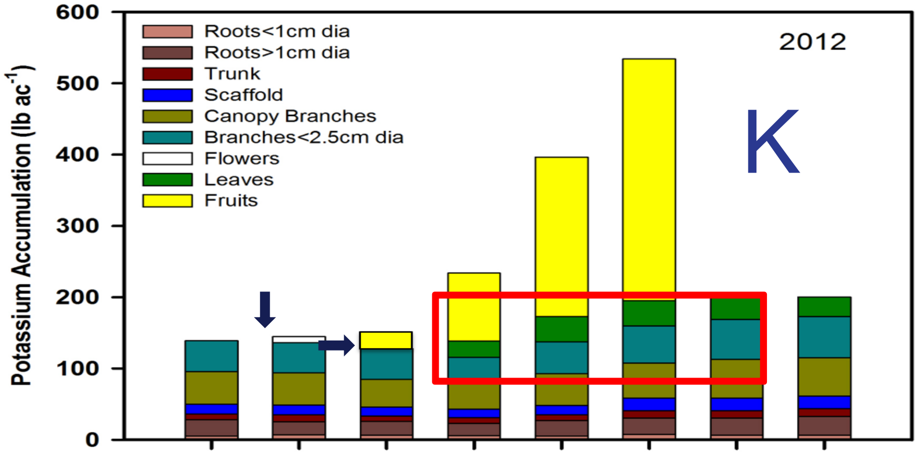
Essential Nutrients

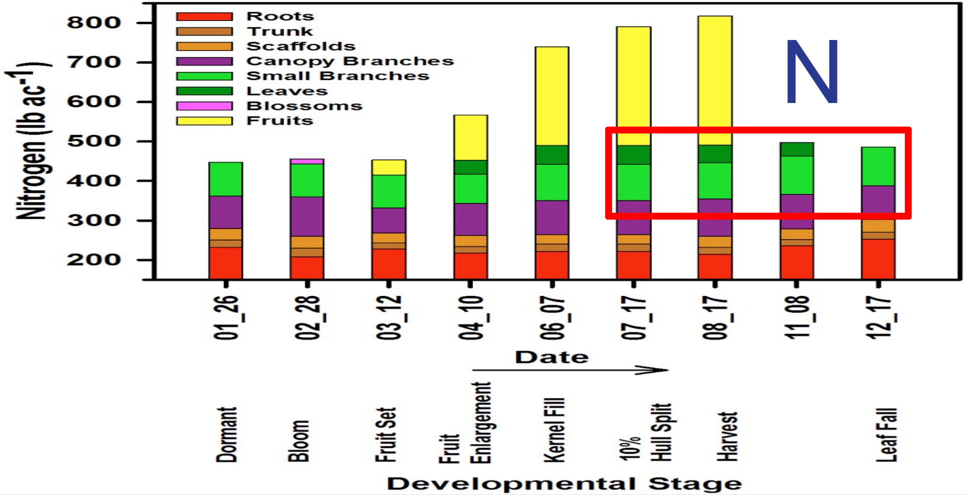
(Lifecycle cannot be completed in their absence)

What about K?

Macro Nutrients	Micro Nutrients
● Nitrogen (red)	● Zinc (red)
● Phosphorus (yellow)	● Iron (green)
● Potassium (red)	● Boron (red)
● Calcium (yellow)	● Manganese (yellow)
● Magnesium (green)	● Copper (green)
● Sulfur (green)	● Chlorine (purple)
	● Nickel (purple)
	● Molybdenum (purple)

- ● (red) Always Manage
- ● (yellow) Monitor and Manage, Prevent/React
- ● (green) Isolated occurrence (Monitor)
- ● (purple) Unknown





K uptake commences a little earlier, stored K pool is smaller than N, but uptake is significantly greater in late fruit development.

K storage occurs earlier than N

Nutrients in removed fruit

N = 68 lb/1000 kernel yield + growth

K = 77 lb/1000 kernel yield + growth

K demand for growth and storage is lower than N.

Potassium Questions:

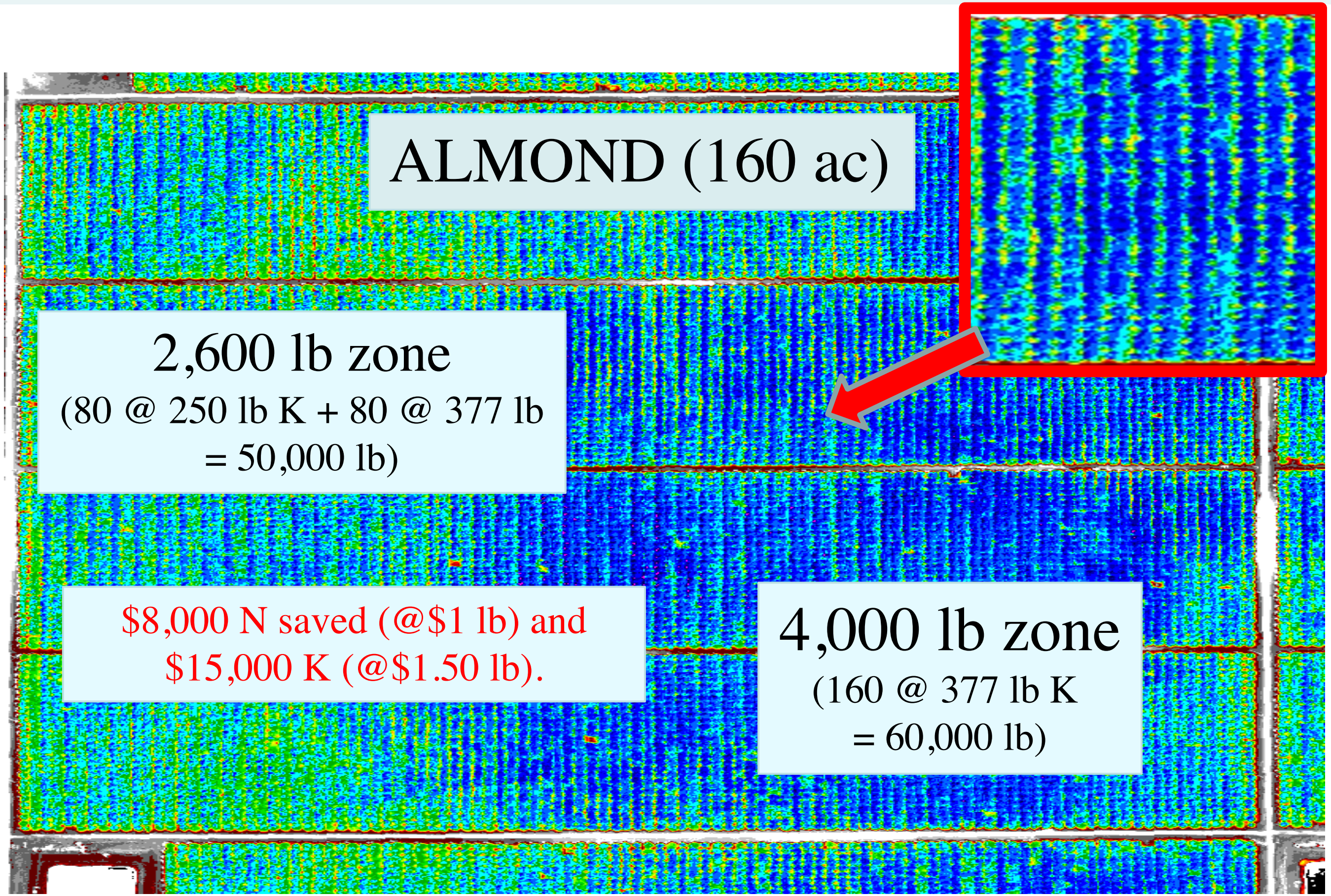
-K is expensive, are we using it efficiently?

-Is SOP banding the right approach in predominantly micro/drip irrigated orchards

- K is WAY more variable than N!
  - K is however, not lost from system

UCDAVIS
DEPARTMENT OF PLANT SCIENCES

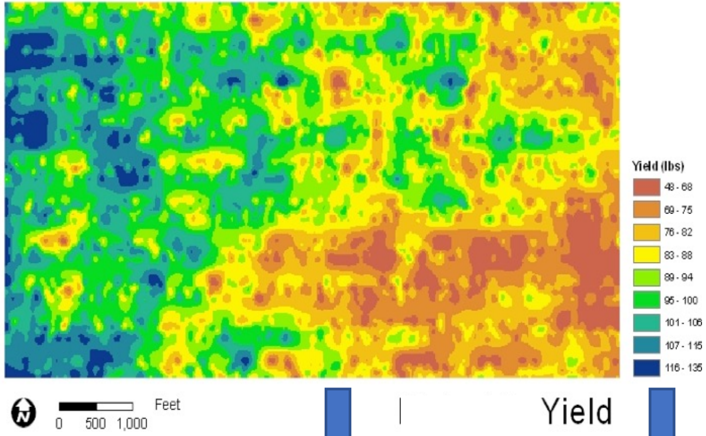
What about Potassium Variability?? As bad as Nitrogen? Same Consequence?



GNDVI 29 April 2009: SmartImage (B,G, NIR only)1 m pixel (Britz Fert. Com.)

- Yield determines both K and N demand.
- Cultivars and zones differ in productivity and hence demand.
- Unlike N, excess K is not 'lost' but remains in the system for future use.
  - Reducing K applications in these areas is possible
- Measuring and interpreting soil and tissue K is more difficult than any other element.

Yield Mapping Enables Precision Ag

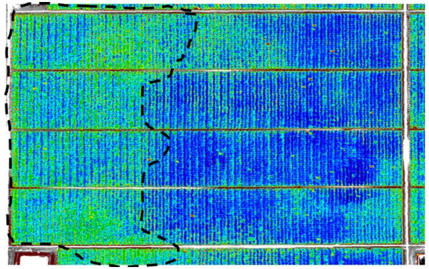


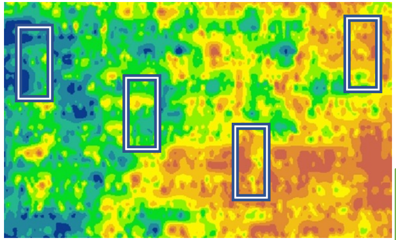
Sub-block Management/Optimization

Targeted Applications

Management and Research Optimization

What causes this? Can we correct or adapt?





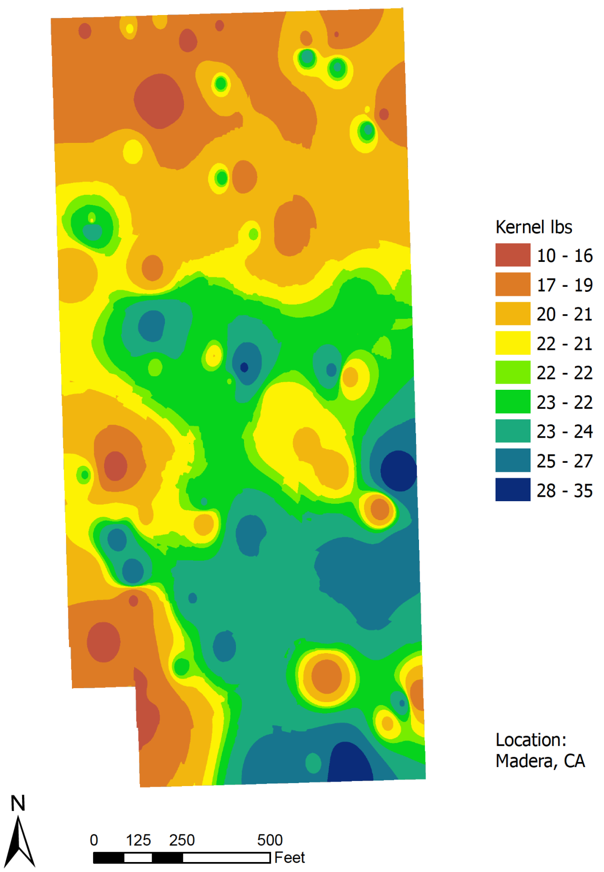
Where should sensors be placed and what do they mean?

Dramatically improved and cheaper research and product/practice testing

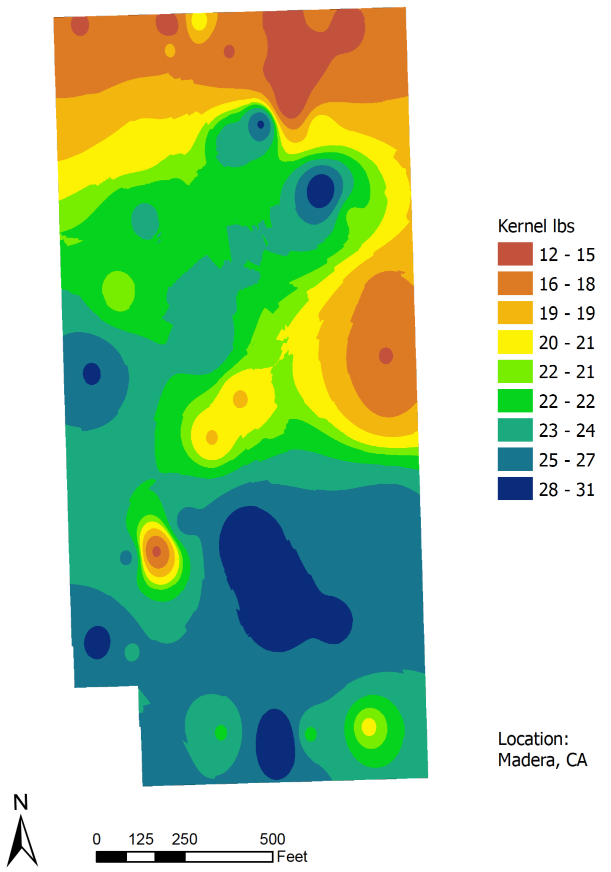
Yield Map

65 acres, 75 single tree yields pre cultivar

Almond Yield (lbs/tree) - Nonpareil



Almond Yield (lbs/tree) - Wood Colony



2800 lb ac Field average

Zones range from 1950 – 3950 lb ac

POSTER 69

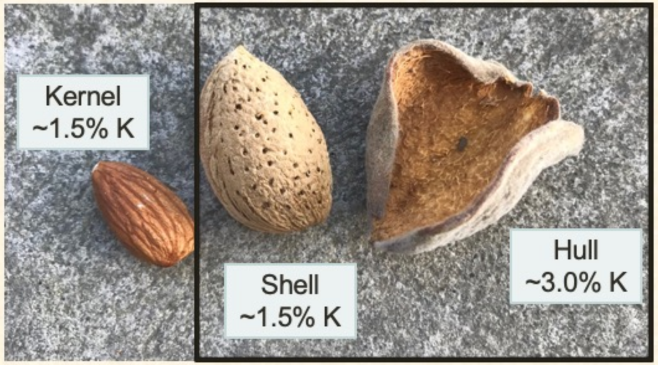
Almond hulls & shells as potassium-rich organic matter amendments

Ellie Andrews
Horticulture & Agronomy Graduate Group
University of California Davis
Doctoral Exit Seminar

WESTERN SARE
Sustainable Agriculture Research & Education

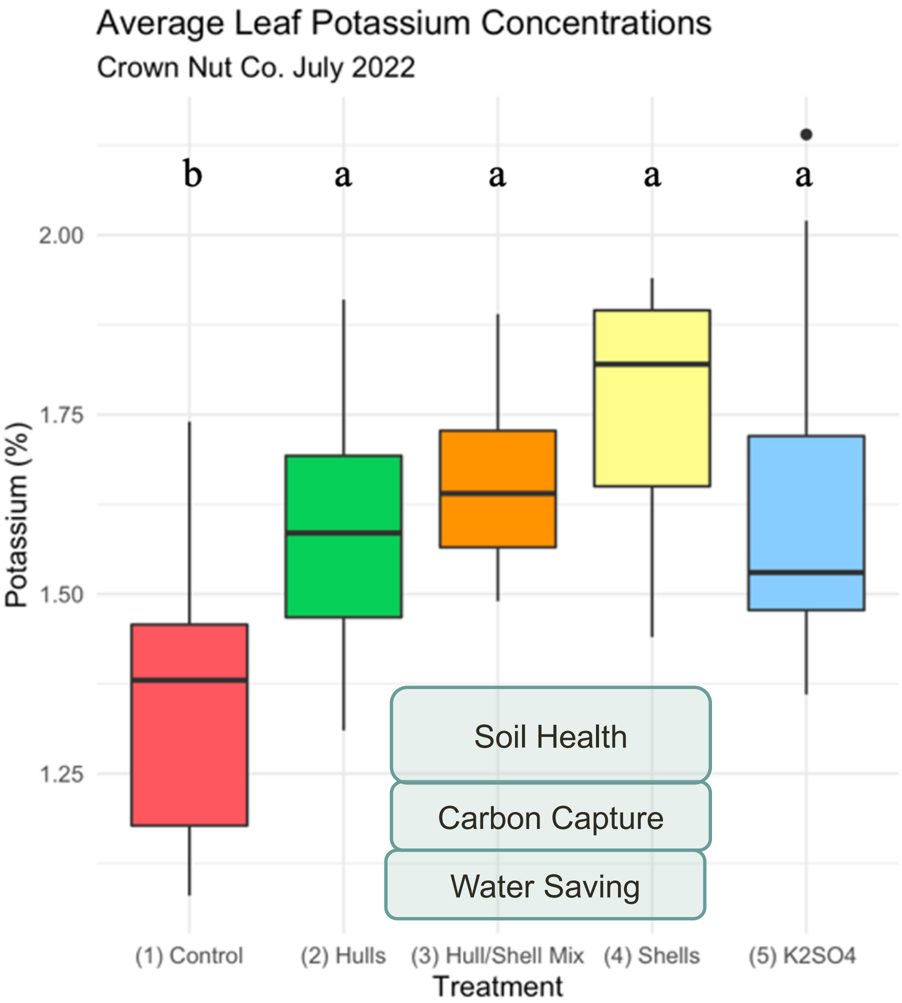
Hulls and Shells Provide Plant K

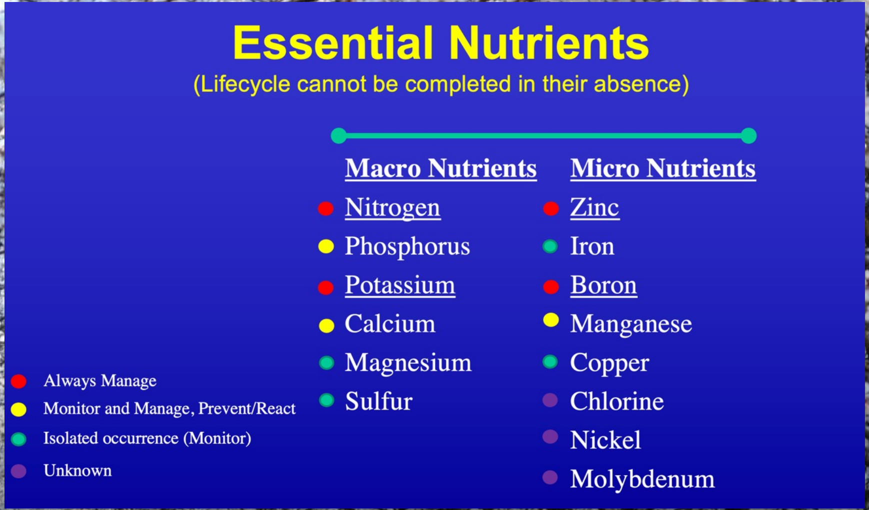
Recycling Almond Fruit (4 ton)



~68% orchard K annual demand, 20% annual N demand → hulls & shells

-at current prices that is $300 in K and N alone
-added soil health, water retention, regenerative.

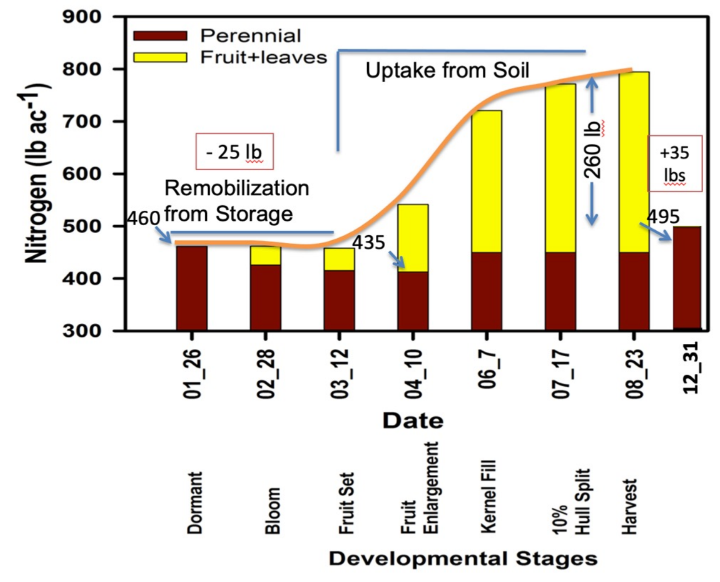


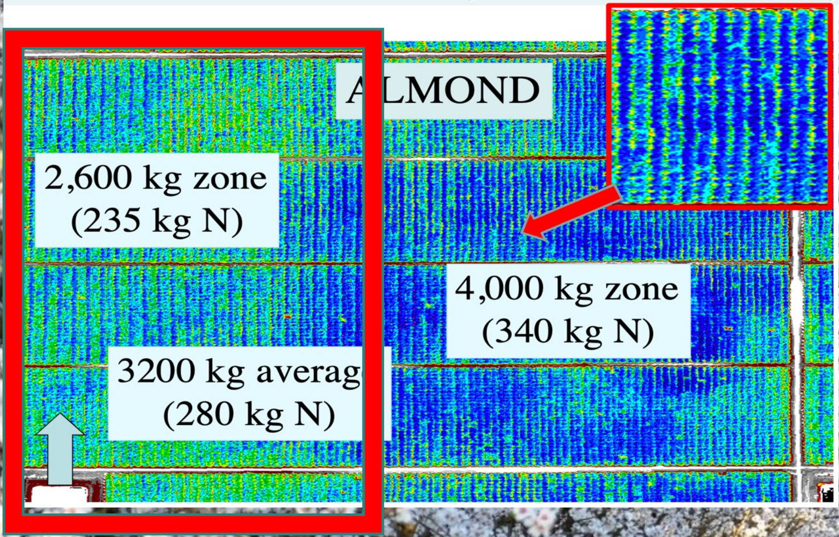


Summary: Almond Nutrition

Doing More with Less

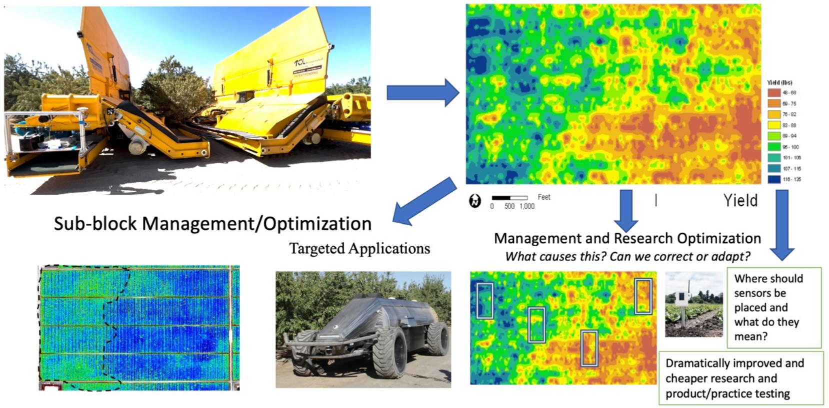
- Use yield based application rates and growth curve based application timing.
- Uptake commences only after mid-leaf out
- Ensuring good spring reserves is essential (bud development and fill is from hull split to just post-harvest)
- Avoid excessive early applications, avoid losses.
- Maintaining tree health during harvest is critical
- There is limited new uptake post-harvest but leaf health is important for N remobilization.



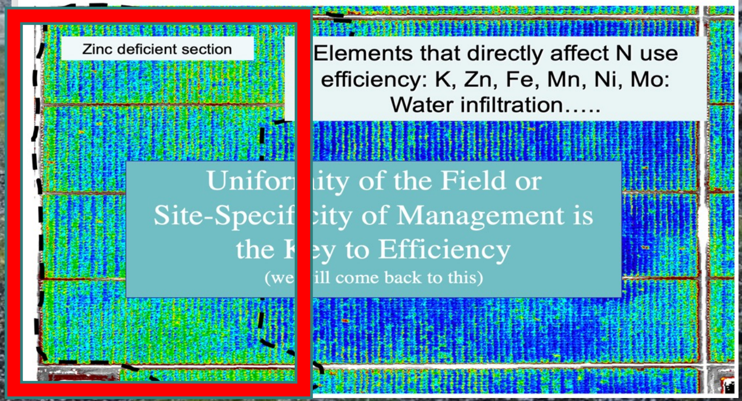


- Variability in yield is a major cause of inefficiencies. Managing the whole orchard to satisfy the hungriest trees is inefficient.
- Cultivars should be managed separately
- Zonal variability should be identified and managed. Micronutrient correction may be cheaper than extra N or K.
- Yield mapping is a critical technology for nutrient optimization.

Off ground Harvesting Enables Yield Mapping and Precision Ag



Optimizing N use efficiency requires Optimal Management of all Inputs: e.g. Zinc deficiency can limit crop response to N



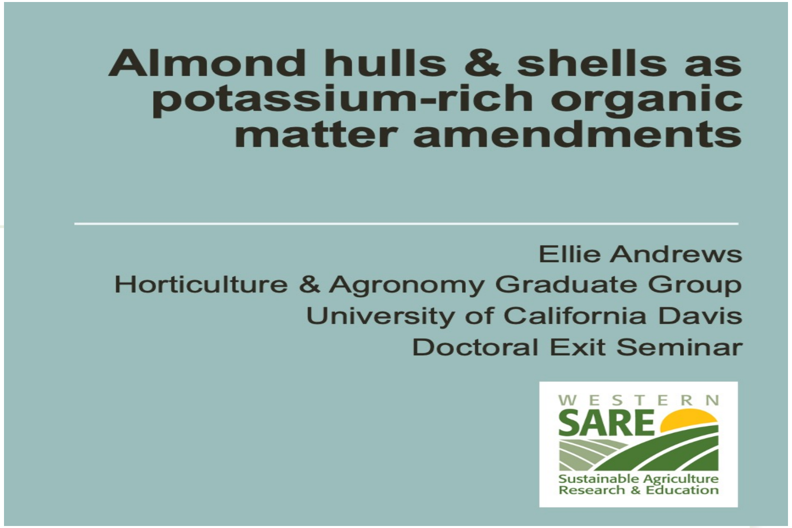
Pictures

Amendment materials applied at Crown Nut Co February 2020

Hulls

Mix

Shells



7/27/2020 Shells (left) and hulls (right) 1 week before the sweepers started, Crown Nut Co.

Thank You!

Miles Hermann '07

THE ALMOND CONFERENCE 50 YEARS

FARM LEVEL FERTIGATION

DEC 7 / TOM BOTTOMS, TREMONT FARMS, LLC

california almonds®
Almond Board of California

FERTIGATION 101

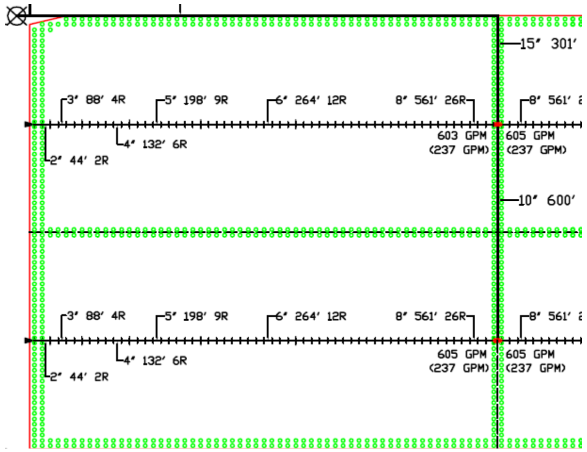
Video plays here

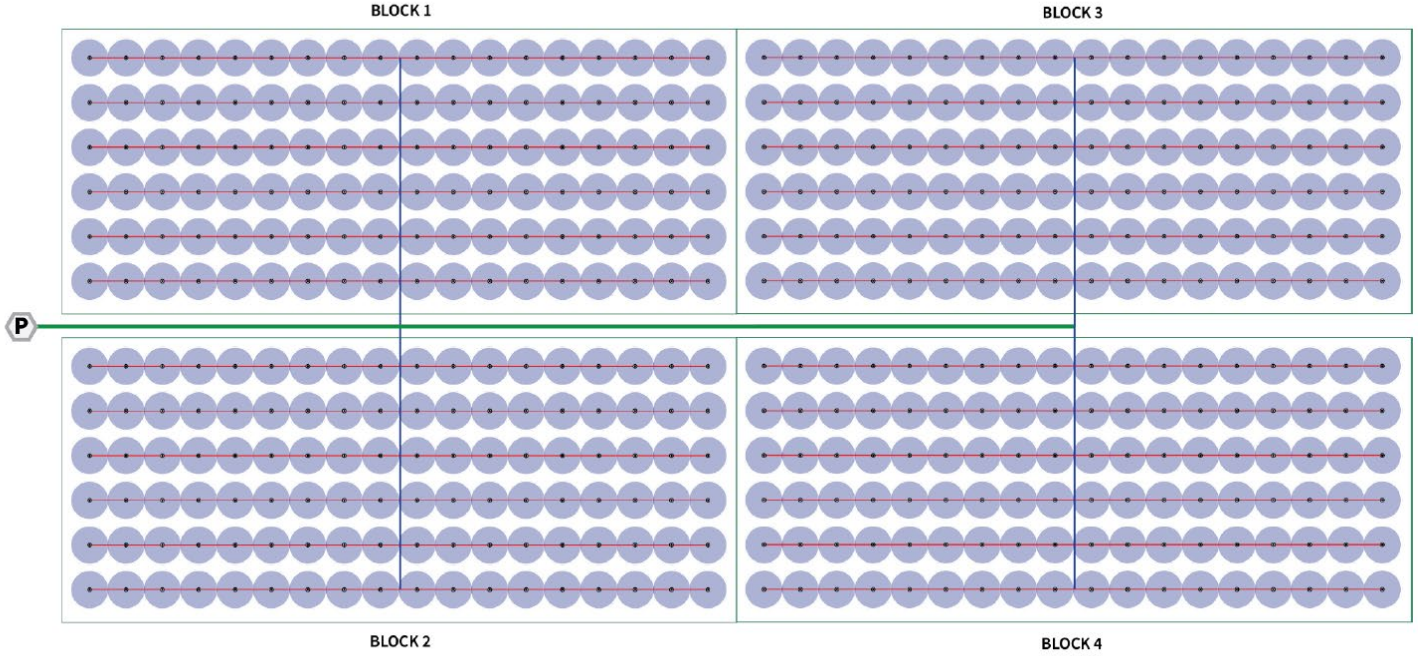
HOW DO YOU ENSURE A SUCCESSFUL FERTIGATION?

1. Study your irrigation system
2. Determine tree demand
3. Develop a management team
4. Adopt a progressive approach

YOUR (DESIGNED) IRRIGATION SYSTEM

1. Distribution uniformity: your fertigation is equal to or less uniform than your irrigation system
2. Starts with knowing your irrigation system design
   - Pressures
   - Expected output





SYSTEM NOTES

(DRIP):
22X15 ALMONDS
132 TPA
13.2 GPM/ACRE
0.1 GPM/TREE
0.029 IN/HR
0.7 IN/24 HOURS

UNIRAM 18 MM, 30" SPACING
@ 1.00 GPH

Photo source: ABC Uniformity and Leaks Presentation

YOUR (ACTUAL) IRRIGATION SYSTEM

1. How is your system performing?
   - Measure pressure (automated or by hand)
   - Measure output in the system
2. Sample water to determine nutrient input
3. Discovering problems

Missing sprinkler
.87 GPM
52.2 GPH
46,771 gal per irrigation season

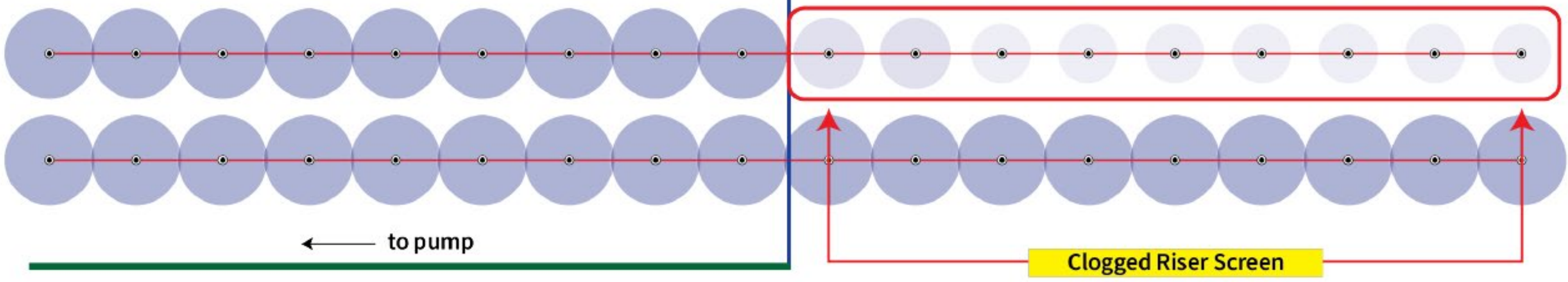
Improper repair
.21 GPM
12.6 GPH
11,290 gal per irrigation season

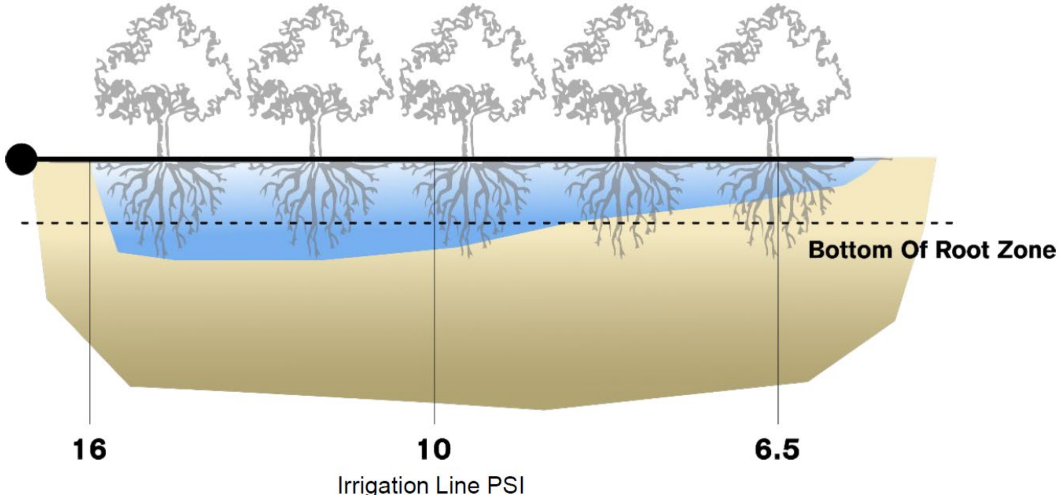
Leaks at filter
.61 GPM
36.6 GPH
20,773 gal per irrigation season

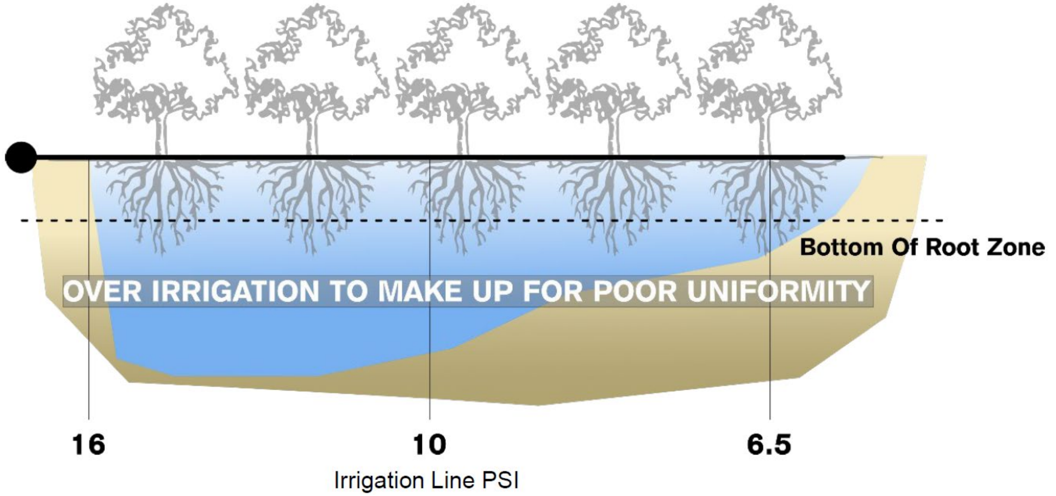
Plugged screen
Loss of 12 PSI in system pressure

Source: ABC Uniformity and Leaks Presentation

SEEK REMEDIES

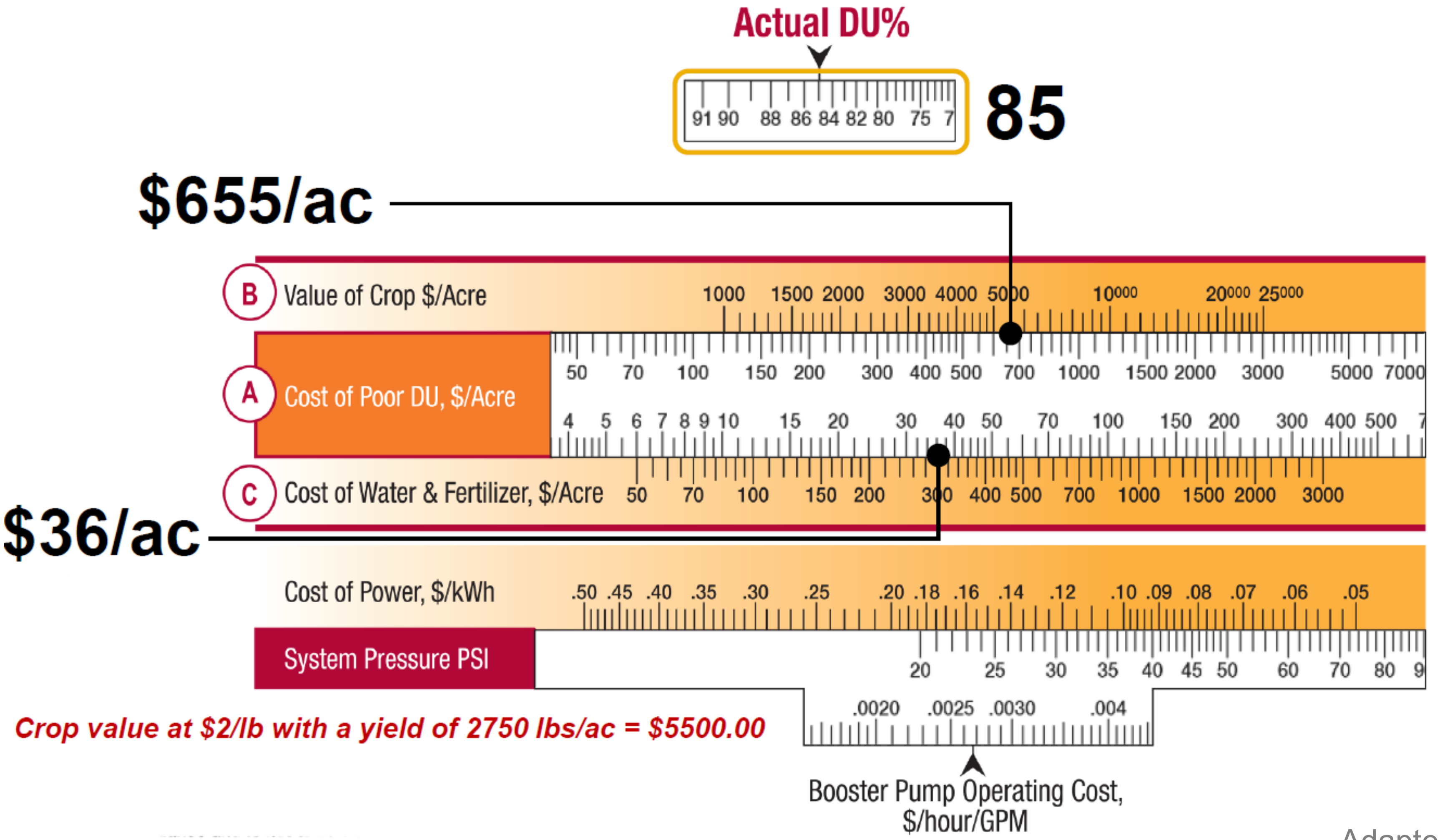






DU Photos: Tom Devol, ABC Irrigation Specialist

COST OF POOR DISTRIBUTION UNIFORMITY



An example of losses on 100 acres of almonds:

Lost yield		Loss
$655/A x 100 acres	$	65,500
Additional water applied		
$36/A x 100 acres	$	3,600
Total loss	**$**	**69,100**

This does not include the loss of nutrients…

Adapted from : Tom Devol, ABC Irrigation Specialist

COST OF INEFFICIENT NUTRIENT APPLICATIONS

2500 lb/ac almonds requires **170 lb/ac N** demand from removal

70% efficiency: 243 lb/ac N

90% efficiency: 189 lb/ac N

DIFFERENCE

54 lb/ac N
15 gpa UAN =
$69/ac

OPPORTUNITY COST

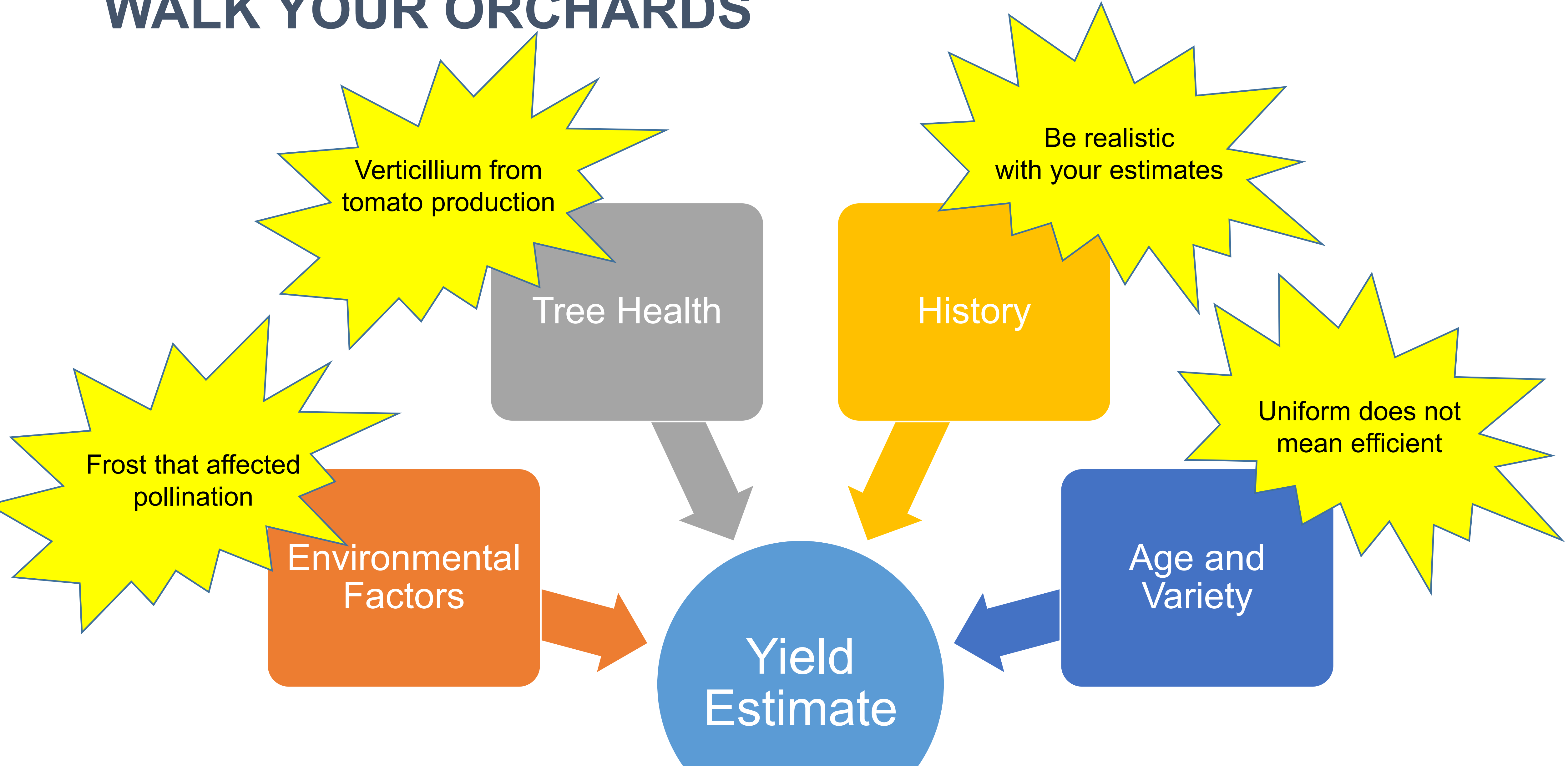
If that same 54 lb/ac N was applied effectively to the orchard it could potentially result in 800 lb/ac almonds.

At $1.50/lb almonds, that could result in an increase of $1200/ac.

Do not cut fertilizer just to cut, but think about how to increase your efficiencies.

Slide Credit: Devin Clarke, Yara North America

WALK YOUR ORCHARDS

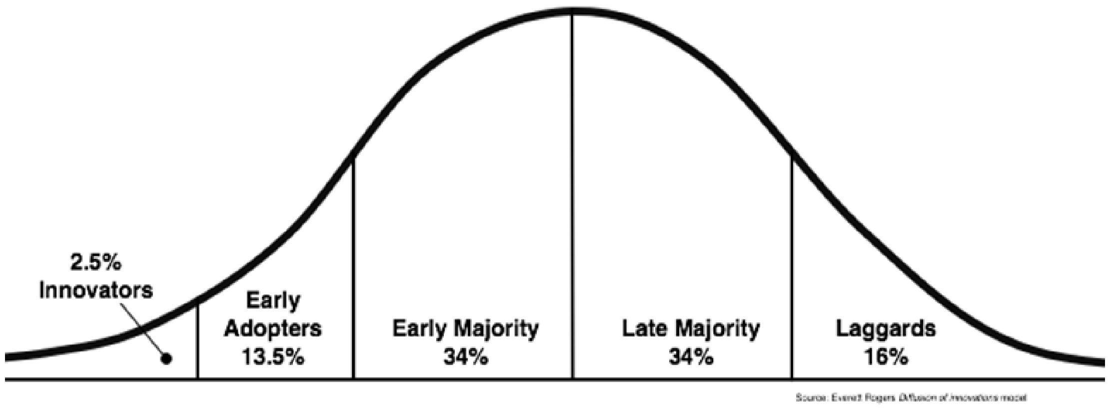


DEVELOPING A MANAGEMENT TEAM

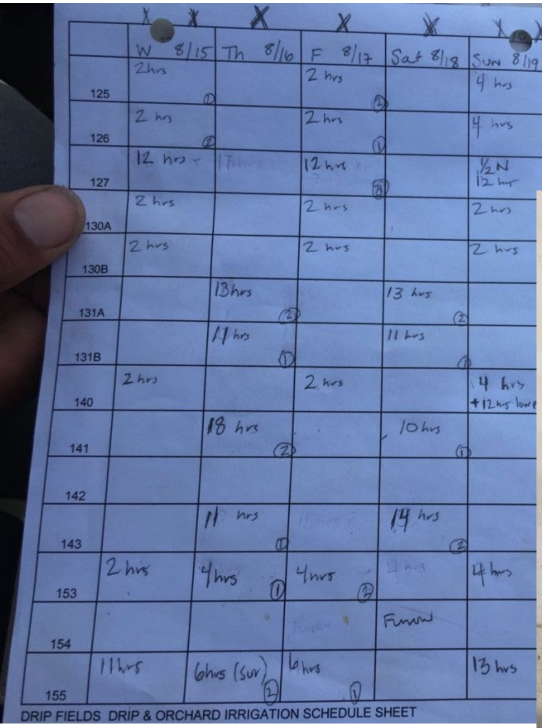
1. Covering the “what”
    - Responsible for feeding the plant
    - Significant portion of the budget is in their hands
2. Getting into the “why”
    - Drive around and look at other orchards- both good and bad
    - Every task eventually leads to a successful harvest
    - Sense of ownership
3. Then comes the “how” with training, time, and trust

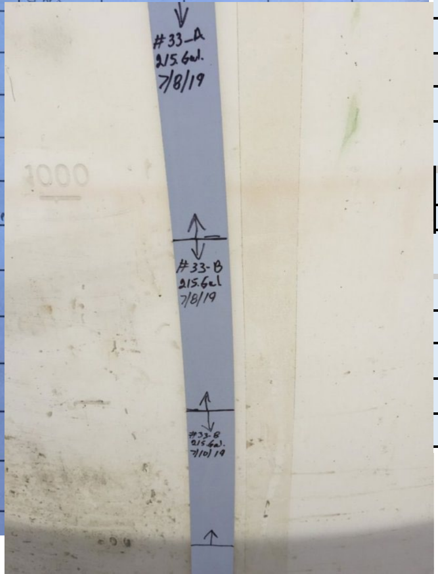
YEARS of The Almond Conference

EVOLUTION OF A SYSTEM



Daily paper schedules → Weekly paper schedules → Weekly spreadsheets → Google docs trial → 100% online → Automation





				W/E Date							
				0-0-12			UN32			ACID	OTRA
				Libras	Galones	Pulgadas	Libras	Galones	Pulgadas	Libras	
Field	Pumps	Crop	Acres								
				0-0-28			UN-32				
222	222	Tomato	15	25	125	4	20	66	3		
223	223	Tomato	25	35	292	9	20	143	5		
				Pot Carb			UN32				
103	102	Almonds	75	15	304	10	10	214	7		
				0-0-28			CAN-17				
180A-B	180	Melons	18	20	103	3	10	82	3		
180C-D	180	Melons	18	20	103	3	10	82	3		
				KTS			CAN-17				
126	125	Peppers	38	15	518	17	15	259	8		
131	130	Peppers	75	20	1364	44	20	429	14		
143	140 &143	Peppers	35	15	477	15	15	150	5		
153	153	Peppers	45	20	243	8	20	409	13		
182	181	Peppers	23	20	153	5	20	209	7		

BEYOND THE SCHEDULES

1. After the irrigation schedules and fertilizer amounts, the art of fertigation begins.
2. Check list
   - Determine fertilizer run times
   - Start pump
   - Check leaks and pressures
   - Calculate, measure, check again
   - Execute application
3. Monitor tank levels

ISSUES FACED

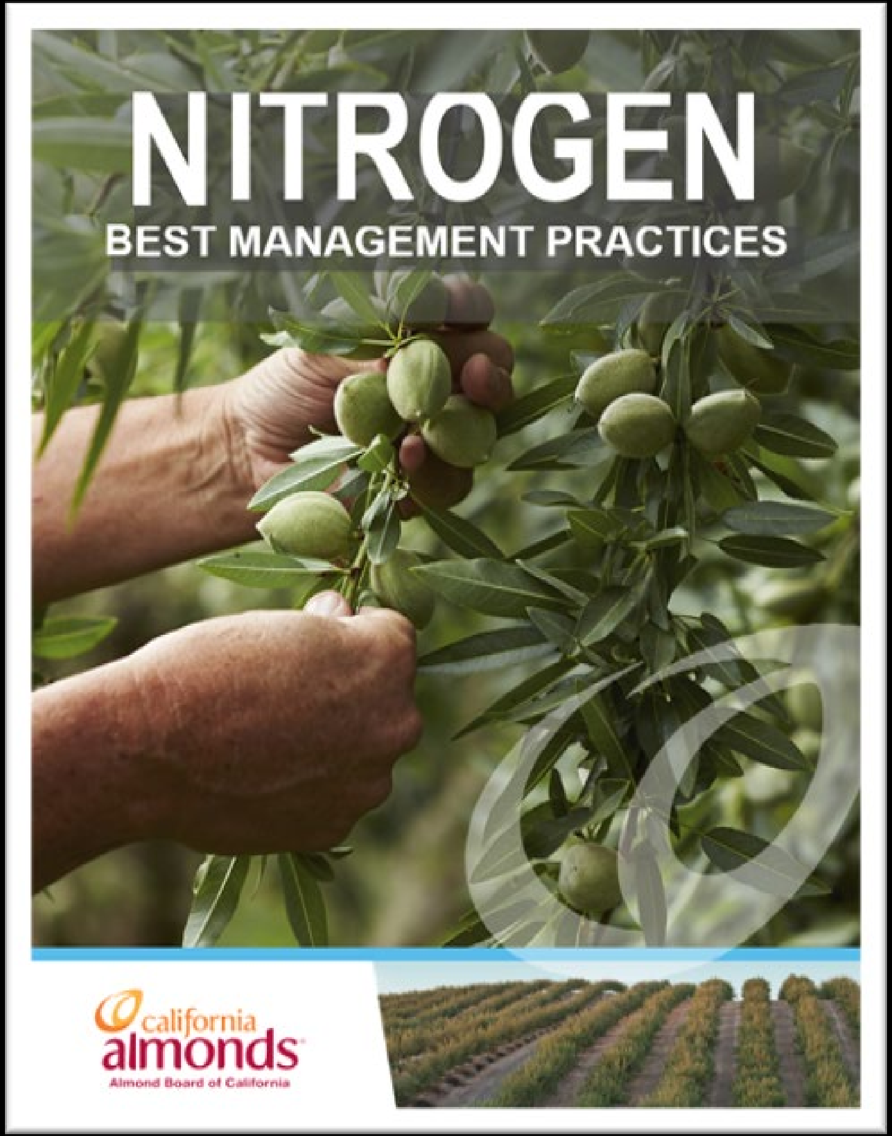
1. Equipment in the field
2. Irrigation system is not up to standard
3. Equipment failures (timers, pumps)
4. Pressure on crew
5. Training materials
6. Calculating rates and amounts
7. Just getting started

CONTINUOUS IMPROVEMENT

1. Understand crop demand
2. Move towards continuous fertigation (high frequency/low volume)
3. Must either develop a solid team, automate, or both
4. Improve estimation of tree yield
5. Do not cut just to cut. Recognize your opportunity cost.
6. If automation is part of the solution, it must be made cheaper and easier to implement.

HELPFUL RESOURCES

1. Fertilizer Research and Education Program (FREP)
2. ABC materials
3. Cal Poly IRTC
4. Other farmers
5. Seasoned staff
6. Experts in the field
    - Devin Clarke, Yara North America
    - Cory Broad, Jain Irrigation
    - Nick Edsall, Bullseye Farms
    - Geoff Klein, Bullseye Farms
    - Ryan Hackett, Gold Leaf Farming
    - Scott Rominger, Rominger Farming, Inc.
    - Jerome Pier, QualiTech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WHAT DID YOU THINK?

Scan the QR Code below and answer 4 short questions to help us in planning future presentations.


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