Welcome to the
Nitrogen Management Plan Self-Certification
Training Program

Training presentation to begin at 9:00 am

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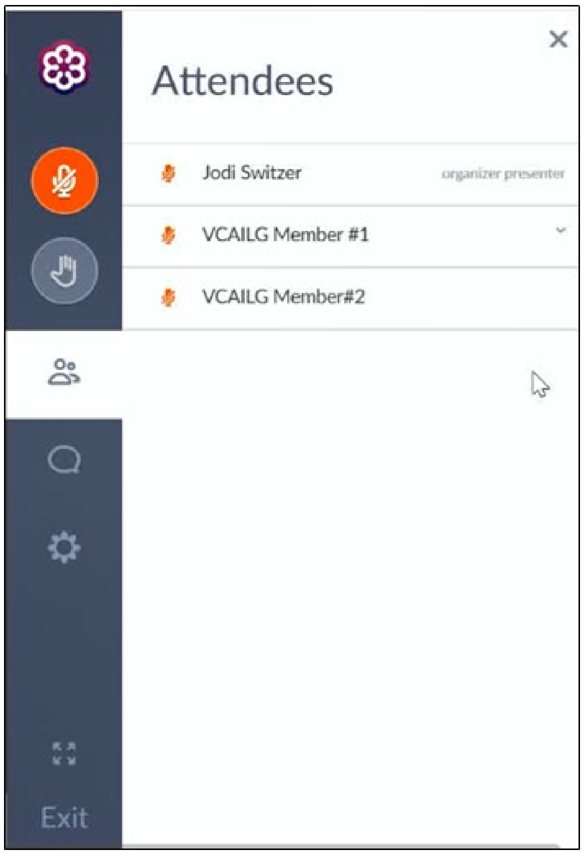
Two Ways to Join

Web browser



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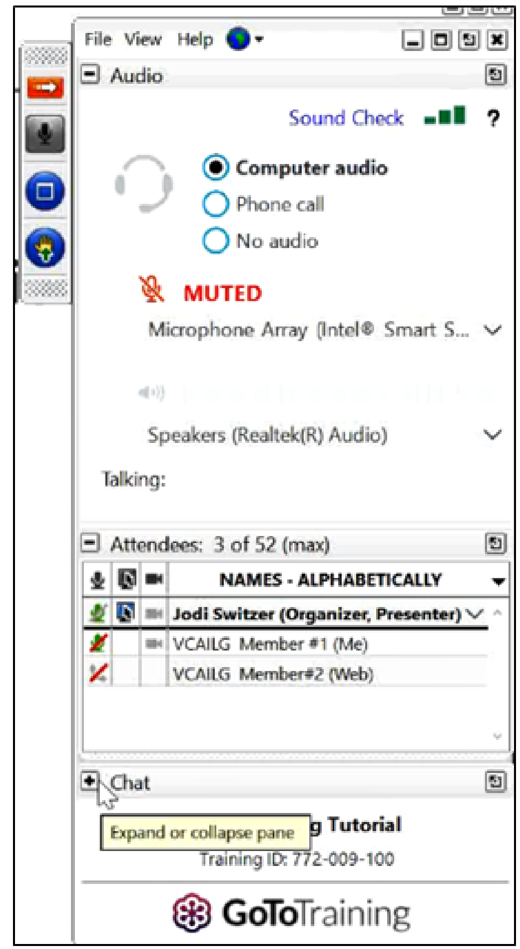

2021

Nitrogen Management Training

for Grower Nitrogen Management Plan Self-Certification

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Nitrogen Management Training

for Grower Nitrogen Management Plan Self-Certification

- Original Presentation Developed by:
  - Patrick Brown, UC
  - Daniel Geisseler, UCCE
  - Allan Fulton, UCCE
  - Tim Hartz, UCCE
  - Stuart Pettygrove, UCCE
  - Terry Prichard, UCCE
  - Larry Schwankl, UCCE
  - Carol Frate, UCCE
  - Marsha Campbell Mathews, UCCE
  - Gabriele Ludwig, Almond Board of CA
  - Asif Maan, CASS
  - Rob Mikkelsen, IPNI
  - Jerome Pier, Crop Production Services
  - Sebastian Saa, Univ. Católica de Chile
- Revised for Ventura County Farmers by:
  - Scott Bucy, Fruit Growers Laboratory
  - Amy Storm, Larry Walker Associates
  - Ben Faber, UCCE Ventura
  - Andre Biscaro, UCCE Ventura
  - Jamie Whiteford, Ventura County RCD

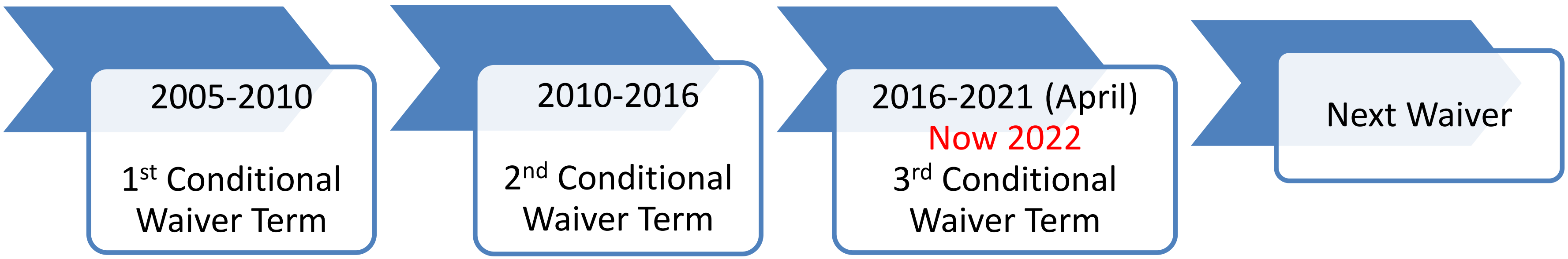
Agenda

April 6th – Session 1		
9:00-12:00	**Welcome and Introduction**	*Jodi Switzer*
	Conditional Waiver Program	Water Program Director
	NMP requirements	Farm Bureau of Ventura County
	Overview of Water Quality Issues (Section 1)	*Amy Storm*
	How nitrate became a problem	Senior Scientist
	Locally impacted waterbodies	Larry Walker Associates
	Nitrogen and Irrigation Management (Sections 2-3)	*Ben Faber*
	Nitrogen in Crop Production Systems	Farm Advisor
		University of California Cooperative Extension
April 7th – Session 2		
9:00-12:00	**Nitrogen and Irrigation Management (Section 4)**	*Ben Faber*
	Nitrogen Fertilizers and Management	Farm Advisor
	Irrigation and Nitrogen Fertigation	University of California Cooperative Extension
	Nitrogen Management Planning (Sections 5-7)	*Ben Waddell*
	Efficient Nitrogen Management	Director of Agricultural Services
	NMP Worksheet Overview	Fruit Growers Laboratory
	Practice Exercises	*Nicole Crouch*
	Review	Environmental Scientist
		Fertilizer Research and Education Program
		California Department of Food and Agriculture

Irrigated Lands Regulatory Program (ILRP) Conditional Ag Waiver

- Corresponding Regional Water Quality Control Board administers each program (Conditional Ag Waiver, Ag Order, or WDR)
- Applies to all growers who irrigate commercial crops
- Regulates water that discharges or "runoffs" into surface water (irrigation & stormwater) as well as leaching to groundwater
- Control and prevent contaminants to protect beneficial uses
- Growers comply individually or by joining a 3rd party coalition (VCAILG)
- Regional Board uses these regulatory programs to specify what growers and coalitions must implement to protect groundwater and surface water

Conditional Waiver Timeline

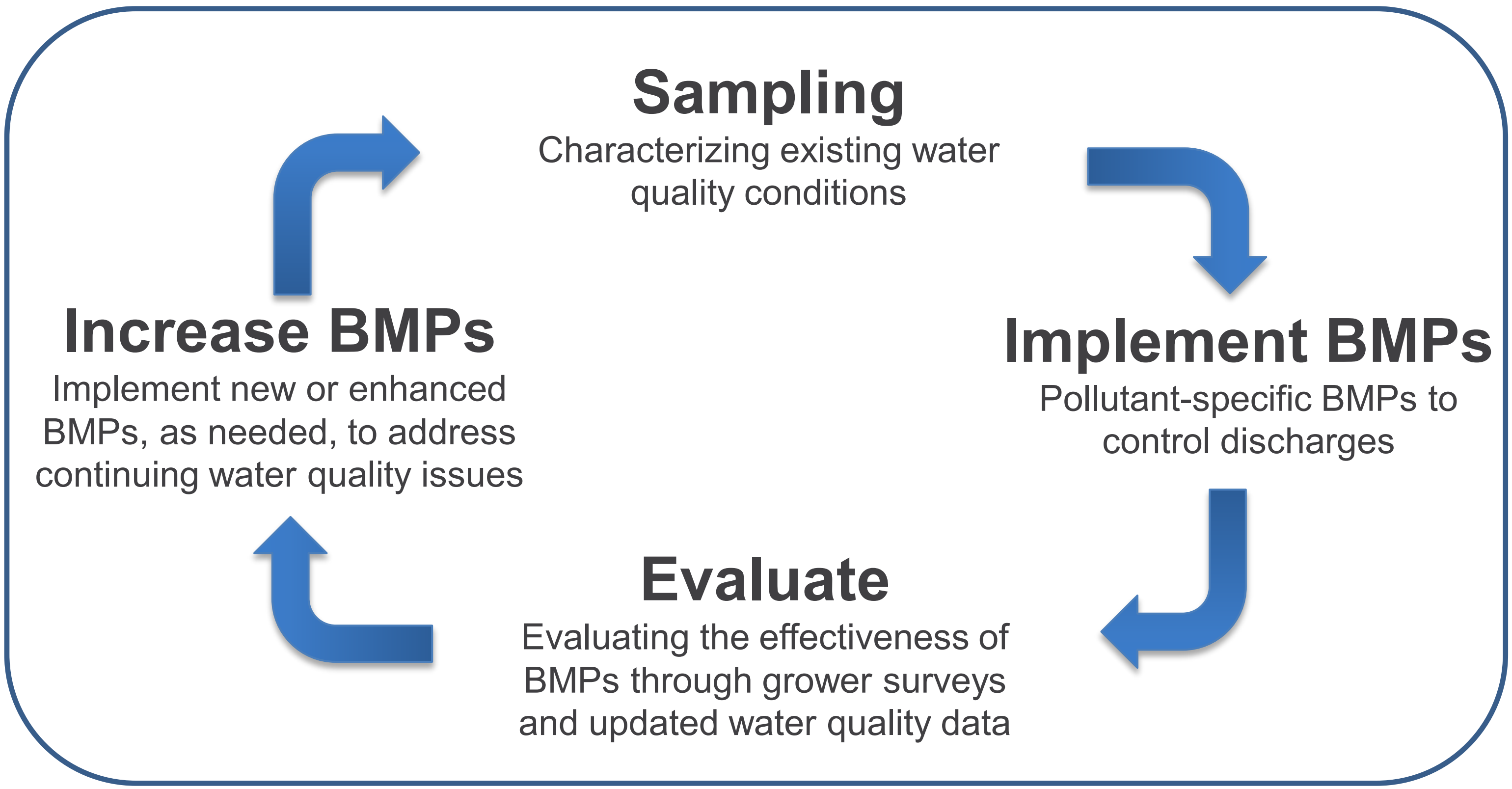


General Program Elements:

- Water quality testing foundation
- Grower BMPs
- Iterative process to evaluate effectiveness
- Reporting
- Education and Outreach

Iterative Process

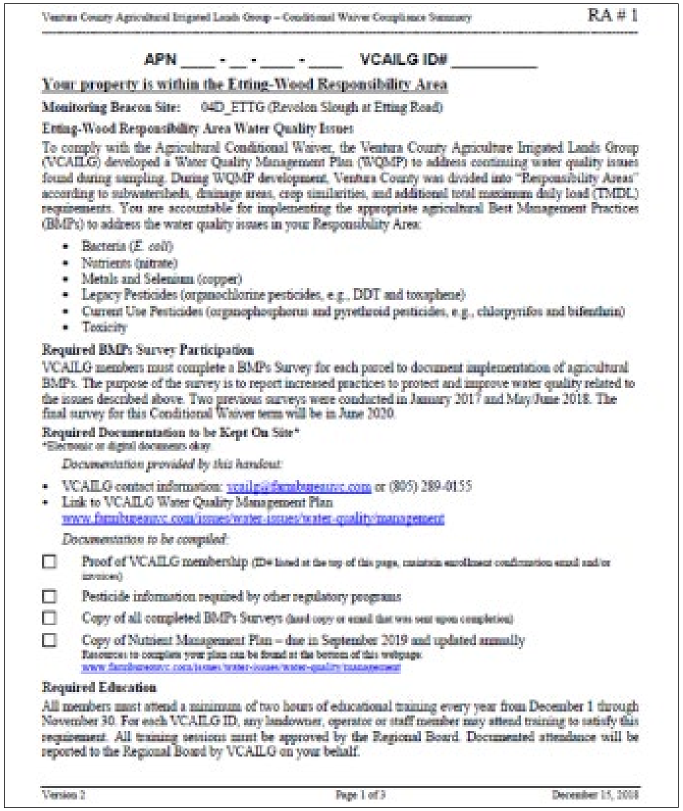
Implement BMPs to the degree necessary to meet water quality objectives



Conditional Waiver Requirements

Responsibility Area Compliance Summary Handouts

- Water quality issues
- Required compliance documentation
- Recommended BMPs



Ventura County Agricultural Irrigated Lands Group – Conditional Waiver Compliance Summary RA # 1

APN ____ - __ - ____ - ____ VCAILG ID# __________

Your property is within the Etting-Wood Responsibility Area

Monitoring Beacon Site: 04D_ETTG (Revolon Slough at Etting Road)

Etting-Wood Responsibility Area Water Quality Issues

To comply with the Agricultural Conditional Waiver, the Ventura County Agriculture Irrigated Lands Group (VCAILG) developed a Water Quality Management Plan (WQMP) to address continuing water quality issues found during sampling. During WQMP development, Ventura County was divided into "Responsibility Areas" according to subwatersheds, drainage areas, crop similarities, and additional total maximum daily load (TMDL) requirements. You are accountable for implementing the appropriate agricultural Best Management Practices (BMPs) to address the water quality issues in your Responsibility Area:

- Bacteria (*E. coli*)
- Nutrients (nitrate)
- Metals and Selenium (copper)
- Legacy Pesticides (organochlorine pesticides, e.g., DDT and toxaphene)
- Current Use Pesticides (organophosphorus and pyrethroid pesticides, e.g., chlorpyrifos and bifenthrin)
- Toxicity

Required BMPs Survey Participation

VCAILG members must complete a BMPs Survey for each parcel to document implementation of agricultural BMPs. The purpose of the survey is to report increased practices to protect and improve water quality related to the issues described above. Two previous surveys were conducted in January 2017 and May/June 2018. The final survey for this Conditional Waiver term will be in June 2020.

Required Documentation to be Kept On Site*

*Electronic or digital documents okay

Documentation provided by this handout:

- VCAILG contact information: vcailg@farmbureauvc.com or (805) 289-0155
- Link to VCAILG Water Quality Management Plan www.farmbureauvc.com/issues/water-issues/water-quality/management

Documentation to be compiled:

- ☐ Proof of VCAILG membership (ID# listed at the top of this page, [illegible] enrollment confirmation email and/or invoices)
- ☐ Pesticide information required by other regulatory programs
- ☐ Copy of all completed BMPs Surveys (hard copy or email that was sent upon completion)
- ☐ Copy of Nutrient Management Plan – due in September 2019 and updated annually
  Resources to complete your plan can be found at the bottom of this webpage: www.farmbureauvc.com/issues/water-issues/water-quality/management

Required Education

All members must attend a minimum of two hours of educational training every year from December 1 through November 30. For each VCAILG ID, any landowner, operator or staff member may attend training to satisfy this requirement. All training sessions must be approved by the Regional Board. Documented attendance will be reported to the Regional Board by VCAILG on your behalf.

Version 2 Page 1 of 3 December 15, 2018

2016 Waiver "New" Requirements

- Increased focus on groundwater
- Source investigation studies for increasing trends
- Time certain deadlines (waiver benchmarks and TMDLs)
- Nitrogen Management Plan requirements

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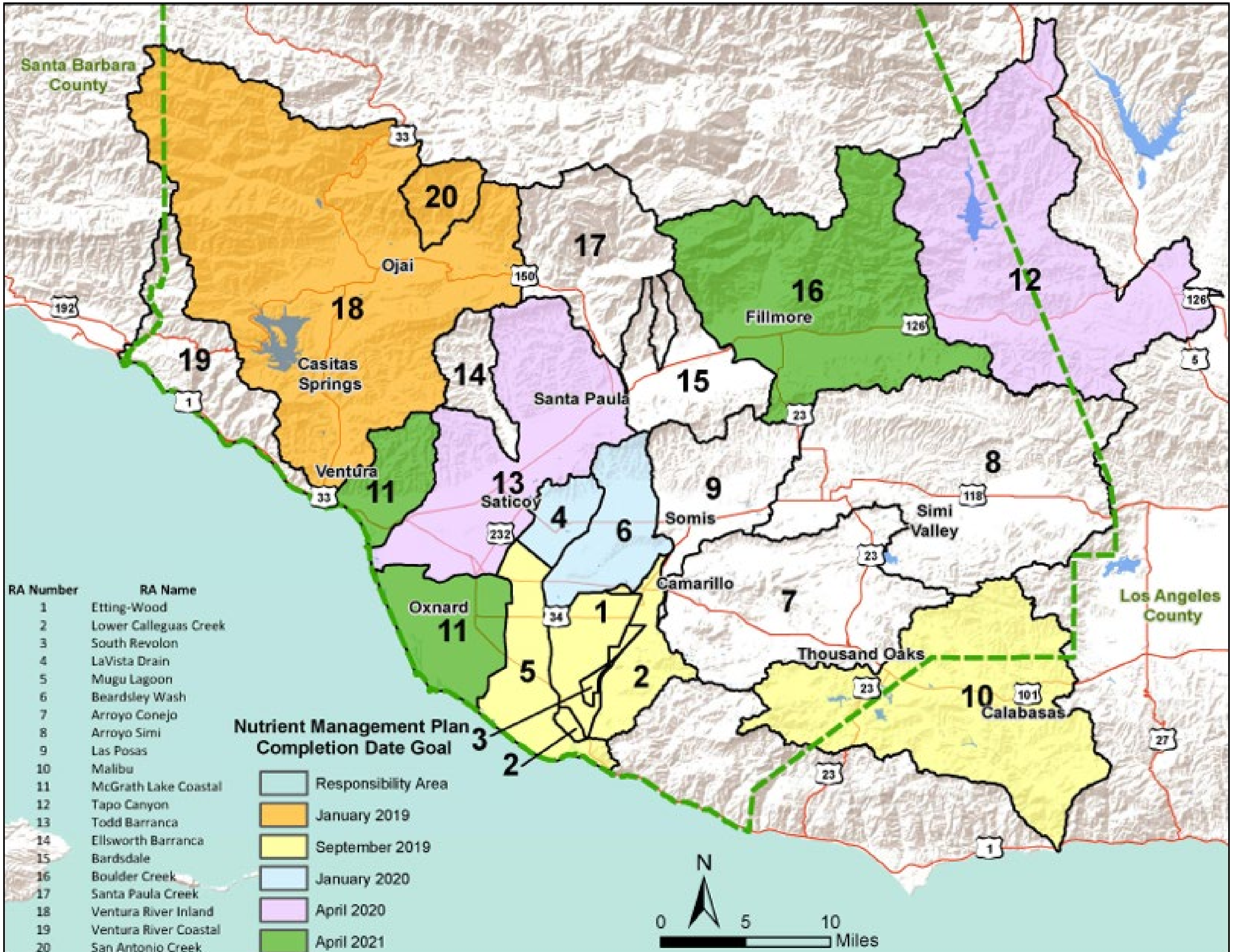
NMP Rollout for Current Waiver



Certifying Nitrogen Management Plans

- **Current waiver requires plan to be certified and available on-farm**

- **Three options for certification:**
  1. Self-certification by grower attending CDFA FREP approved training and passing exam (70%)
  2. Self-certification by grower adhering to site-specific recommendations from NRCS Technical Service Providers (must apply through EQIP)
  3. Certified by Crop Advisor (CCA) certified by the American Society of Agronomy

Next Waiver Outlook

- East San Joaquin WDR adopted by State Water Resources Control Board (2018)
- Precedential for all Irrigated Lands programs in California
- Irrigation and Nutrient Management Plans required for all operations
- Applied/removed nitrogen amount must be reported

Grower Self-Certification Requirements

- **Nitrogen Management Plan Training (6 hours)**
  - Training is intended to provide information on:
    - Efficient use of nitrogen fertilizers and irrigation management
    - Practices to minimize environmental impacts
    - Meeting Regulatory compliance requirements
- **Exam (30 questions)**
  - Passing grade (70%) on test
  - Test is closed book but any equation/conversions needed will be provided (no memorize needed)
  - Take initial test by 5:00 pm Thursday
  - Test can be taken multiple times

Grower Self-Certification Requirements

- **Maintaining Certification**
  - Complete Continuing Education Unit (CEUs)
  - 7 hours in 3 year time period (this workshop counts)
  - NMP CEU = any VCAILG CEU with nutrient focus
  - This workshop counts for both VCAILG and NMP CEUs
- **Certification valid in other regions**
  - Certification program started in Central Valley Region (administered by CURES)
  - Trainings are equivalent, if certified in the Central Valley, you do not need to repeat Ventura County VCAILG program, and vice-versa

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: ___

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)				
2. VCAILG ID#				
3. Name:				

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. **Crop**		17. Nitrogen Fertilizers		
7. **Production Unit**		18. Dry/Liquid N (lbs/ac)		
8. **Projected Yield** (units/ac)		19. Foliar N (lbs/ac)		
9. N Recommended (lbs/ac)		20. Organic Material N		
10. **Acres**		21. Available N in Manure/Compost (lbs/ac estimate)		
Post Production Actuals				
11. **Actual Yield** (units/ac)		22. **Total Available N Applied** (lbs/ac) (18+19+21)		
12. **Total N Applied** (lbs/ac) (22+26)		23. Nitrogen Credits(est)		
13. **N Removed** (lbs N/ac)*		24. Available N carryover in soil (annualized, lbs/ac)		
14. **Notes**:		25. N in Irrigation water (annualized, lbs/ac)		
		Irrigation sources		
		Irrigation amount applied (ac/ft)		
		26. **Total N Credits** (lbs/ac) (24+25)		
		27. **Total N Recommended & Applied** (22+26)		
		Actual N Applied (12) vs **Actual N Removed** (13)		

CROP NITROGEN MANAGEMENT PLANNING

28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified - approved training program attended	
	31. Self-Certified - NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

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Questions?

Overview of Nitrogen and Groundwater Quality Issues

Section 1

Section 1 Learning Objectives

- Recall areas that are more vulnerable to nitrate contamination.
- Distinguish between the different ways to measure nitrate.
- Recognize how nitrate became a problem.
- List the sources of nitrogen.

Nitrate Problem Areas in California

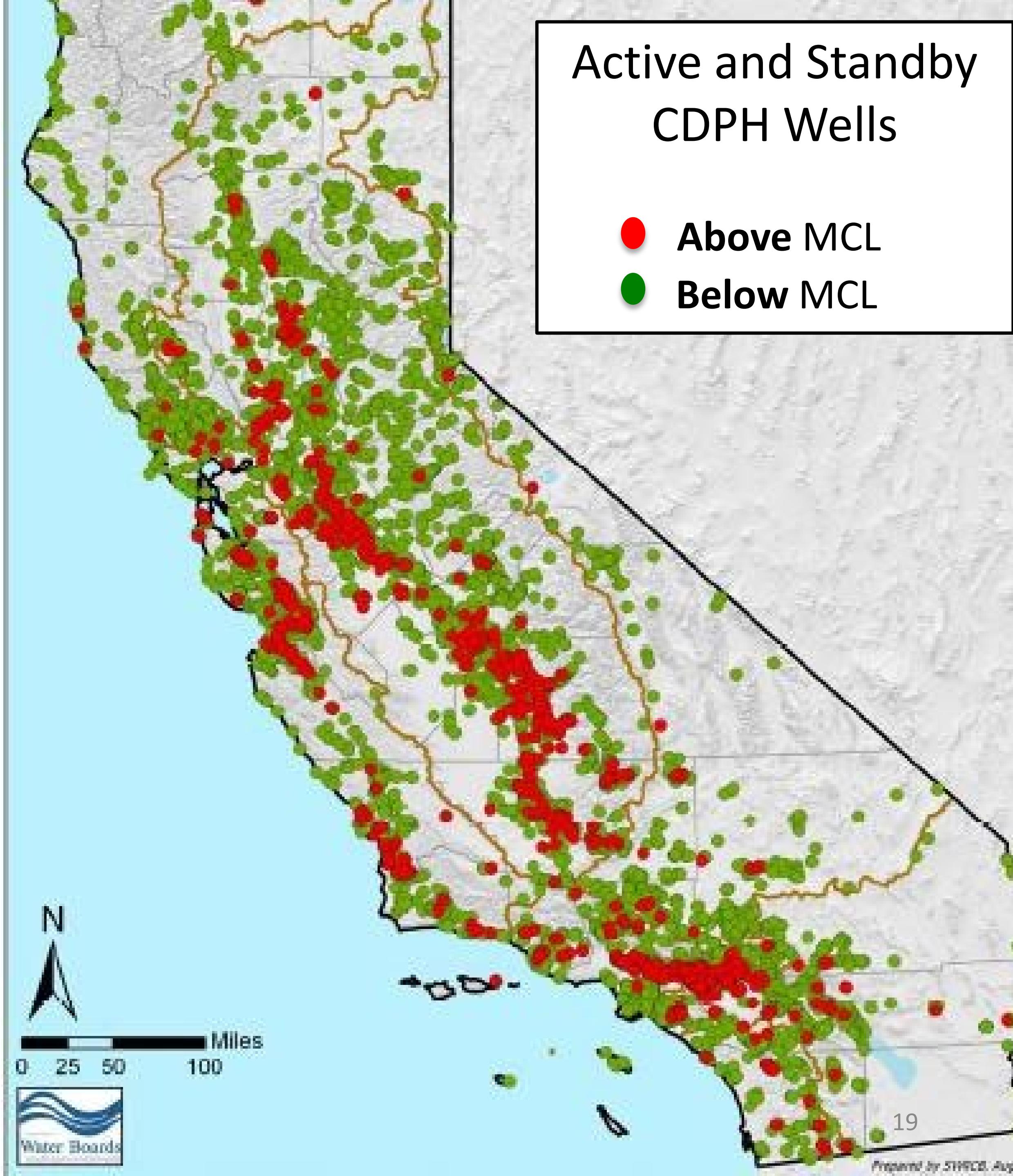
Areas with high connectivity to groundwater and intensive agriculture are vulnerable to nitrate contamination

MCL
(Maximum Contaminant Level)

- 45 ppm Nitrate

or

- 10 ppm Nitrate-N



Measuring Nitrate and Nitrate-N Concentrations

Maximum contaminant levels

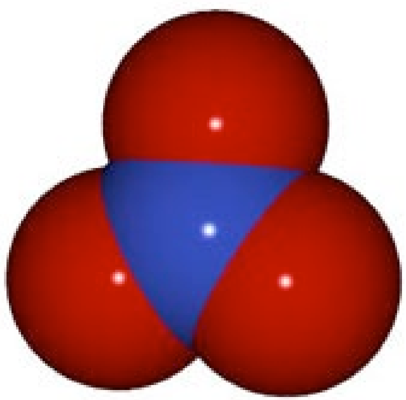
Measuring **Nitrate**:

45 ppm NO_3 (measure **N + O**)

Measuring **Nitrate-N**:

Preferred Unit

10 ppm NO_3^-- N (measure **N** only)



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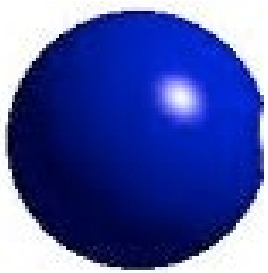
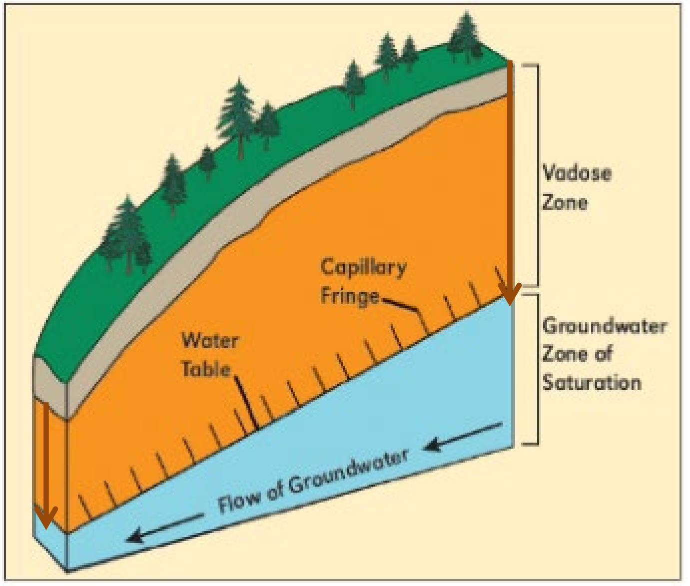


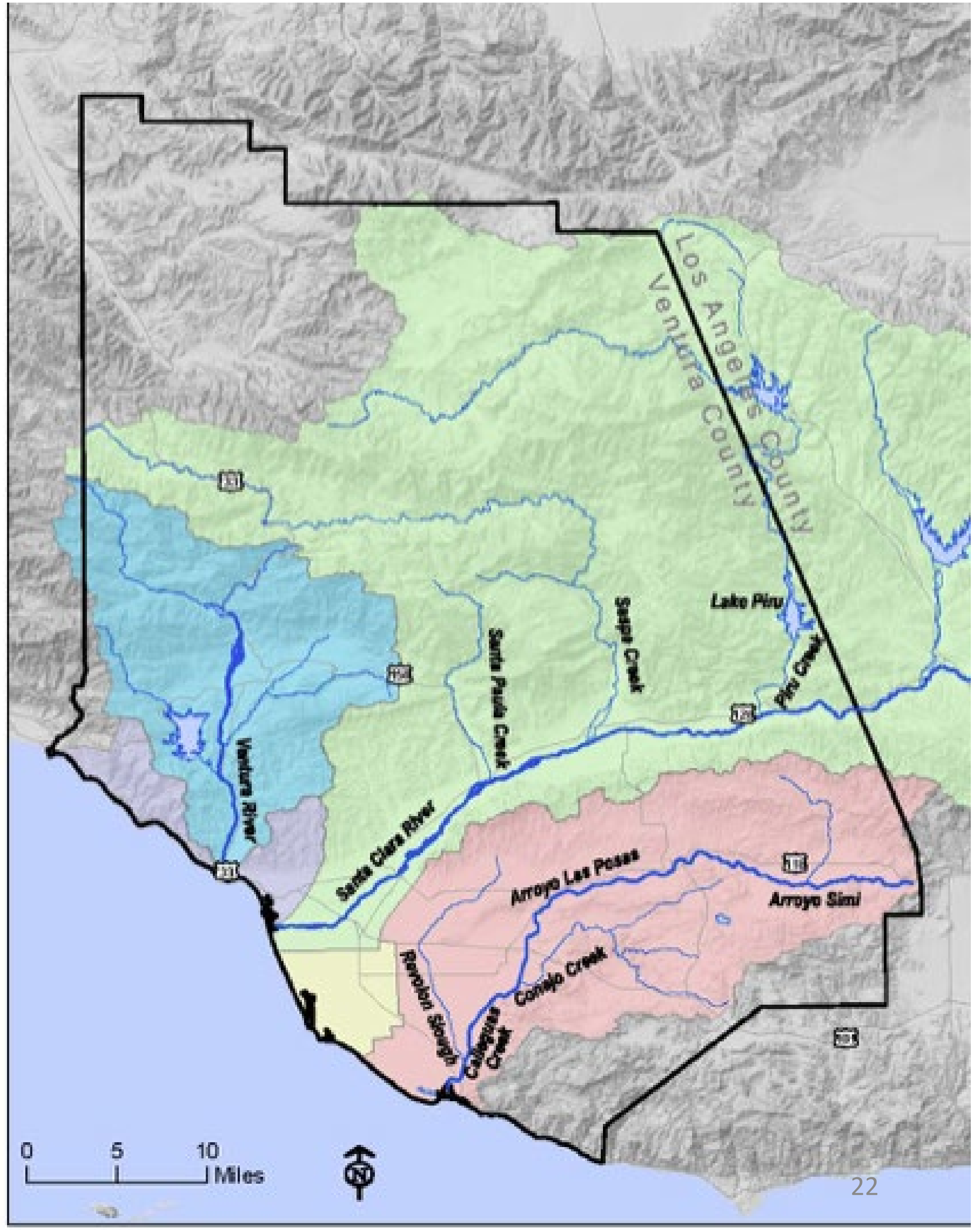
Groundwater Impacts

- Nitrate ($N0_3^-$) is an anion (negatively charged) and is not retained by the soil. It moves with water.
- Water moving below the root zone can carry nitrate with it.
- After years of downward flow with water, nitrate eventually reaches the aquifer.
- The **farther** from the source, the **longer** nitrate takes to reach the groundwater.



Watersheds with Nutrient TMDLs

- Ventura River (Algae)
- Calleguas Creek (Nitrogen)
- Santa Clara River (Nitrogen)
- Malibu Creek (Nutrients)



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How Did Nitrate Become a Problem?

- In nature, nitrogen (N) cycles through soil, water, and plants at low concentrations.
- Agriculture requires high N input to produce profitable crops which increases soil N concentrations over time.
- **Inefficiency** of irrigation and N applications leads to nitrate losses via:
    - Leaching past the root zone
    - Transport with surface runoff
    - Tile drain discharge

Dealing with Nitrate Pollution

- No inexpensive method exists to remove nitrate once it is in water
- Source control: Accounting for all the sources of nitrogen in the system leads to more efficient use of nitrogen and fertilizer products.
  - Sources of nitrogen:
    - Mineralization of organic nitrogen
    - Residual soil nitrogen
    - Nitrogen in irrigation water
    - Nitrogen fertilizers

Questions?

Section 2 – Nitrogen in Crop Production Systems

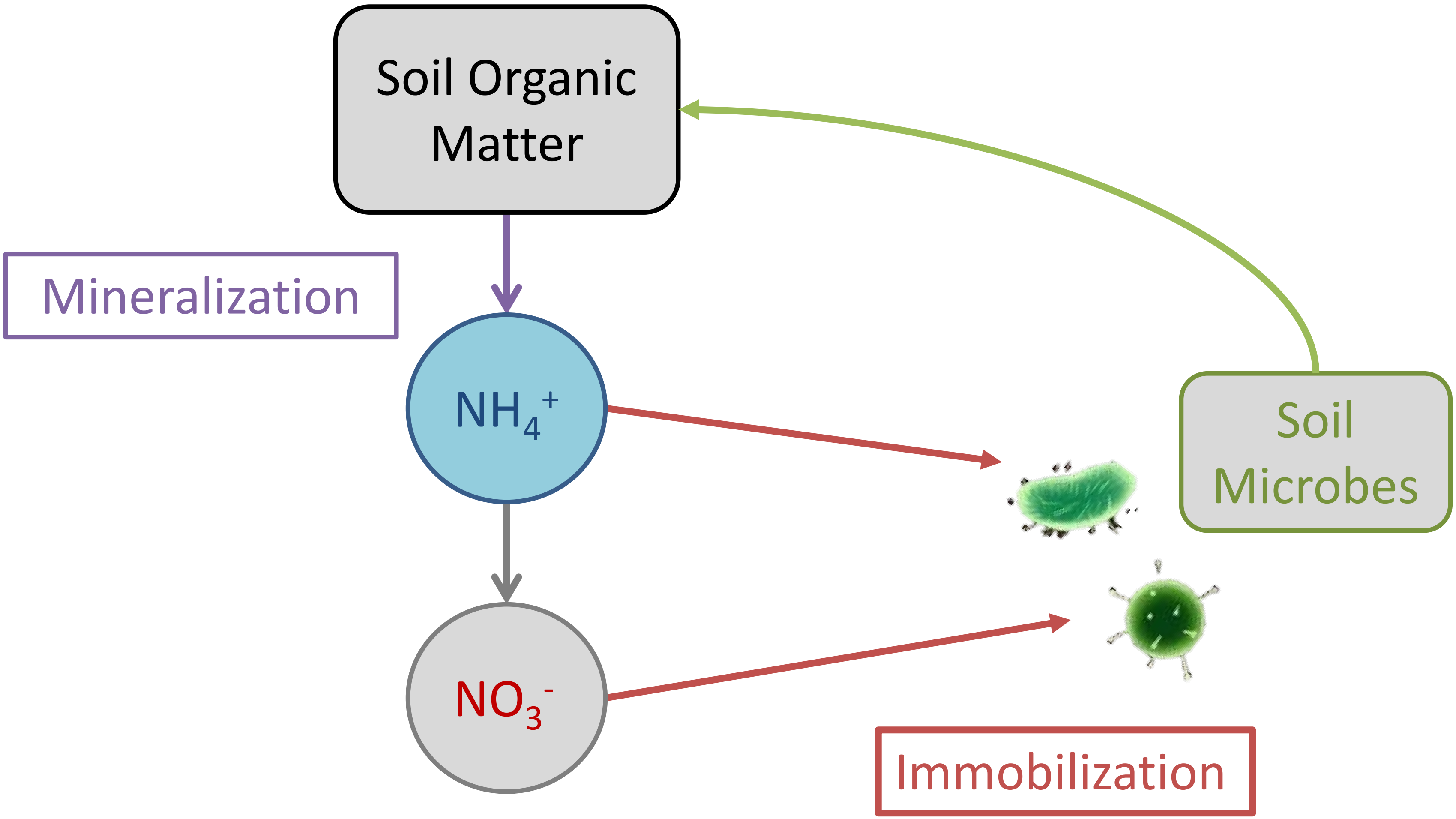
Section 3 - Nitrogen Fertilizers and Management

Ben Faber,
Farm Advisor,
University of California Cooperative Extension,
Ventura County

Section 2 Learning Objectives

- Identify the parts of the nitrogen cycle and recognize conditions that favor their occurrence
  - Mineralization
  - Immobilization
  - Nitrification
  - Leaching
  - Volatilization
  - Denitrification
  - Plant uptake

Nitrogen Cycle
Mineralization and Immobilization



Mineralization

A microbial process that converts ***organic*** N to plant available ***inorganic*** N in the form of ammonium (NH_4^+)

Soil Organic Matter

Mineralization

NH_4^+

Ammonium

Soil Organic Matter

- Soil organic matter stores carbon and nutrients in the soil
- The process of N release from soil organic matter is driven by microbes
  - Carbon and nutrients are taken up as plants and microorganisms grow, then mineral N is released upon death (mineralization)

Mineralization

Organic N to Mineral N (NH_4^+ and NO_3^-)

- Carbon to Nitrogen ratio (C:N) of organic materials is one of the main factors controlling mineralization rates

- Environmental conditions such as temperature, tillage (aeration), and moisture enhance mineralization rates

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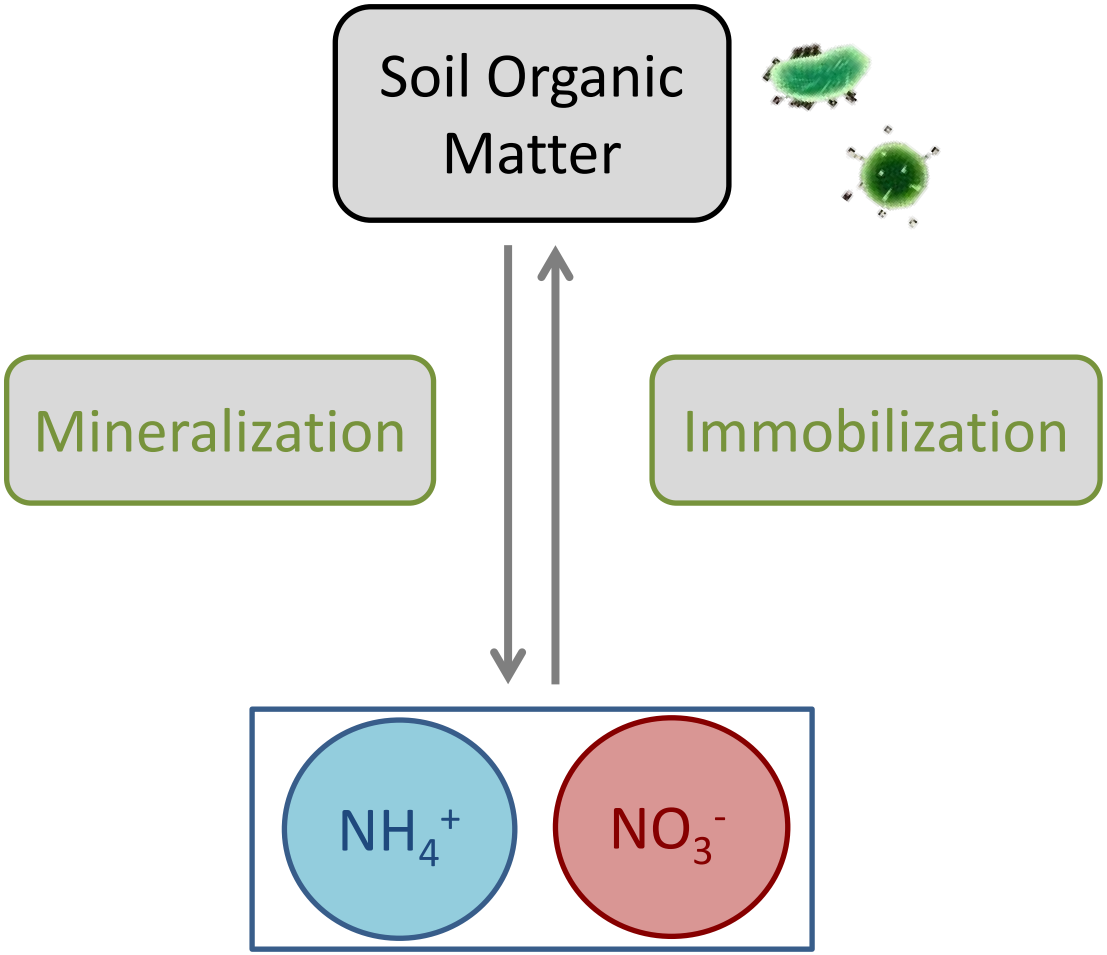
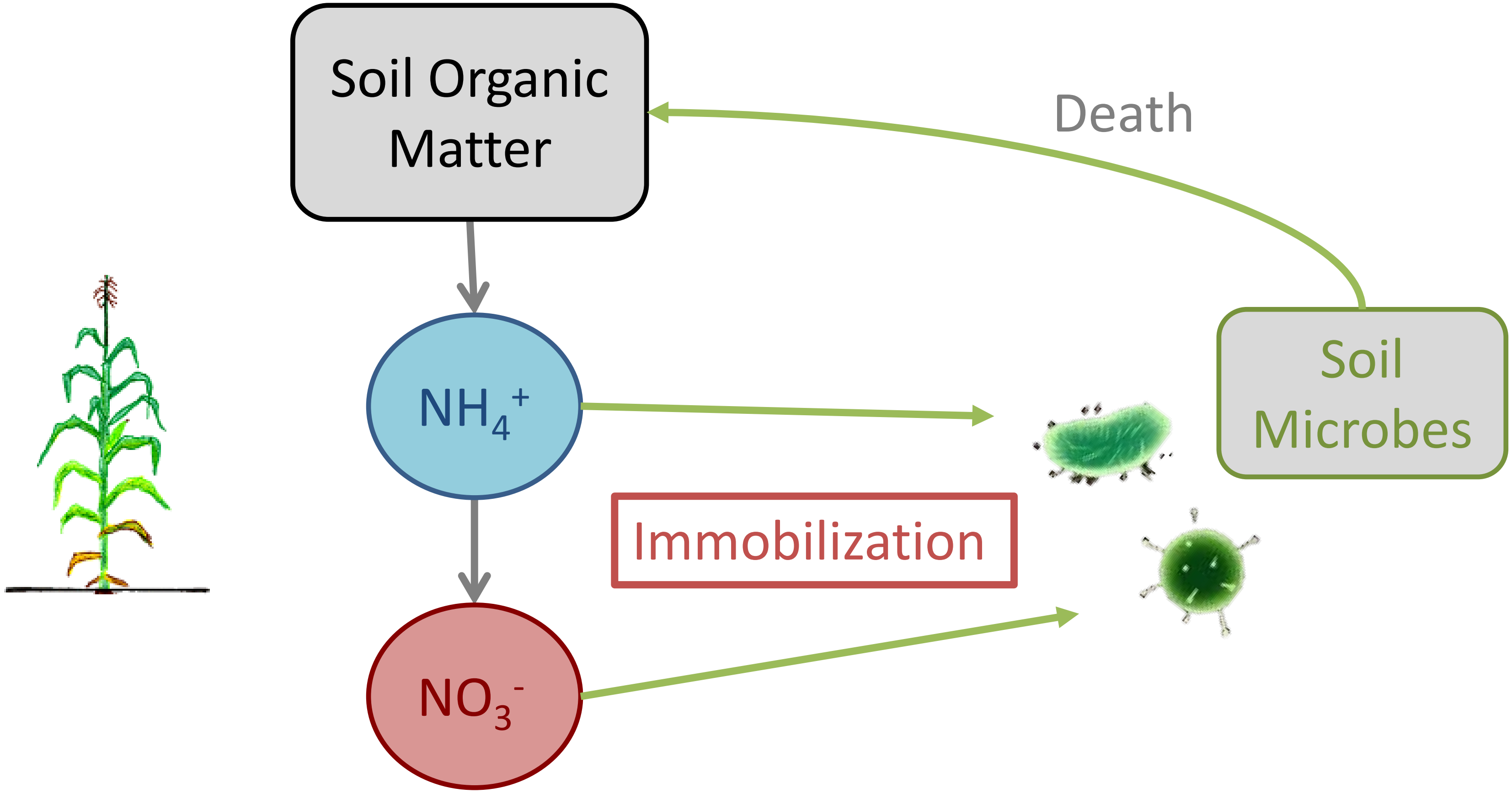
Nitrogen Cycle – Soil Microbes



Immobilization

Microbes incorporate **mineral** N from soil solution into **organic** compounds in their cells



Immobilization

Mineral N to Organic N

- If C:N ratio is high microbes have priority in using available mineral N until decomposition of Soil Organic Matter (OM) declines to about 20:1 C:N

Organic Matter Decomposition in Soils

- Decomposition rates depend on the source:
  - Main Sources: Crop and plant residues (cover crop, compost) and animal manure
  - Sources contain different organic carbon compounds depending on crop residue type and age

Sugars, Starches Proteins Weakly Bound Carbon Materials Woody tissues	Rapid decomposition ↓ Slow decomposition

Organic Matter C:N Ratios

Material	% C	% N	C:N
Sawdust	50	0.05	600
Wheat Straw	38	0.5	80
Corn residue	40	0.7	57
Rotted Manure	41	2.1	**20**
Broccoli Residues	35	1.9	18
Vetch Cover Crop	40	3.5	11
Soil Bacteria	50	10	5

Slow Decomposition /Favors Immobilization

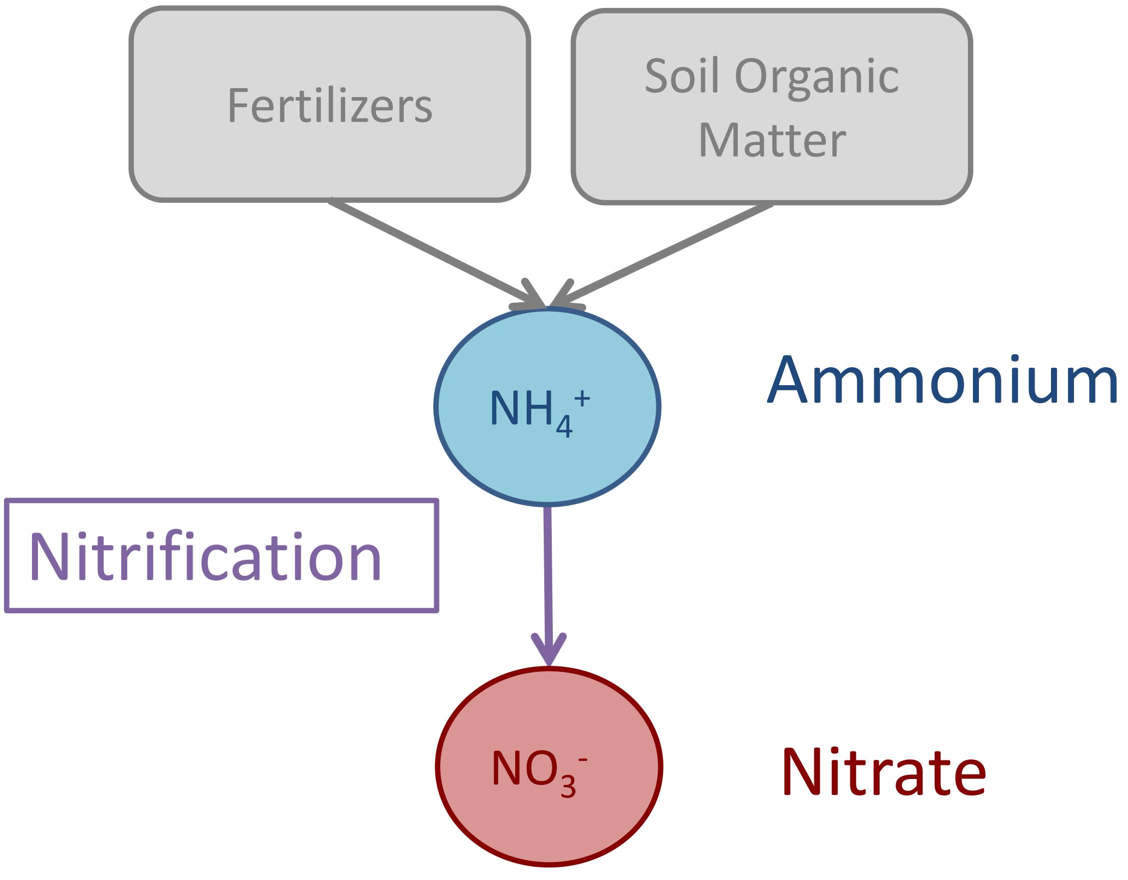
20:1 (2% N)

Rapid Decomposition /Favors Mineralization

Generally: A C:N ratio of **20:1** (2% N) is the dividing line between **mineralization** (immediate release) and **immobilization** (N binding and subsequent release).

Nitrification

A microbial process that converts ammonium (NH_4^+) to nitrate (NO_3^-)



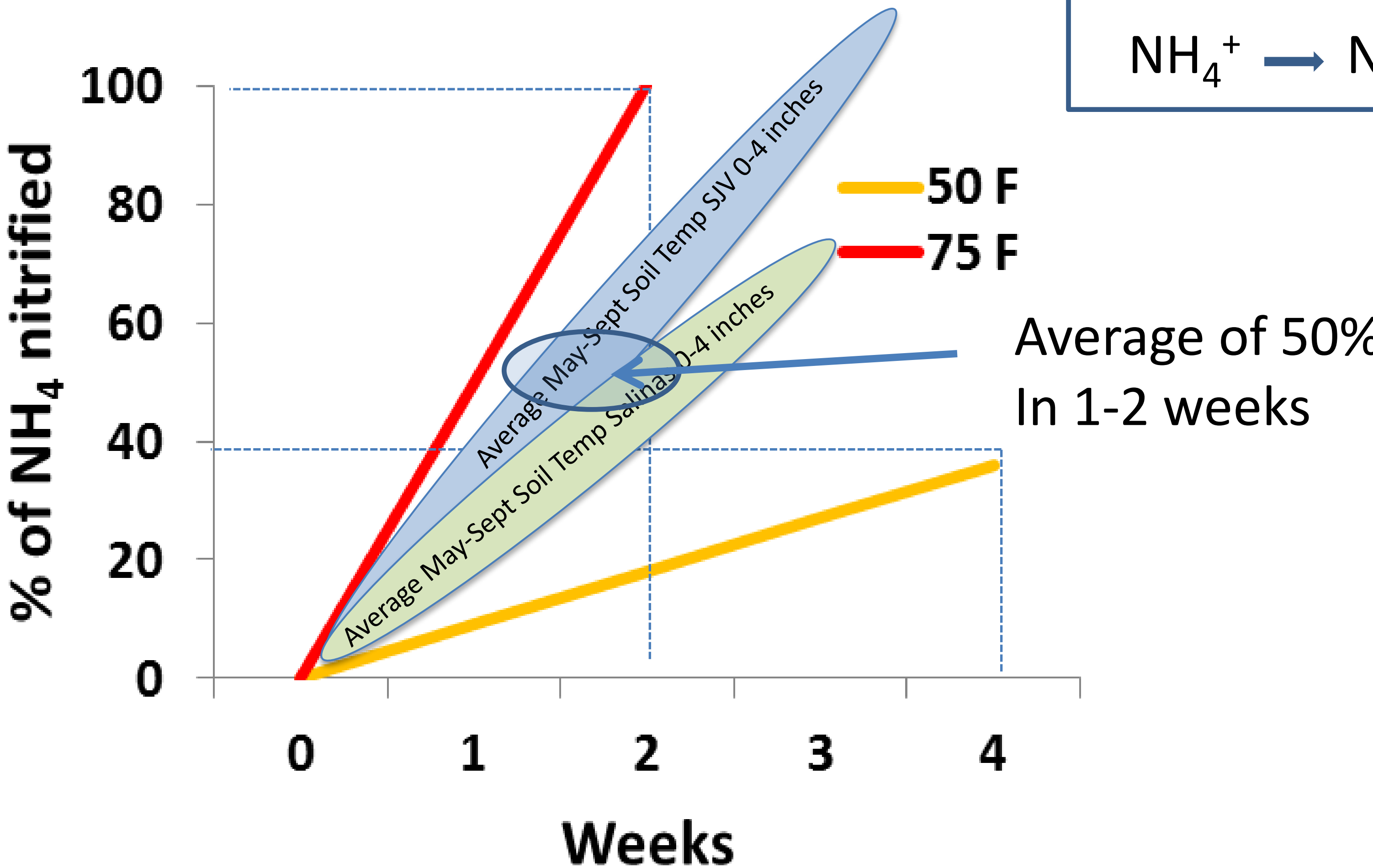
Nitrification

Ammonium → Nitrate

- Ammonium is used as an energy source by bacteria resulting in the production of nitrate
- Process enhanced by warm, moist, and well aerated soils

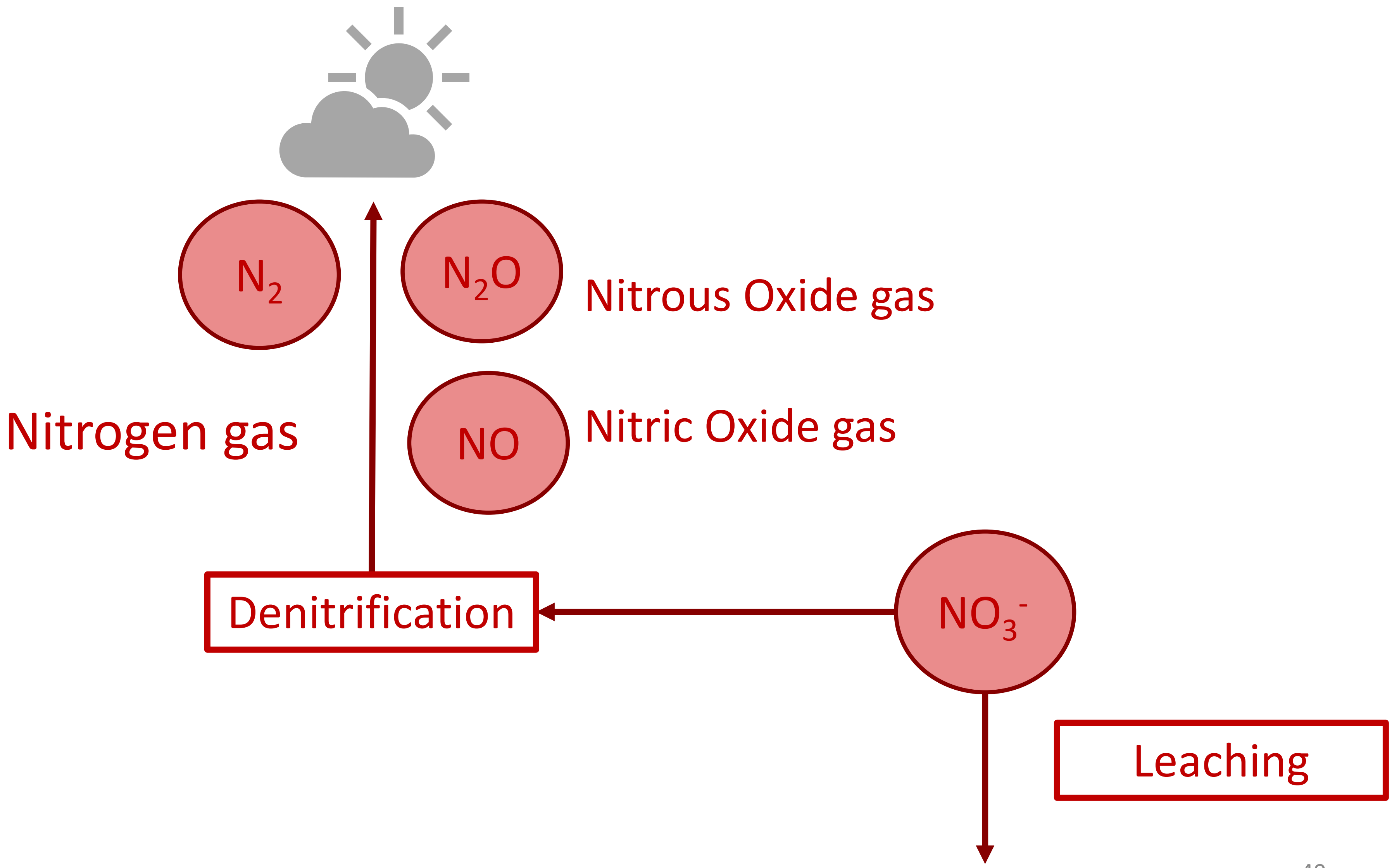
Nitrification: How Quickly Does it Occur?

$NH_4^+ \rightarrow NO_3^-$



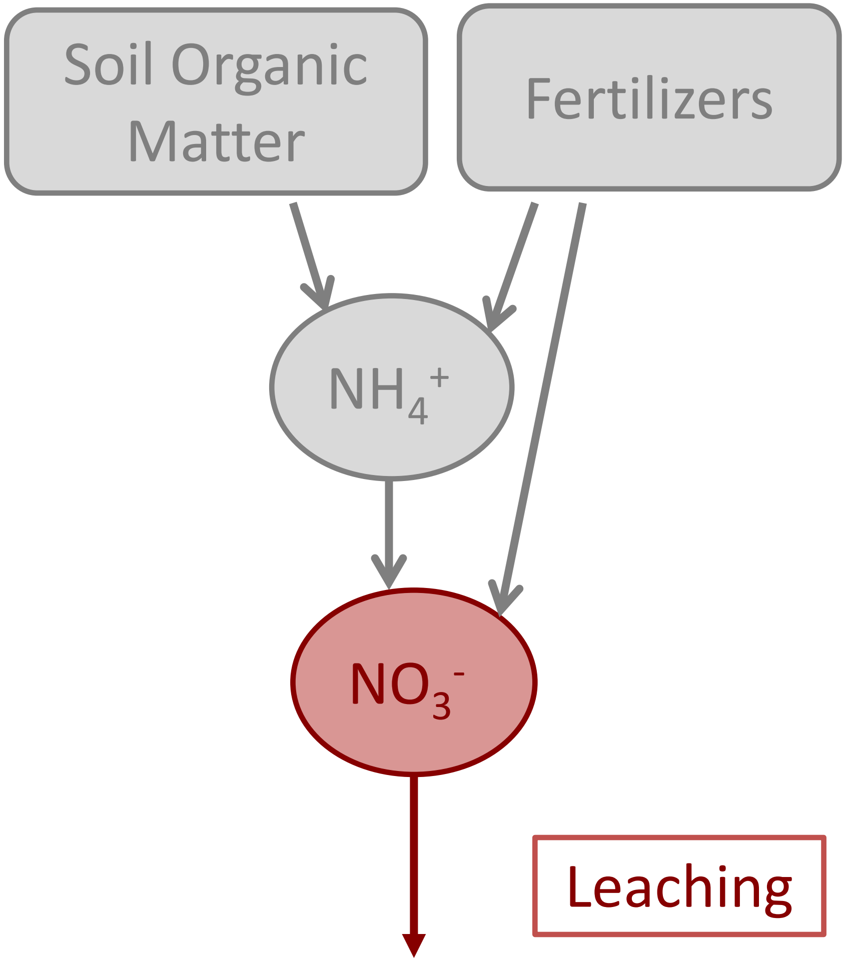
(Figure: Estimate of nitrification rates in California soils (San Joaquin and Salinas Valleys), depending on soil temperature. Adapted from Western Fertilizer Handbook)

Nitrogen Cycle –Nitrate Losses



Nitrate Leaching

Loss of nitrate (NO_3^-) from the soil due to irrigation or rain.
Greatest loss potential of nitrogen from the soil.



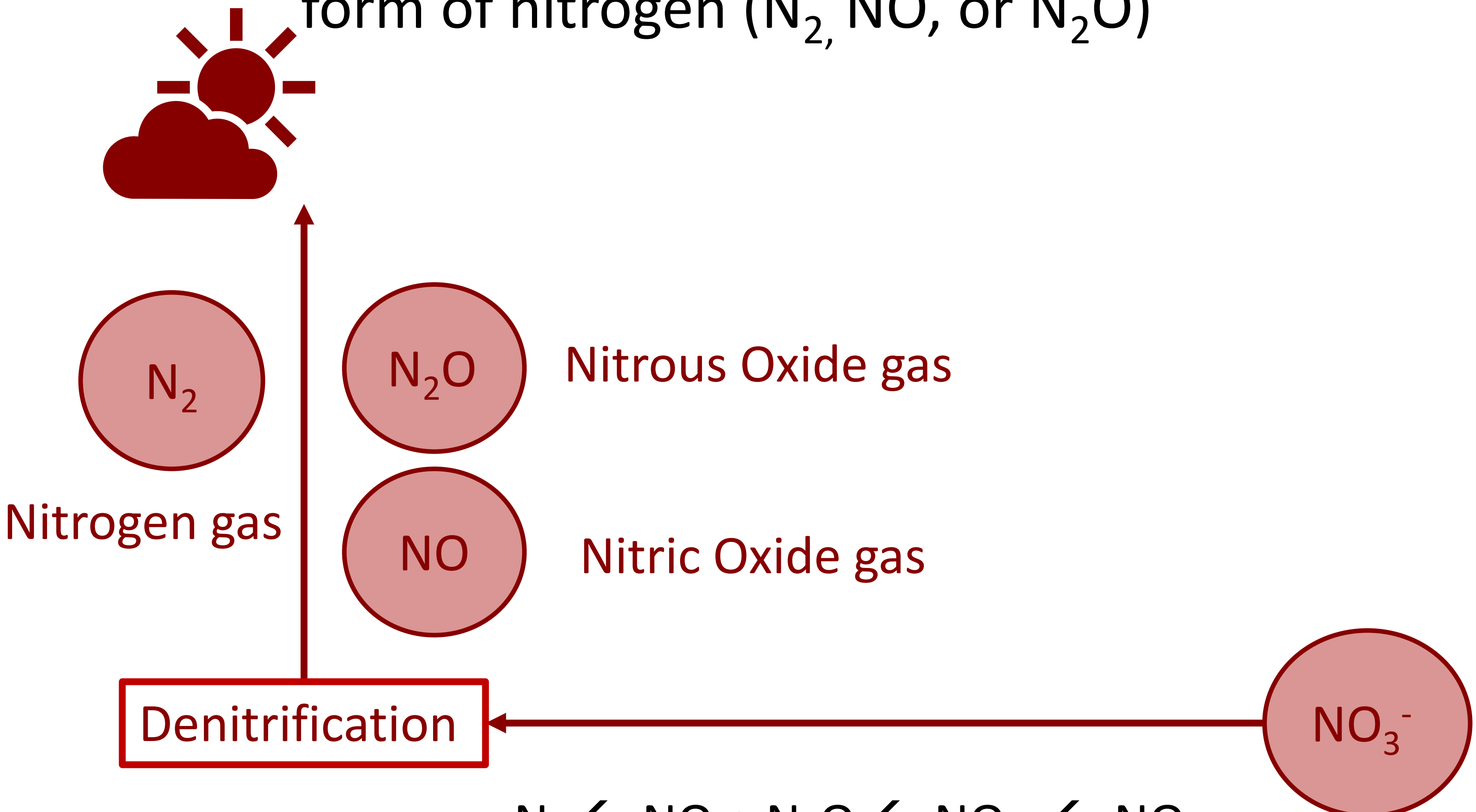
Nitrate Leaching

Movement of nitrate below the root zone

- Reasons why nitrate can leach:
  - Nitrate (NO_3^-) is negatively charged, so it is not held by the soil particles because they are also negatively charged
  - Poor management practices such as applying excess N and irrigation water and not matching application timing with crop demand

Denitrification

A microbial reduction of nitrate (NO_3^-) to a gaseous form of nitrogen (N_2, NO, or N_2O)



$$N_2 \leftarrow NO + N_2O \leftarrow NO_2^- \leftarrow NO_3^-$$

Denitrification

Anaerobic reduction of $NO_3 \rightarrow N_2O$, NO, and N_2 gas

- Occurs under warm, anaerobic conditions
  - Most significant in wetlands and rice paddies

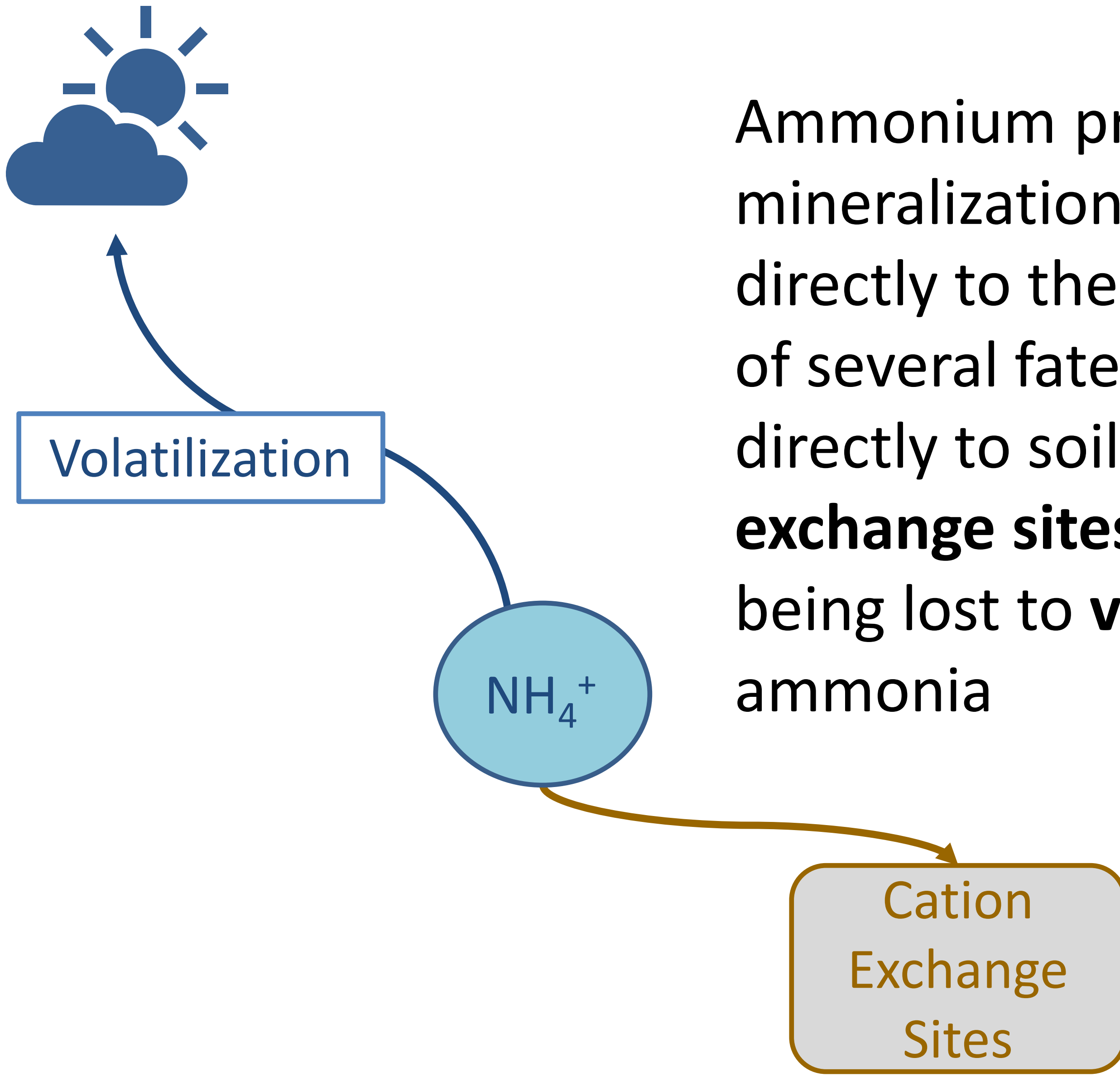
- In irrigated agriculture most N loss occurs during a brief period when the soil is warm, wet, and high in nitrate (i.e. fertigation)

- Of the N losses denitrification is potentially the smallest

(1- 4 lbs N/acre per irrigation or rain event)

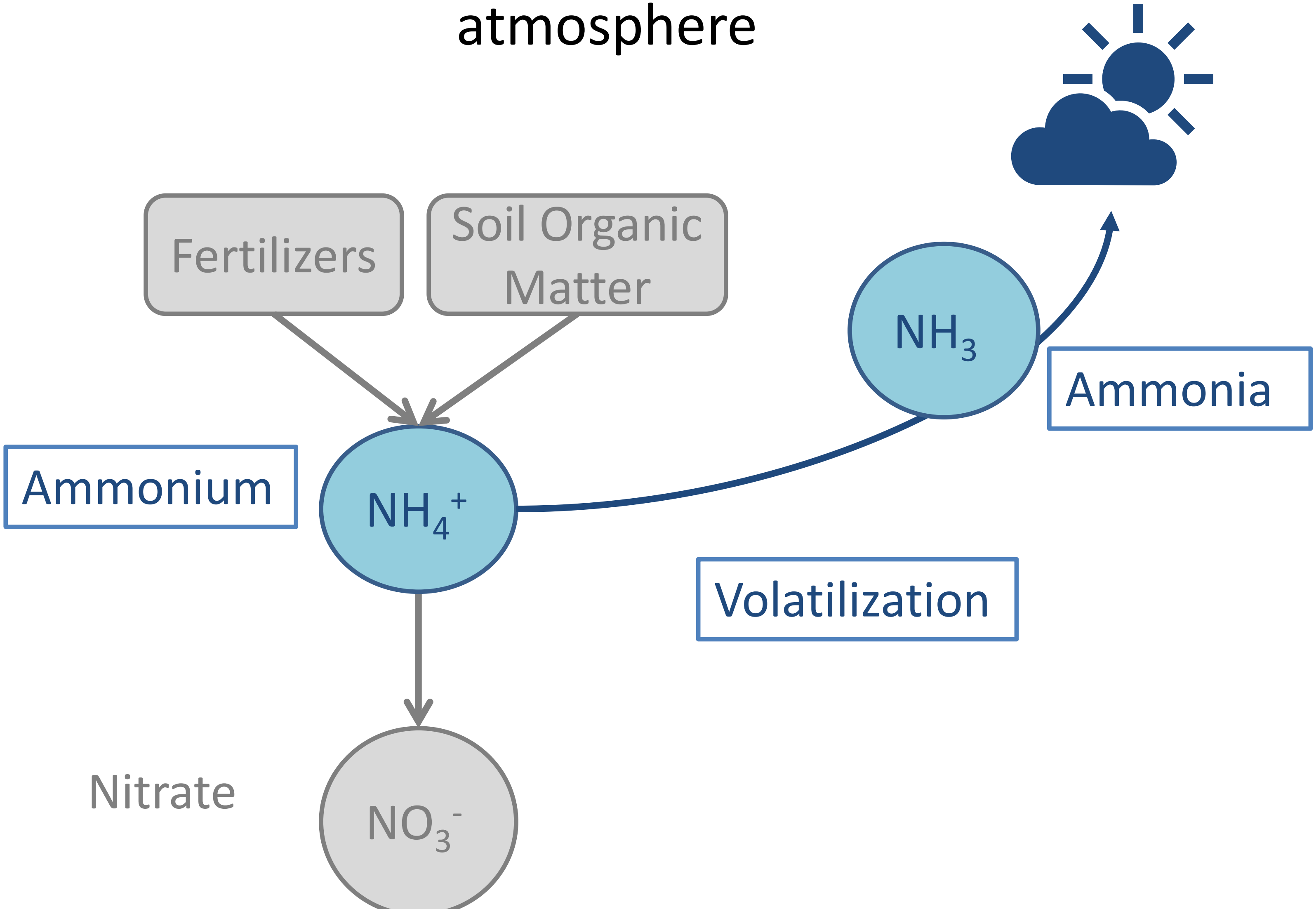
Nitrogen Cycle –Ammonium losses

Ammonium produced by mineralization or added directly to the soil has one of several fates: binding directly to soil at **cation exchange sites (CEC)** or being lost to **volatilization** as ammonia



Ammonia Volatilization

Volatilization is the loss of gaseous ammonia to the atmosphere

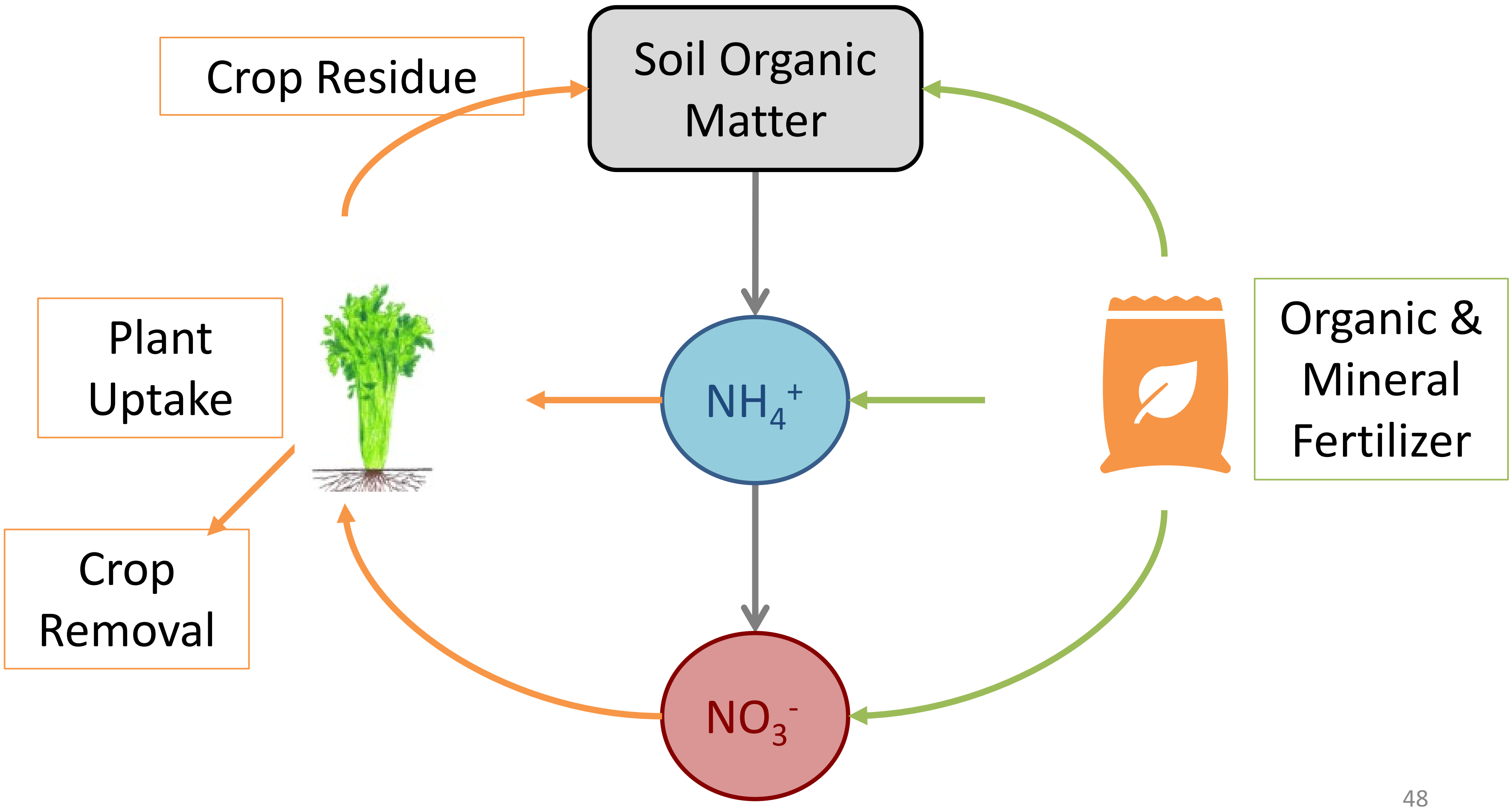


Ammonia Volatilization

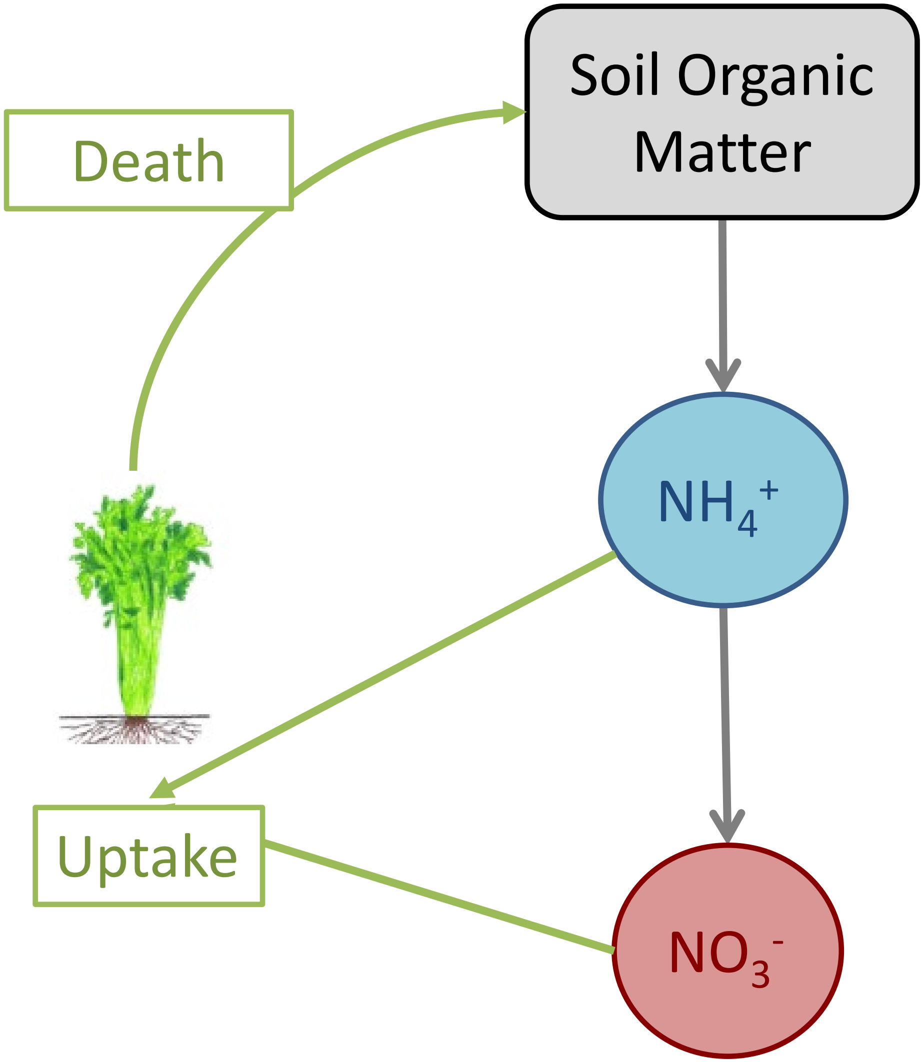
The loss of gaseous ammonia (NH_3) to the atmosphere

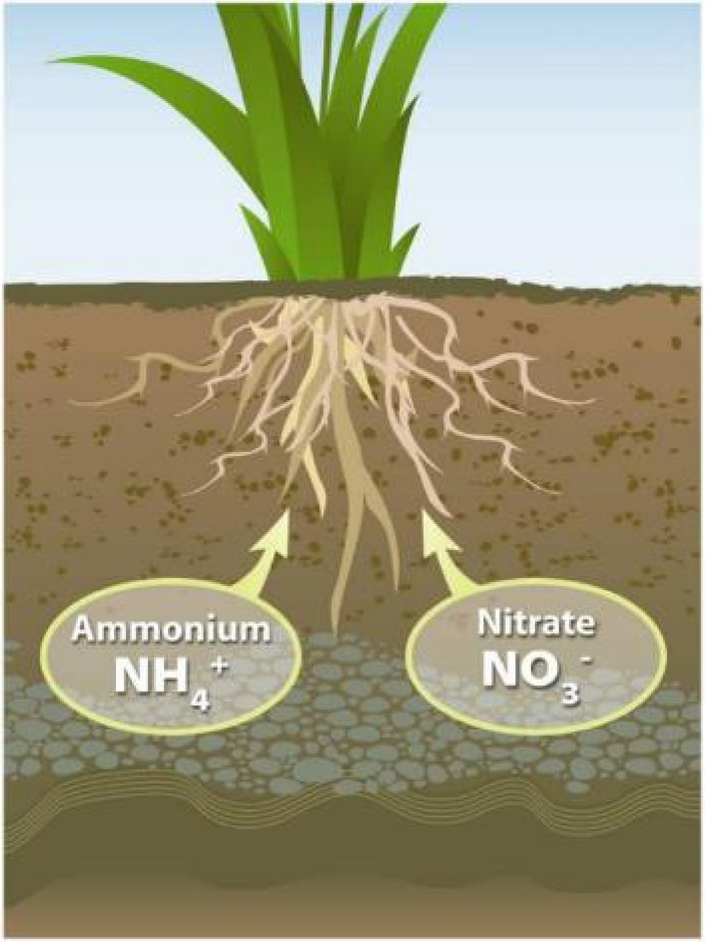
- Materials where ammonia gas is present or is a result of their breakdown include fresh manure, ammonia injections, urea, and UAN
- Conditions that favor volatilization
  - Lack of soil incorporation
  - Dry soil (low moisture content)
  - Coarse-textured soils (sandy)
  - High pH soils/water

Nitrogen Cycle- Fertilizer Inputs and Crop Removal



Nitrogen Cycle -Plant Uptake





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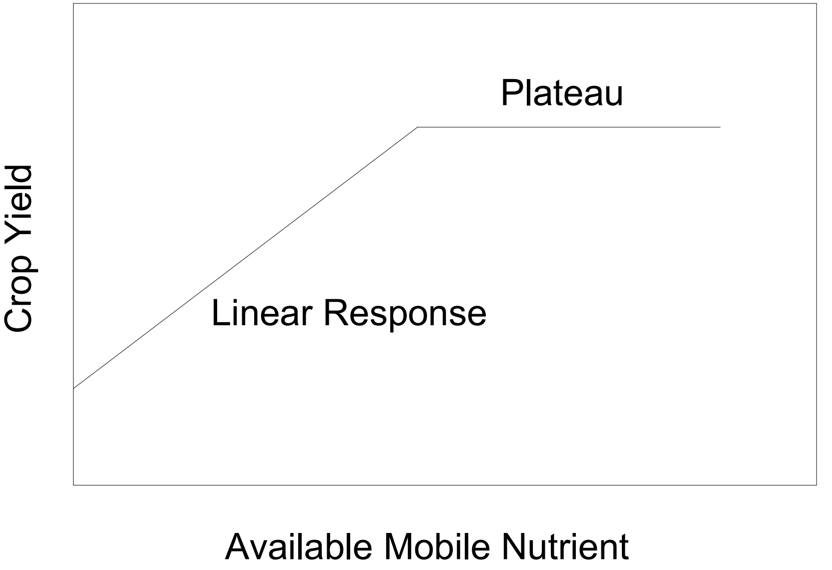
Nitrogen Assimilation

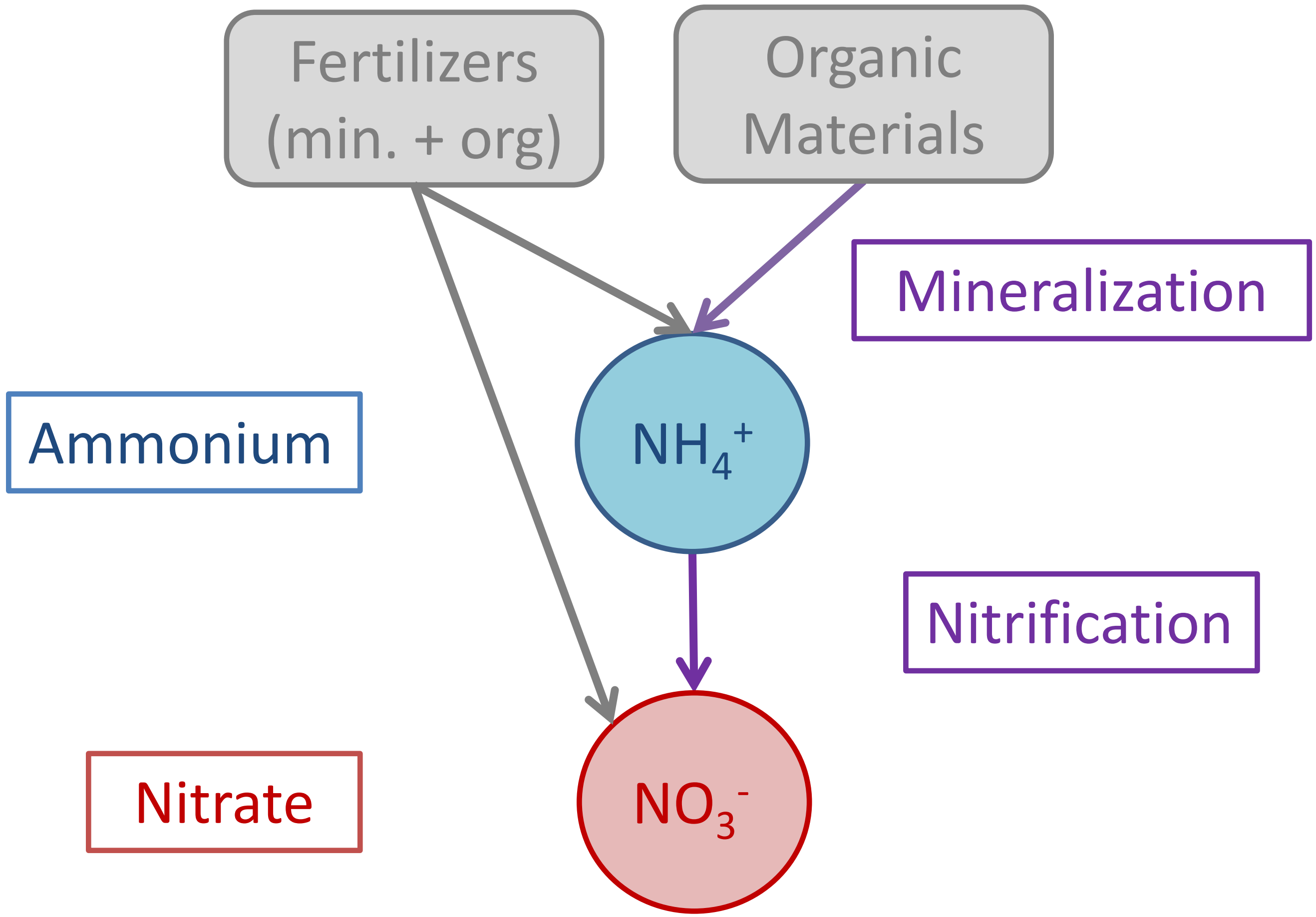
- Assimilation drives plant N uptake
  - Plants only assimilate the needed amount plus a small amount of “luxury consumption”
  - Thus N available in the soil, that is in excess of immediate plant needs, may be leached to groundwater

Nitrogen in Plants

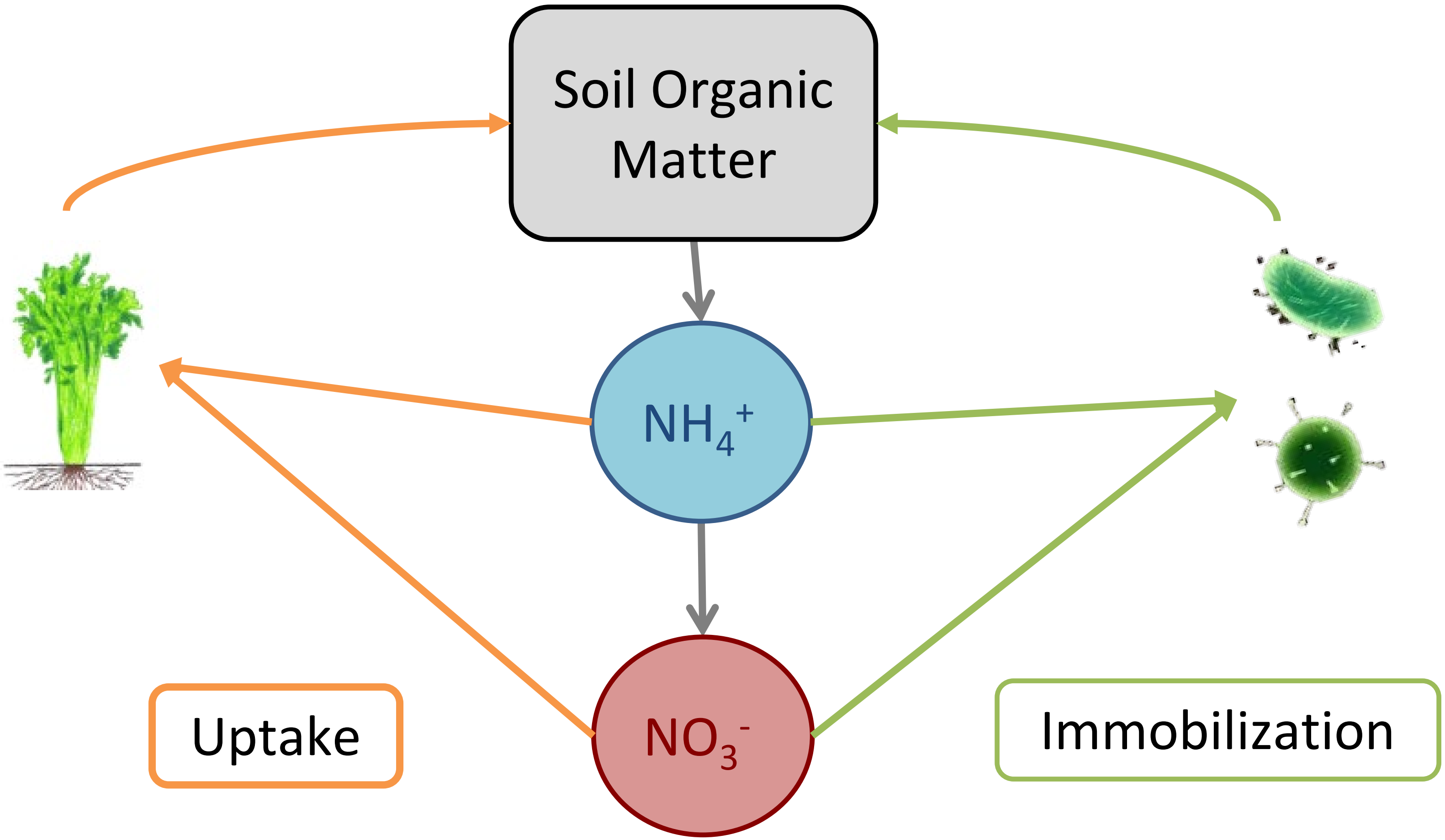
- Nitrogen availability generally limits crop productivity until adequacy is reached, then response to N plateaus
  - Fertilization past a level of adequacy does not increase productivity



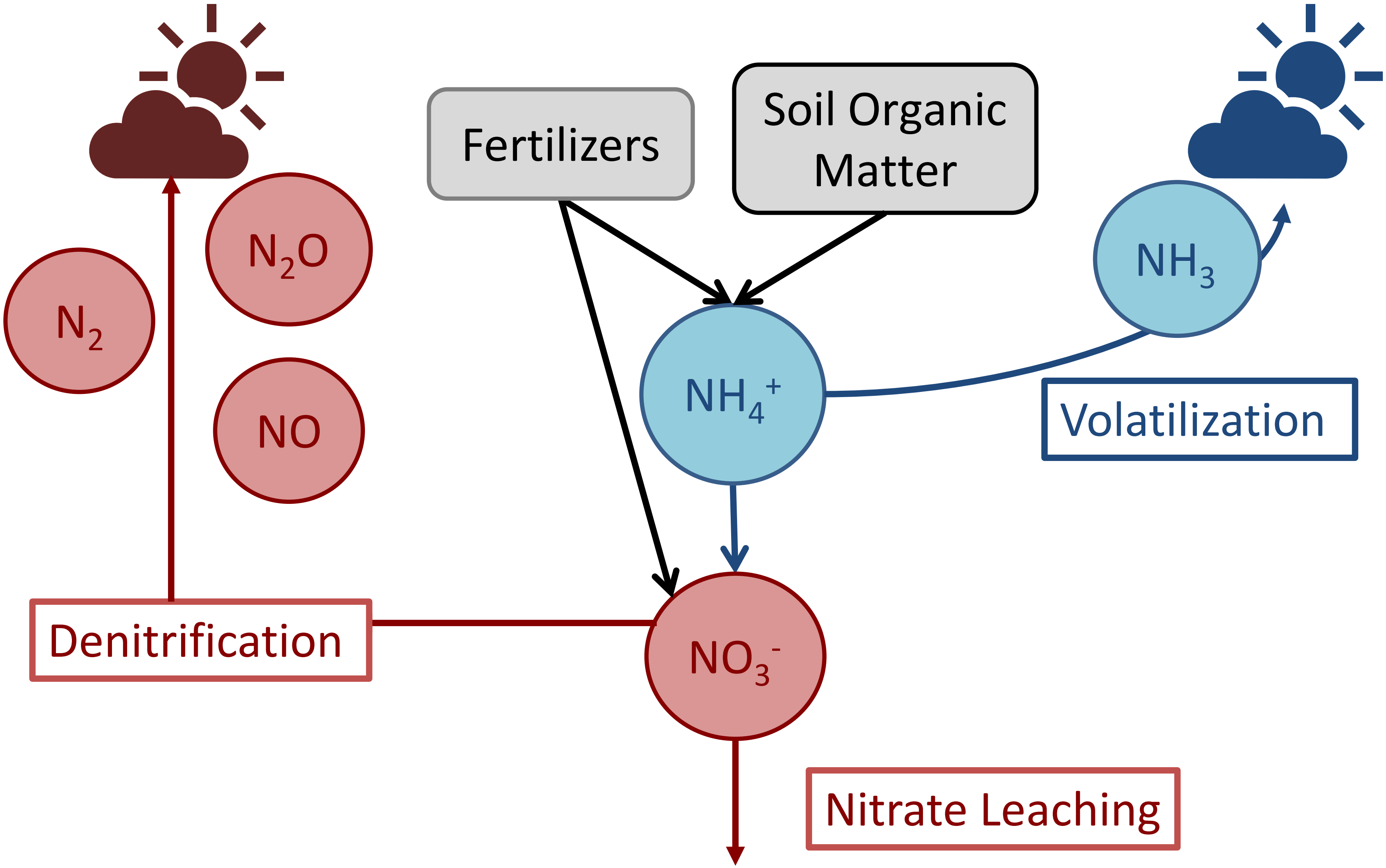
Nitrogen Cycle Review – Mineralization and Nitrification



Nitrogen Cycle Review –Plants and Microbes



Nitrogen Cycle Review -losses



Questions?

Nitrogen Fertilizers and Management

Section 3

Section 3 Learning Objectives

- Recognize the different categories of nitrogen fertilizers and their composition
- Identify their potential for N loss

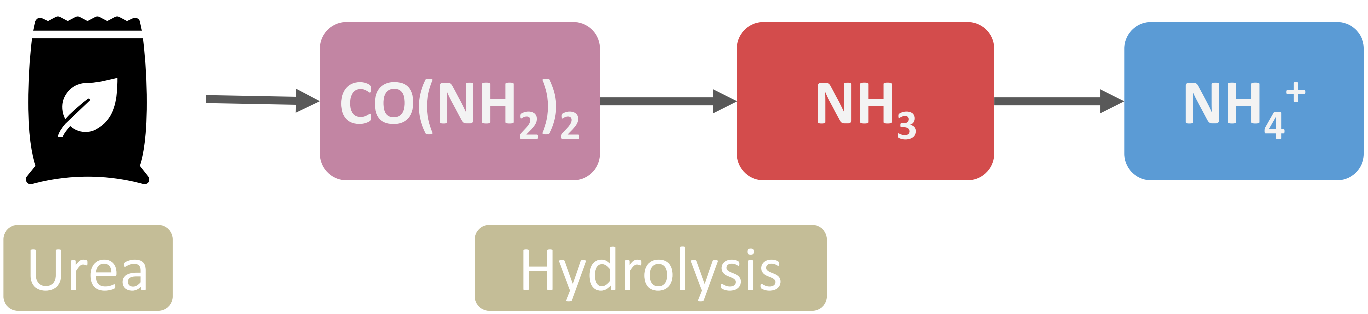
Nitrogen Source Groups

- Ammonium-forming fertilizers
  - Form ammonium on reaction with soil moisture or by urease conversion
- Ammonium containing fertilizers
- Nitrate fertilizers
- Combination fertilizers
- Organic materials
  - Release mineral N over time through microbial activity

Ammonium-forming Fertilizers

Urea

- Highly soluble and uncharged and moves freely through soil with water
- Enzymatic breakdown of urea in the soil produces NH_4^+ and bicarbonate, but leads to acidity eventually
- Rate of hydrolysis increases with temperature and decreases under high application rates



Volatilization of Urea

How large can losses be?

- When urea is surface applied and not incorporated volatilization losses can be high
  - Up to 30% loss in 14 days without rainfall or irrigation
- Factors that increase volatilization
  - Surface application without incorporation or irrigation
  - High temperature and wind speed
  - Low soil buffering capacity (sandy soils)
  - High pH soils

Ammonium Fertilizers

- Ammonium sulfate [$(NH_4)_2SO_4$]

- Ammonium fertilizers are temporarily resistant to leaching until converted to nitrate (nitrification)
  - Short timeframe especially in warmer weather

Nitrate Fertilizers

- Potassium nitrate
- Calcium nitrate (CN-9)

- Nitrate is negatively charged and moves with the water front
  - Most susceptible to N loss via leaching
  - Causes soil pH to increase

Combination Fertilizers

- Calcium ammonium nitrate (CAN-17)
  - 17% N (32% of N as ammonium, 68% as nitrate)

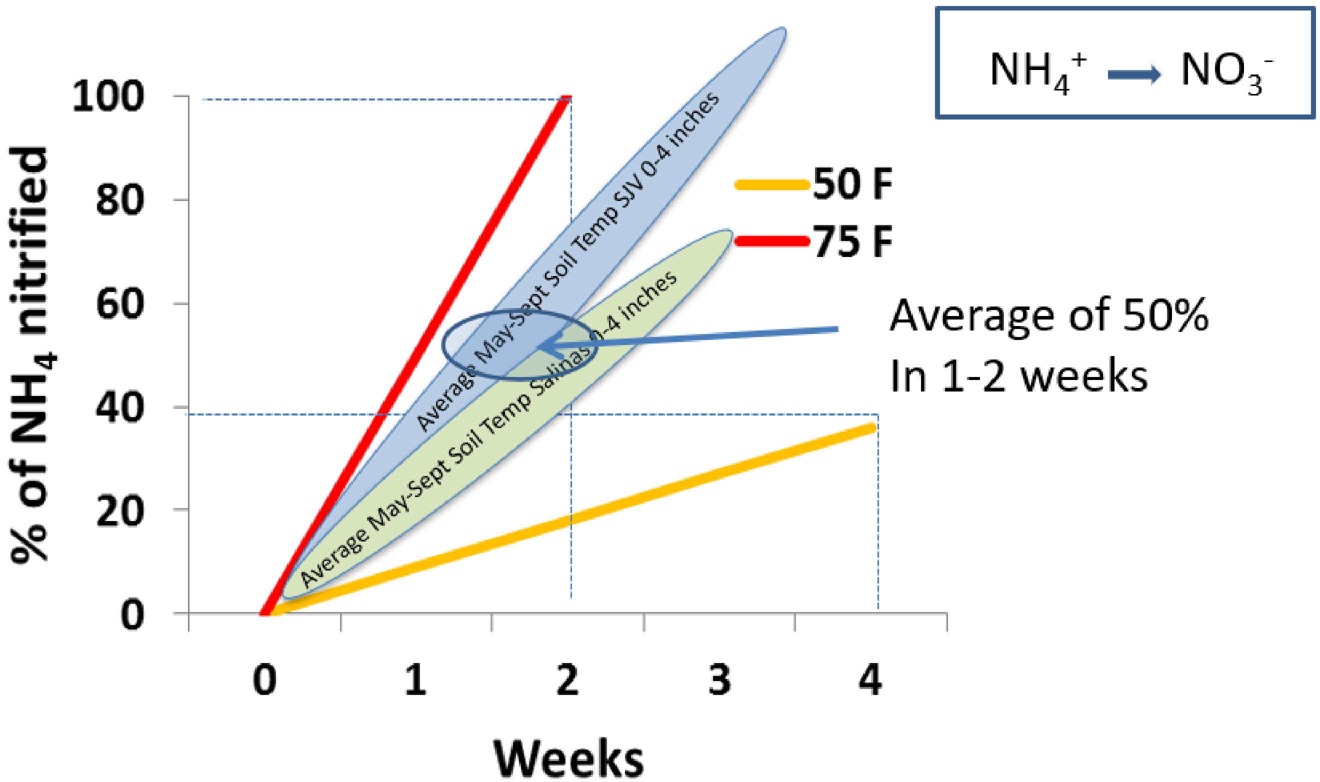
- Urea ammonium nitrate (UAN) solutions
  - UAN 32- 32% N (50% as urea, 25% ammonium, 25% nitrate)

- Combination fertilizers can provide a rapid availability of nitrate and a continued supply as the ammonium is converted to nitrate.

Organic Materials

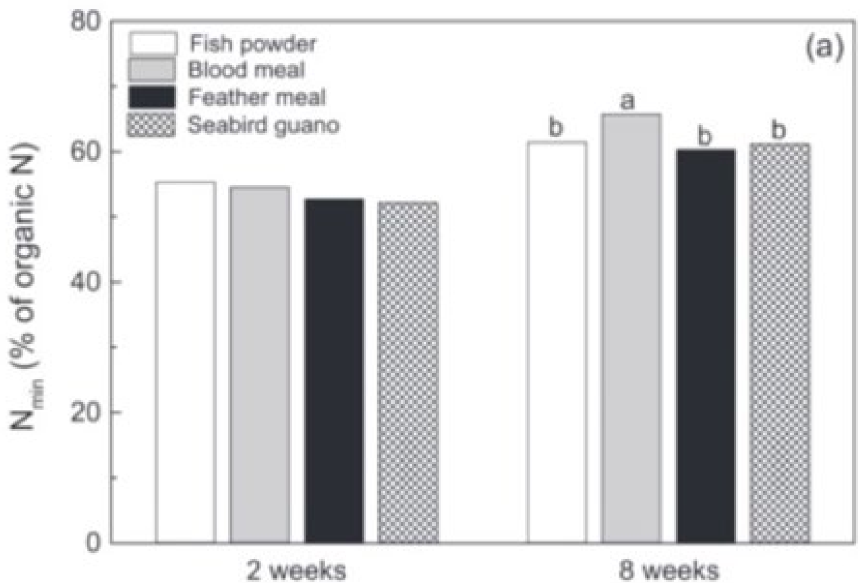
- Organic materials differ from mineral fertilizers by the rate that N mineralizes and becomes plant available
- Sources
  - Manure and other animal byproducts
  - Crop residues, cover crops, compost and green waste
- May contain both
  - Mineral N (NH_4^+ and NO_3^-): immediately available
  - Organic N: slowly available after microbial conversion

Nitrification: How Quickly Does it Occur?

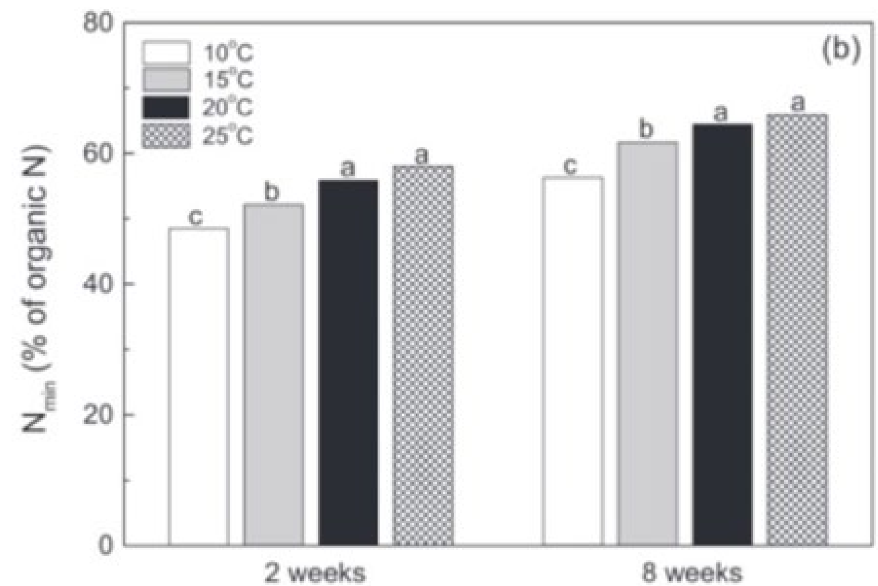


(Figure: Estimate of nitrification rates in California soils (San Joaquin and Salinas Valleys), depending on soil temperature. Adapted from Western Fertilizer Handbook)

Nitrogen Mineralization from Organic Sources



Time of Incubation



Time of Incubation

Fig: Net nitrogen mineralization (N_{min}) from organic fertilizers across temperatures (a) and temperature effects on N_{min} across fertilizers (b)

Hartz, T.K. and P.R. Johnstone. 2006. Hort Technology 16:39-42

Controlled Release Fertilizers

The release of nutrients can be controlled using an organic coating on fertilizers

- Benefits
  - Can slow N release to the soil and consequently decrease NO_3^- concentrations
  - May reduce leaching potential compared to pre-plant or single side-dress systems
- Drawbacks
  - Higher cost per unit of N
  - Match between N release and crop N uptake is often imperfect

Section 3 Summary

- Selecting the appropriate N source for the crop / irrigation management situation can lead to the greatest nitrogen use efficiency

- Proper management of these sources can help reduce nitrogen losses from volatilization, denitrification, leaching, and runoff

POLL POLL

Questions?

*Please complete the evaluation that will launch at the end of this session.

Irrigation and Nitrogen Fertigation

Section 4

Ben Faber,

Farm Advisor,

University of California Cooperative Extension,

Ventura County

Section 4 Learning Objectives

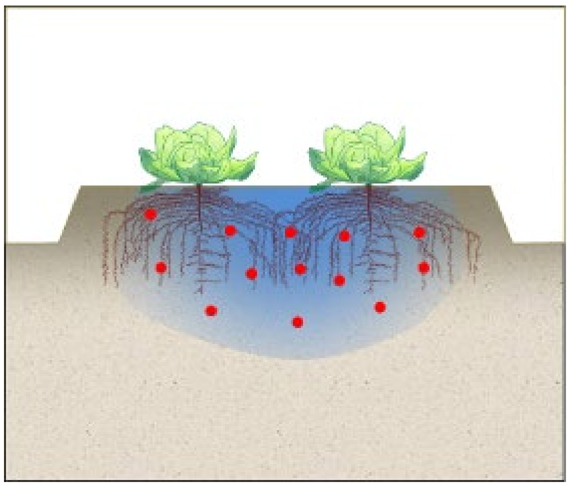
- Describe the three steps to becoming a more efficient irrigator
  - Proper irrigation scheduling (when and how much)
  - Measure applied water
  - Design and maintain high performing irrigation systems
- Recall what causes non-uniformity in pressurized irrigation systems and identify methods to address non-uniformity
- Identify proper methods for fertigation timing and length

Irrigation and Nitrogen Management

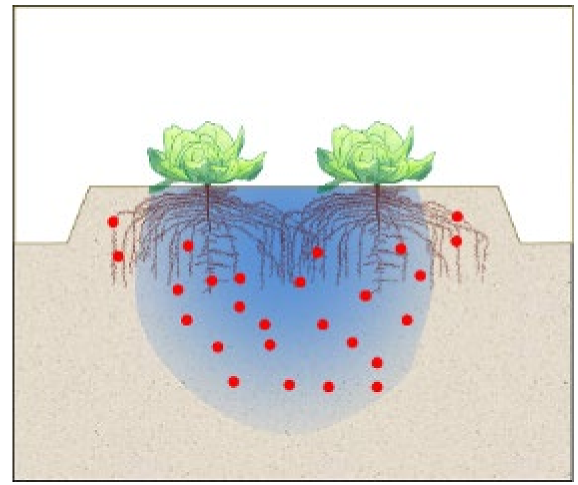
- Successful nitrogen management depends on efficient irrigation management
- Irrigation efficiency is a measure of how much of applied water goes to beneficial uses
  - Beneficial uses: plant water needs, salt leaching, frost protection
  - Non-beneficial uses or losses: Deep percolation below root zone, surface runoff

Efficient Irrigation and N Fertilization

Right rate and right time



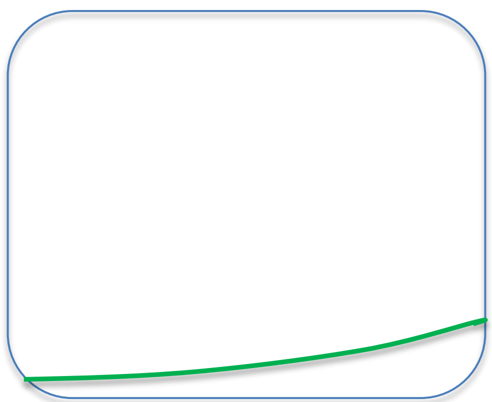
vs

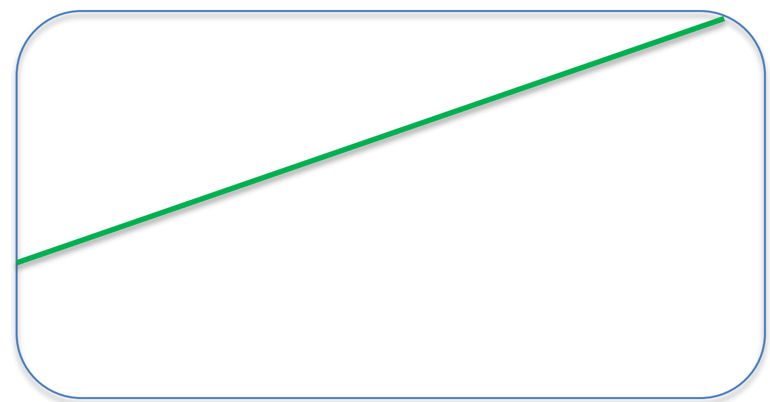


Efficient irrigation

Inefficient irrigation

Establishment up to 1/3 of crop cycle	Remaining 2/3

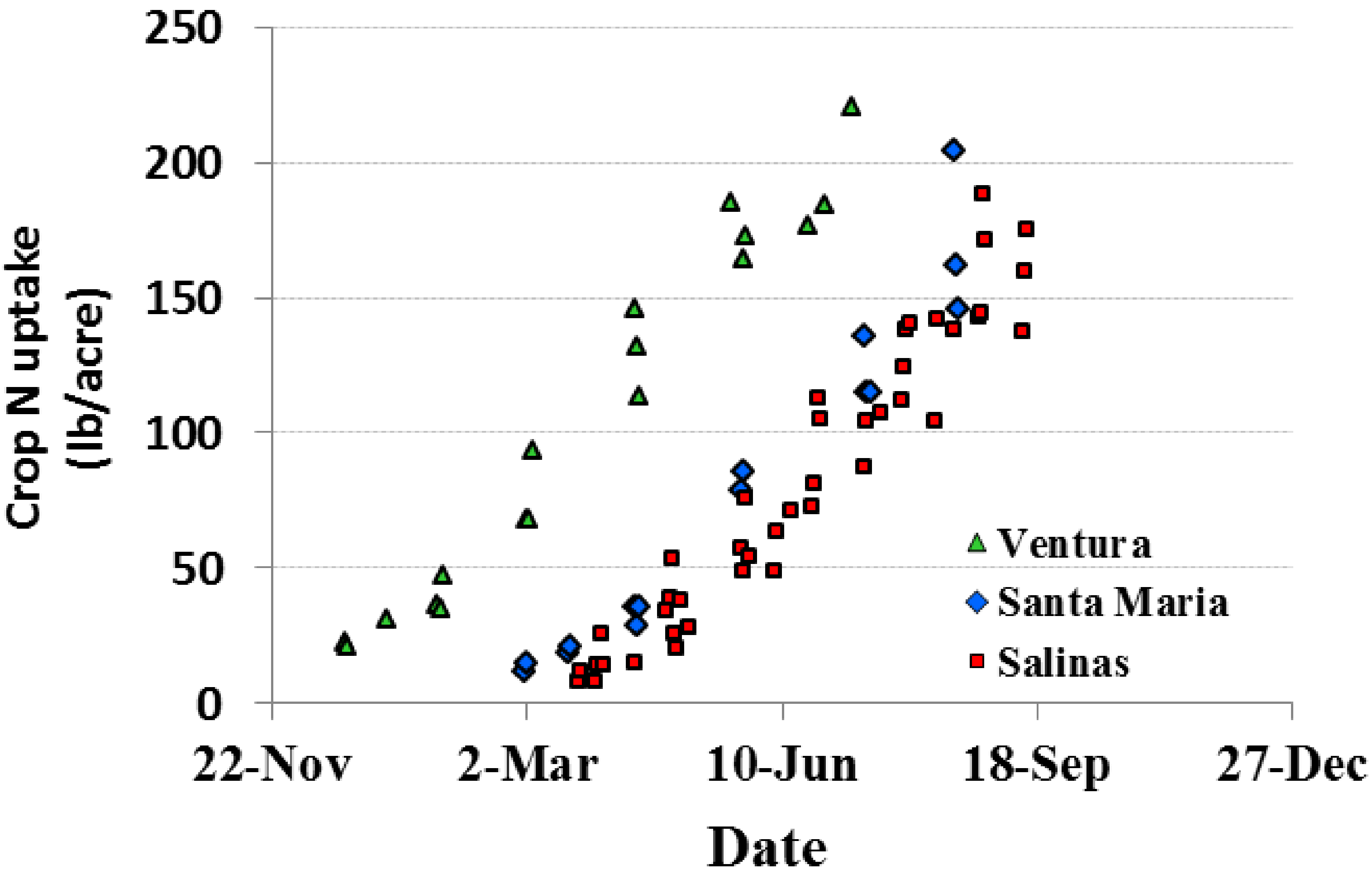




- Very little N uptake
- Little water demand, high susceptibility to water stress
- Shallow root system

- Constant N uptake rate (predictable)
- Increasing water demand
- Increasing and deeper root system

Strawberry N uptake



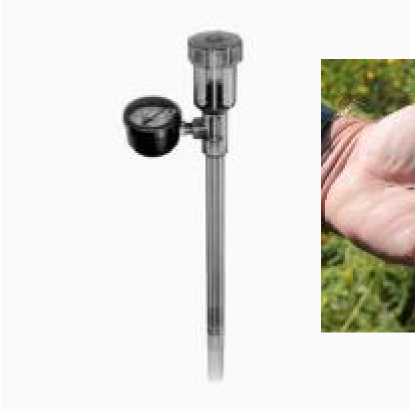
Where does all the N go?

Representative Avocado Tree	
Tree Part	**Dry Weight (kg)**
Small Roots	25
Scaffold Roots (> 1")	28
Rootstock Trunk	36
Scion Trunk	24
Wood (> 6")	42
Scaffold Branches (wood 4-6")	61
Branches (2-4")	41
Small Branches (wood 1/2-2")	25
Shoots (green < 1/2")	36
Leaves	26-40
Fruit (58 kg)	26

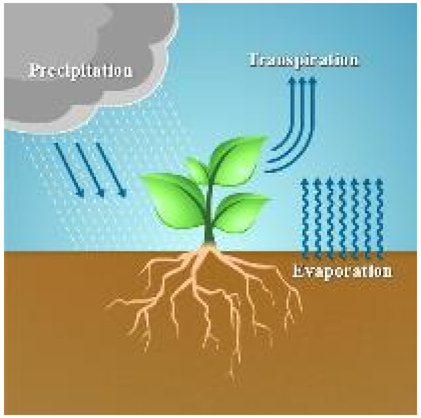
Lovatt, C.J. 1998. Nitrogen nutrition of the 'Hass' Avacado: Where does all the N go? Acta. Hort. 1:152-159.

Irrigation Scheduling

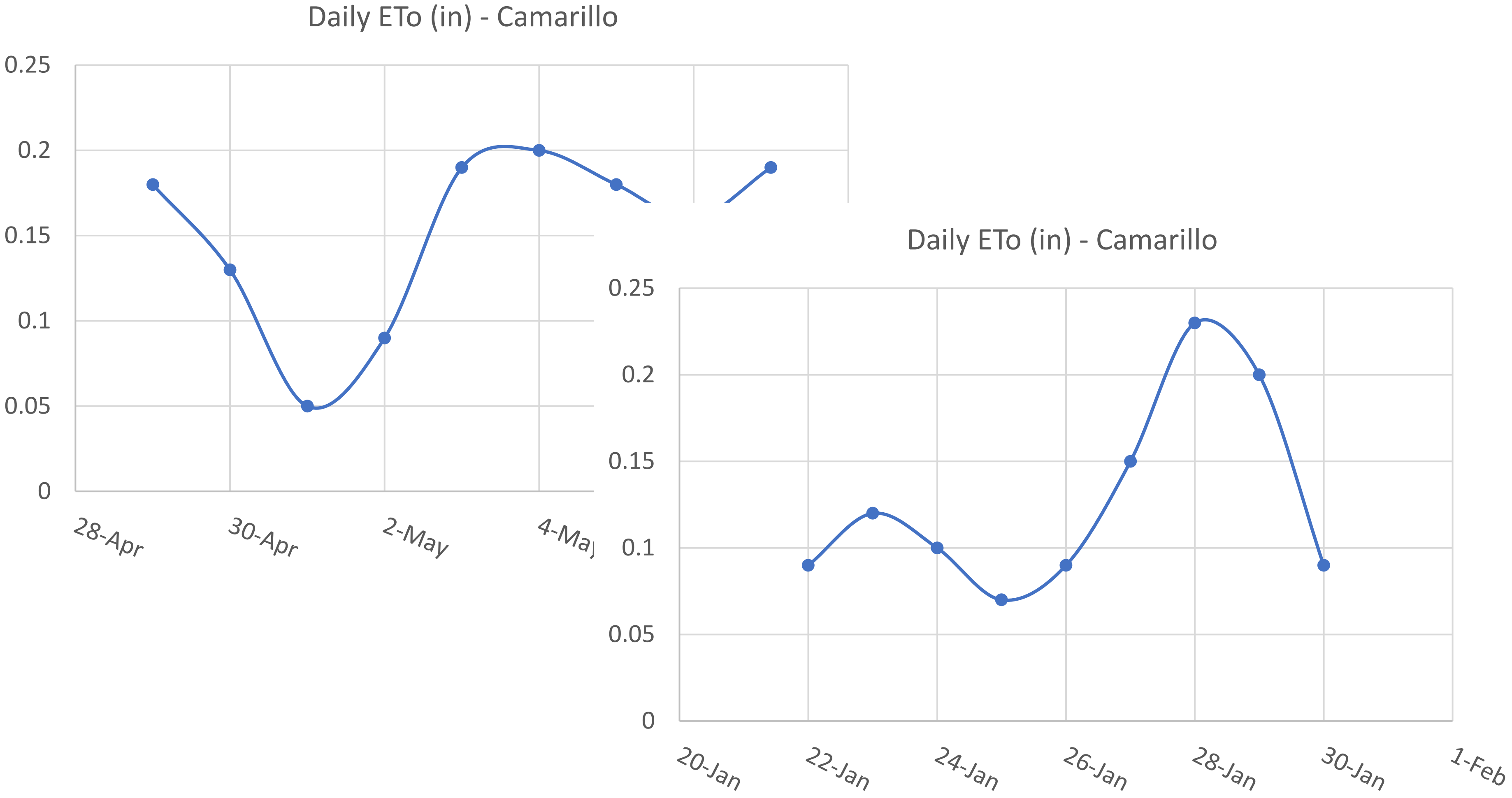
1. Deciding when to irrigate



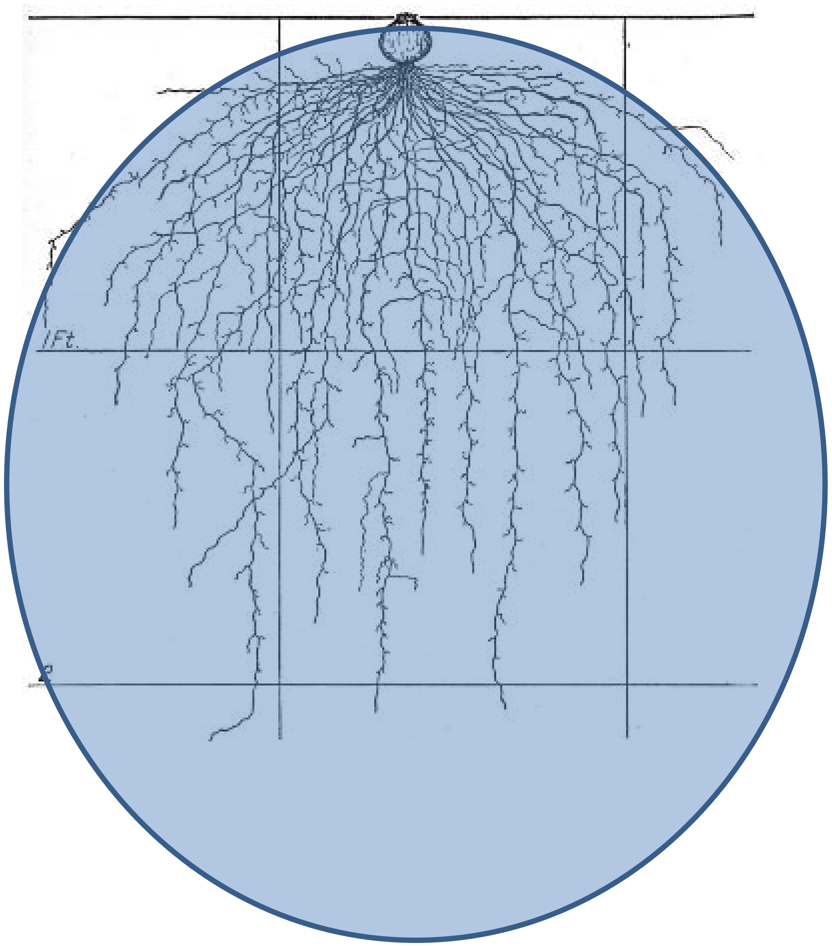
2. Deciding how much to irrigate

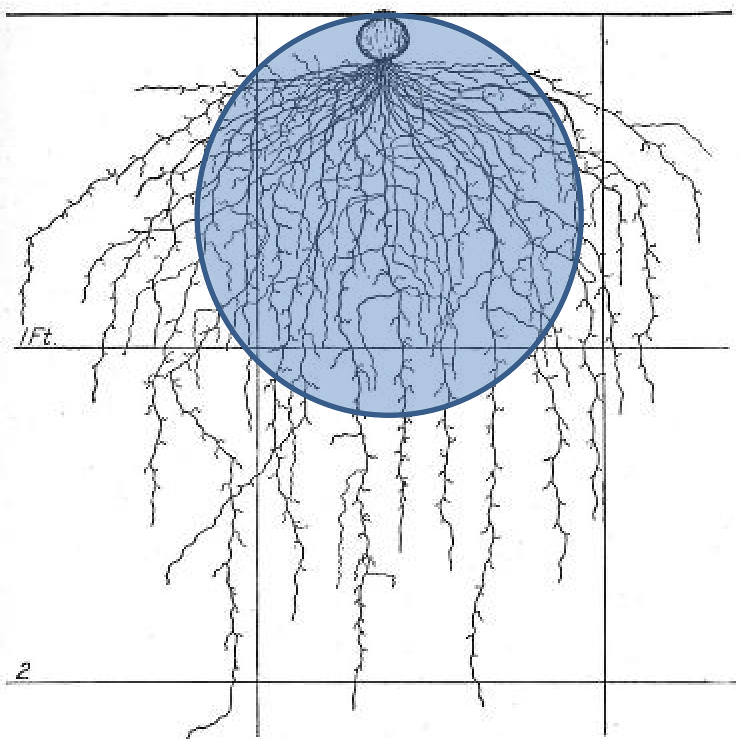


Why is irrigation scheduling challenging?

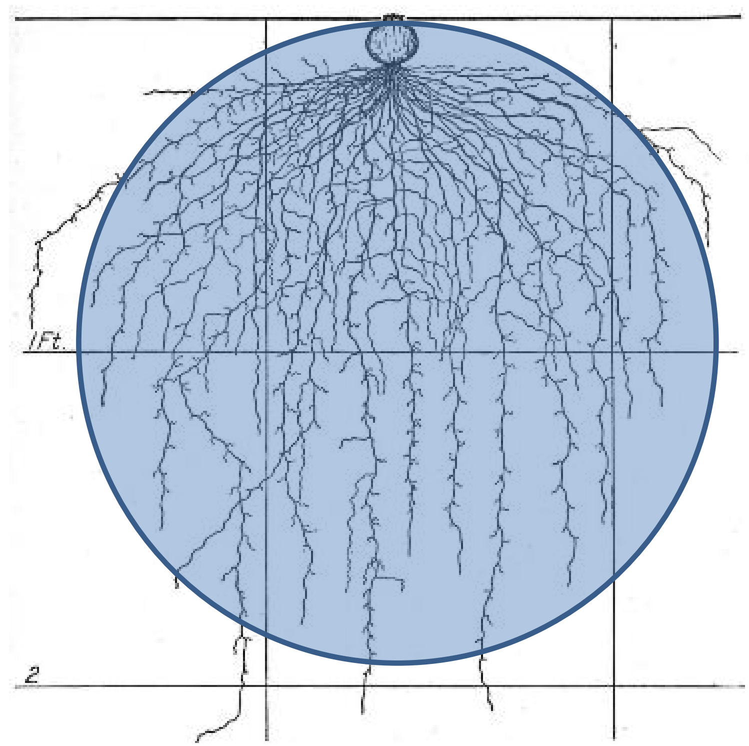


Inefficient irrigation scenarios





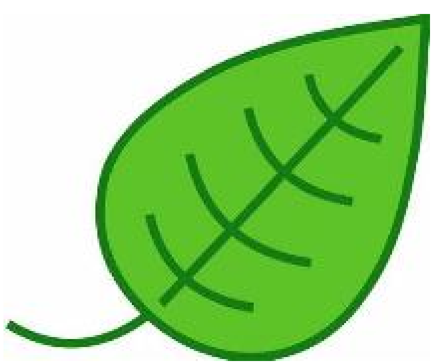
Ideal irrigation scenario



Deciding When to Irrigate and How Much to Apply?

- Aside from costs and availability of water there are three main factors to consider

Plant

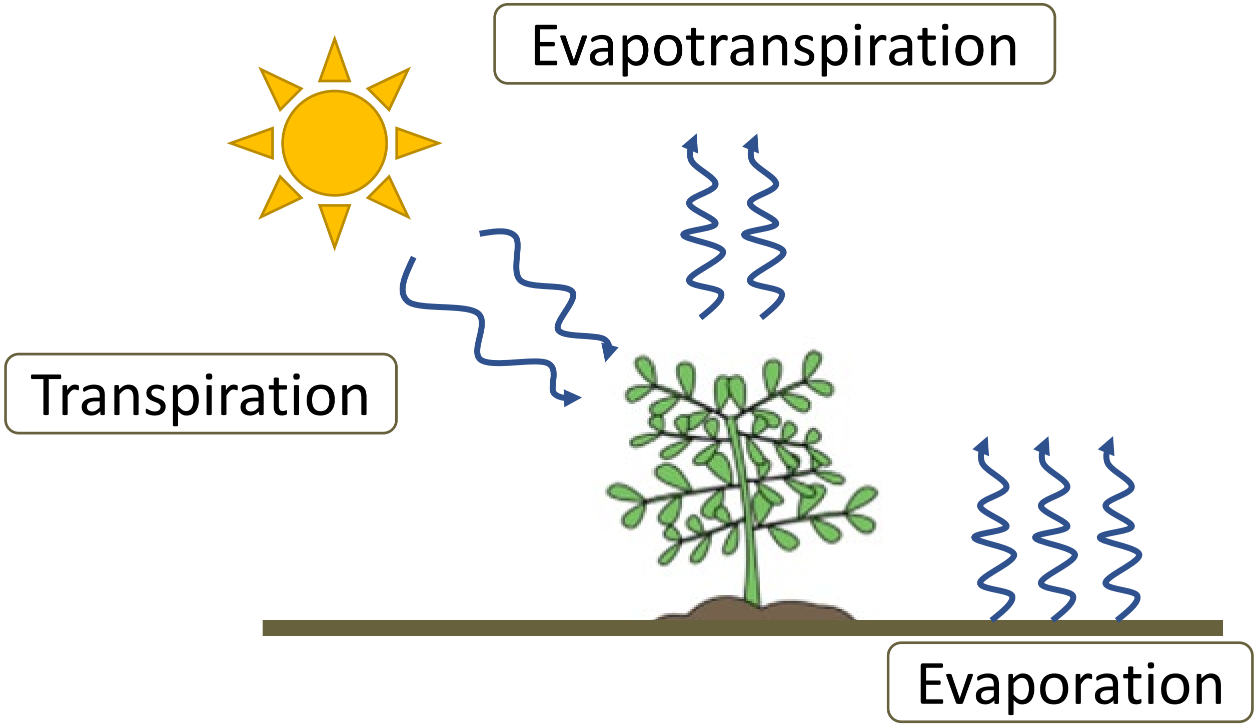


Soil

Weather

Weather Monitoring Approach

- Climatic conditions including solar radiation, temperature, humidity, wind speed, drive plant water use (ETc)



Estimating Crop Water Use (ETc)

- ETc = Crop Water Use
- ETo = Reference Evapotranspiration
  - Provided by CIMIS network of nearly 100 weather stations throughout California
- Kc Crop Coefficient
  - Ratio at which the crop uses water compared to the reference crop (pasture grass)
  - Dependent on crop type, size, and age

$$ET_c = ET_o \times K_c$$

www.cimis.water.ca.gov

CIMIS and ETo

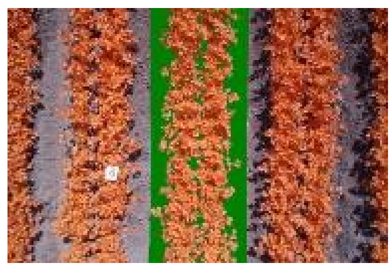
- CIMIS provides real-time and historic ETo estimates
- California has 18 reference zones that vary due to climatic factors

www.cimis.water.ca.gov

Estimating Crop Water Use (ETc)

ETo x **Kc** = **ETc**

20%



60%

90%

https://cimis.water.ca.gov/

Crop Water Use (ETc)

Example: Celery, Daily Eto (CIMIS station #152)

	Kc	**ETo**	**ETc**
Jun 1	1.1	0.21	0.23
Jun 2	1.1	0.20	0.22
Jun 3	1.1	0.25	0.28
Jun 4	1.1	0.24	0.26
Jun 5	1.1	0.10	0.11
			1.10

AVOCADOSOURCE.COM

Search | Tools | Site Index: <SELECT PAGE>

Instructions for the Irrigation Scheduling Calculator

English | Español

Principles of Irrigation

Select a Crop: Avocado

Kc Source: California (New Values) | English Units | Metric Units

Reference Evapotranspiration (ETo): ____ in./day or period | Data Source: <SELECT SOURCE>

Crop Coefficient (Kc): ____ Get Kc for a month <SELECT>

Distribution Uniformity (DU): ____ %

Leaching Requirement (LR): ____ %

Method: Trees per Acre: ____ | Tree Spacing ____ by ____ ft.

Number of Emitters per Tree: 1

Surface area under tree canopy (ft^2): ____ (enter only when surface area covered by canopy is less than 65%)

Emitter Output (Gal/Hour): ____

Grove Size (acres): 1

All fields with yellow boxes must be filled out, white fields are optional.

Calculate | Click on 'Calculate' after any changes are made to recompute totals.

Water per tree per day or period: ____ gallons

Watering time per tree per day or period: ____ hours, ____ minutes

Total Water Requirements for Grove: ____ gallons

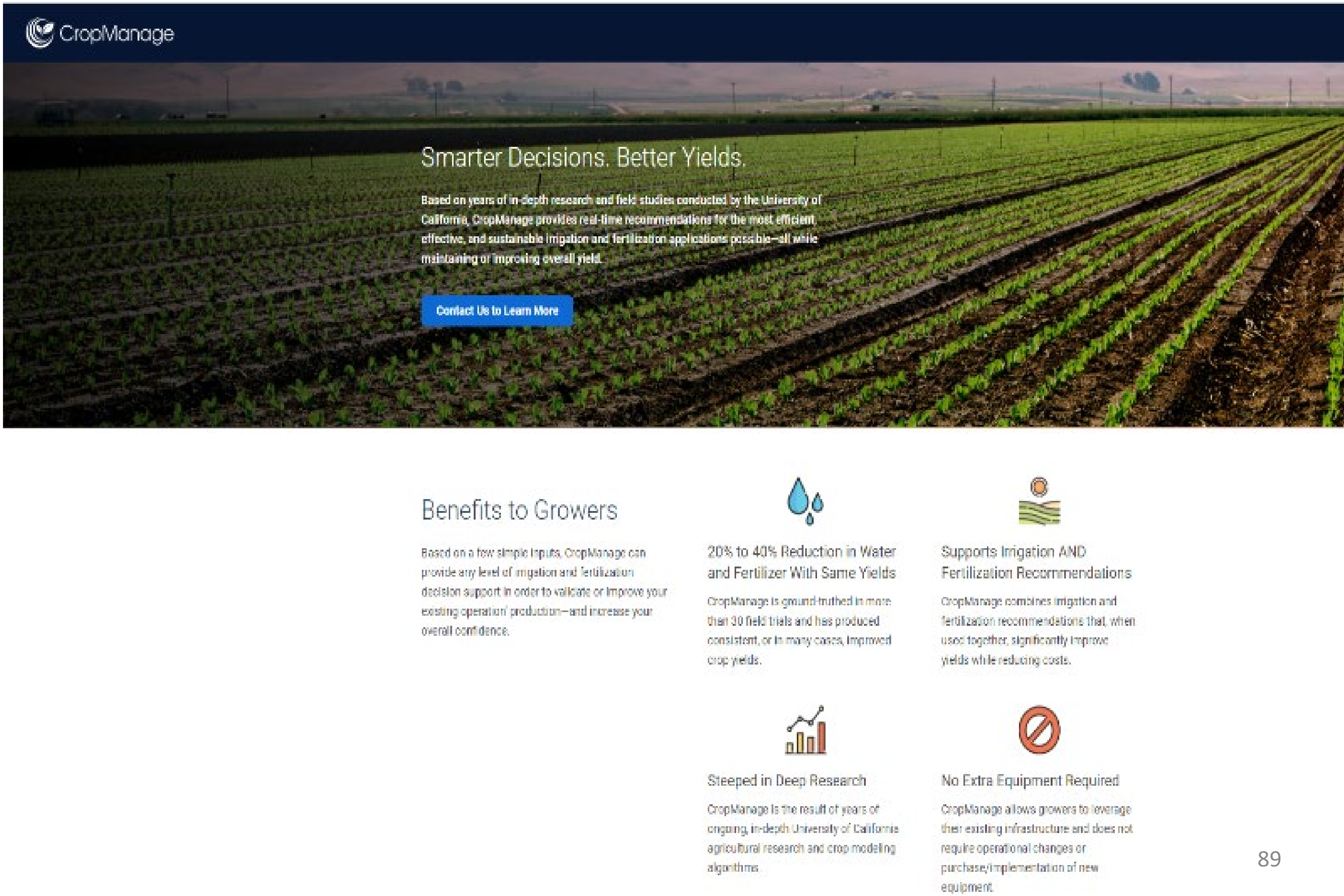
Allocated Water for Grove: ____ gallons

Shortfall: ____ gallons

http://www.avocadosource.com/tools/IrrigationCalculator.asp

Determine the application rate

cropmanage.ucanr.edu



CropManage

Smarter Decisions. Better Yields.

Based on years of in-depth research and field studies conducted by the University of California, CropManage provides real-time recommendations for the most efficient, effective, and sustainable irrigation and fertilization applications possible—all while maintaining or improving overall yield.

Contact Us to Learn More

Benefits to Growers

Based on a few simple inputs, CropManage can provide any level of irrigation and fertilization decision support in order to validate or improve your existing operation' production—and increase your overall confidence.

20% to 40% Reduction in Water and Fertilizer With Same Yields

CropManage is ground-truthed in more than 30 field trials and has produced consistent, or in many cases, improved crop yields.

Supports Irrigation AND Fertilization Recommendations

CropManage combines irrigation and fertilization recommendations that, when used together, significantly improve yields while reducing costs.

Steeped in Deep Research

CropManage is the result of years of ongoing, in-depth University of California agricultural research and crop modeling algorithms.

No Extra Equipment Required

CropManage allows growers to leverage their existing infrastructure and does not require operational changes or purchase/implementation of new equipment.

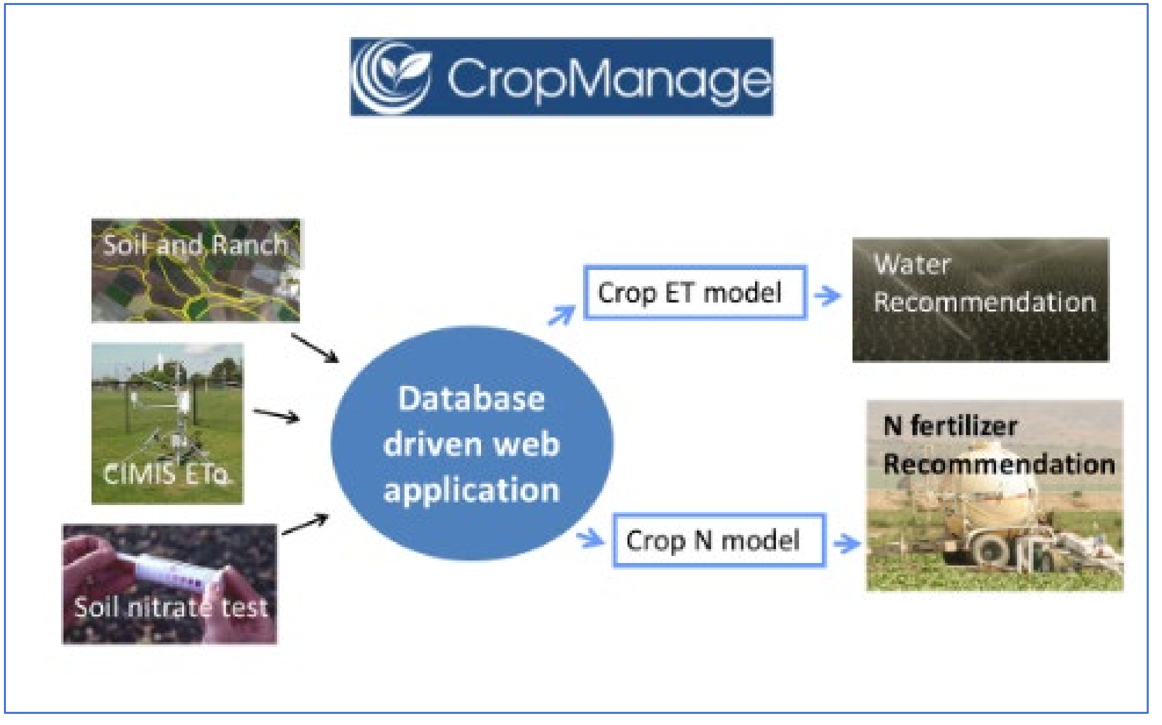
CropManage

Ventura County

- Strawberry
- Celery

Six replicated studies

- Equal or higher yields
- Water/N fert use vary



Irrigation Scheduling
Soil Monitoring Approach

- Estimates **available water** in the root zone by measuring how tightly water is held in the soil (water tension) or by estimating water content

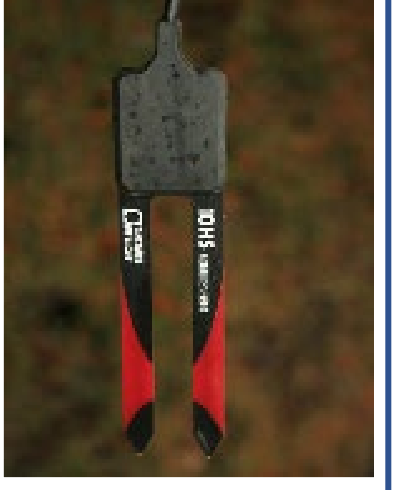
Soil Moisture Monitoring Devices

Electrical Resistance Blocks

Tensiometer

Neutron Probe

Dielectric Sensors



Measure Water Tension

Estimate Water Content

Tension Sensors

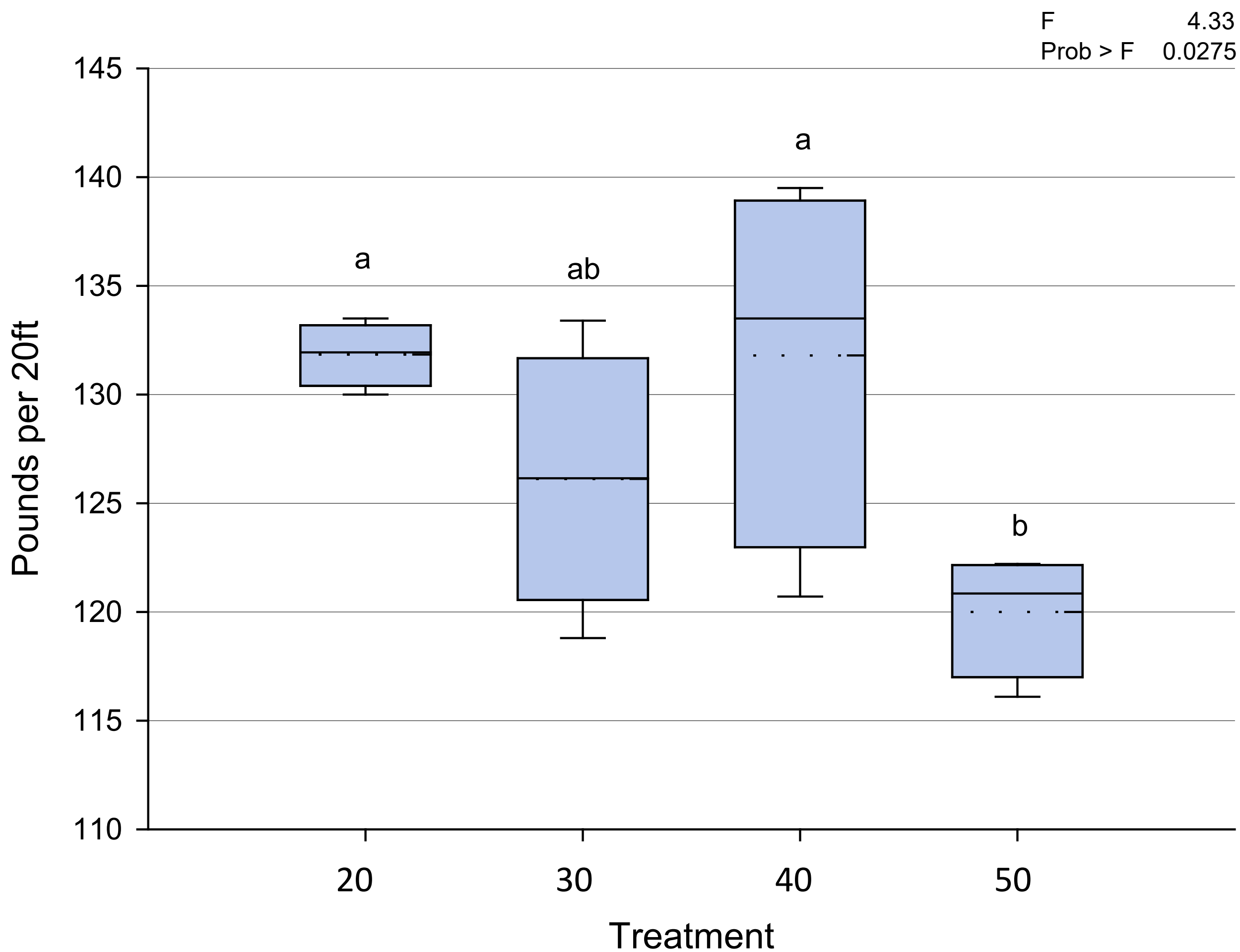
Advantages (Pros)

- Direct measure of tension
- Can interface with data logger
- No salinity interference
- Responsive at high moisture
- Contents independent of soil texture

Disadvantages (Cons)

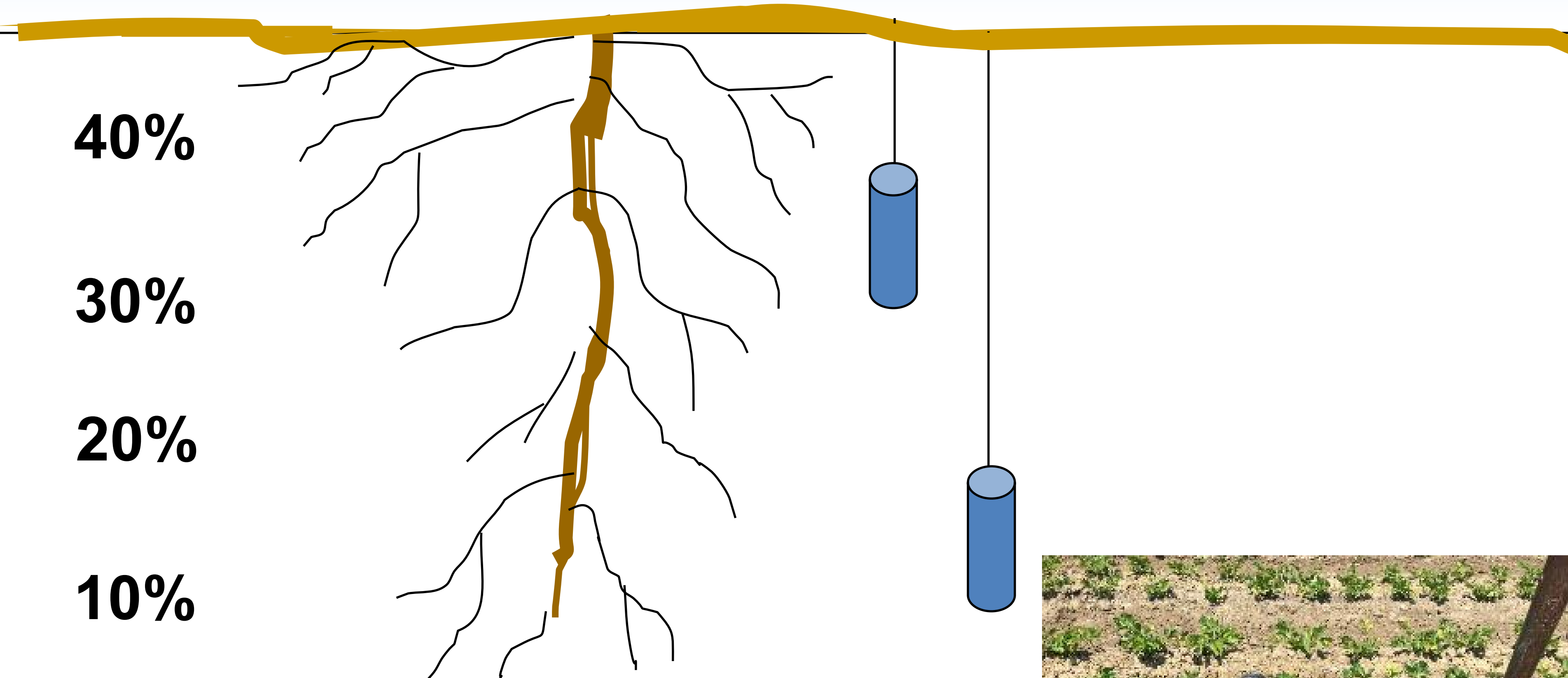
- May require frequent maintenance

Celery Marketable Yield Response to Different Soil Moisture Levels



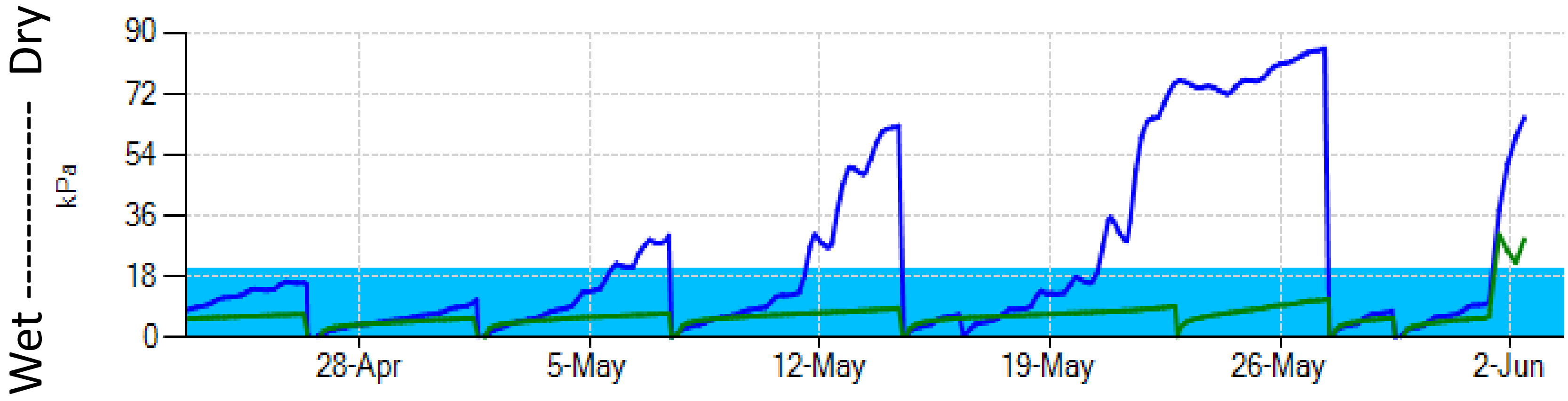
Soil water tension thresholds for starting irrigation (centibars)

Sensor Depth and Installation are Key



Irrigation Management Context

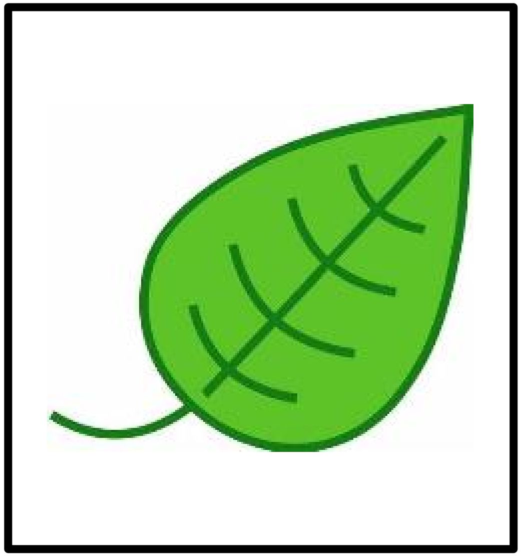
- Overall, most irrigators over-irrigate early in the season and under-irrigate later
- Why? Mostly lack of information



Irrigation Scheduling

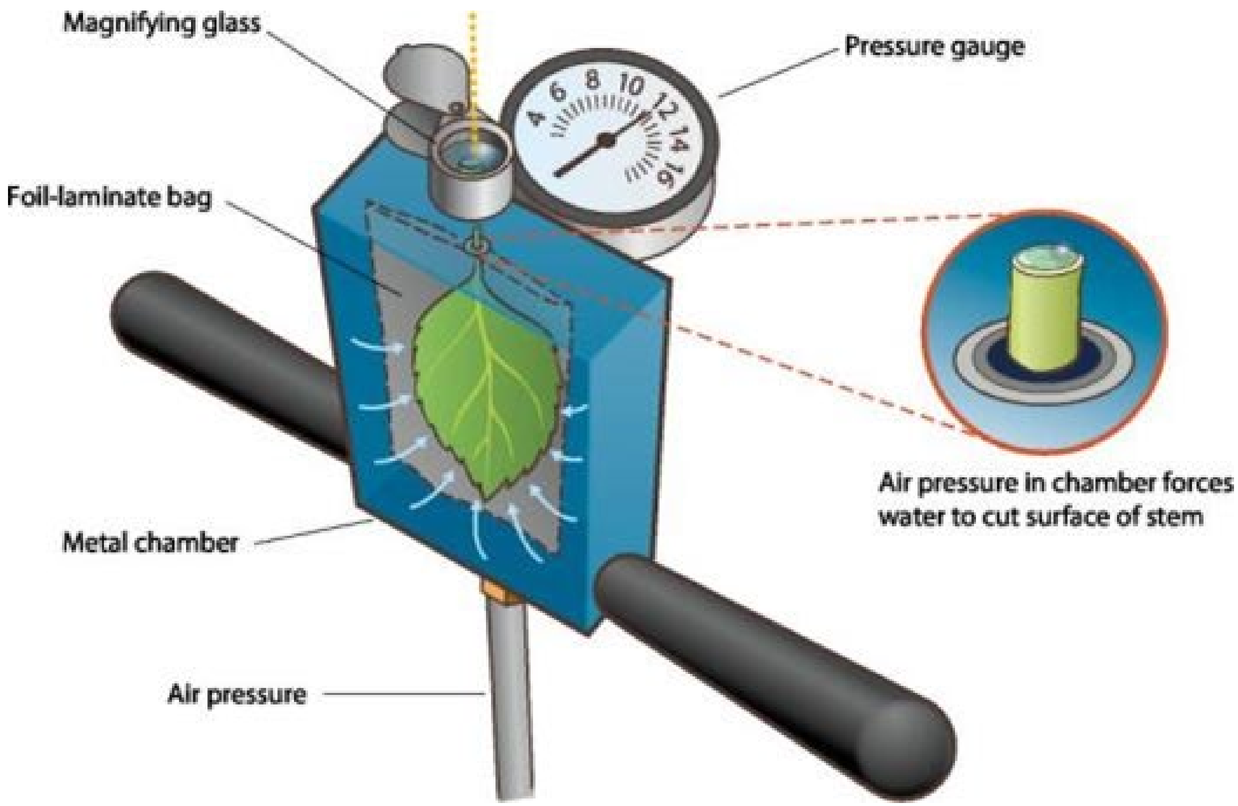
Plant Monitoring Approach

- Measure signs of plant water stress to Indicate **when** to irrigate
  - Mainly used in tree crops



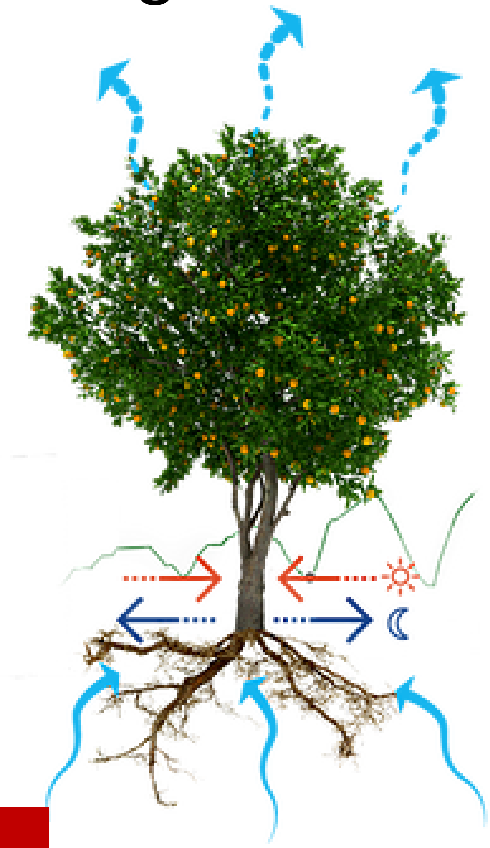
Pressure Chamber

- Measures stem water potential, a level of plant water stress, which if used with critical level information can tell you **when** to irrigate.



Dendrometer

- Measures shrink/swell of trunk or stem, which an be correlated with stem water potential and can tell you **when** to irrigate.



POLL POLL POLL

Photo: www.phytech.com

Fertigation Practices

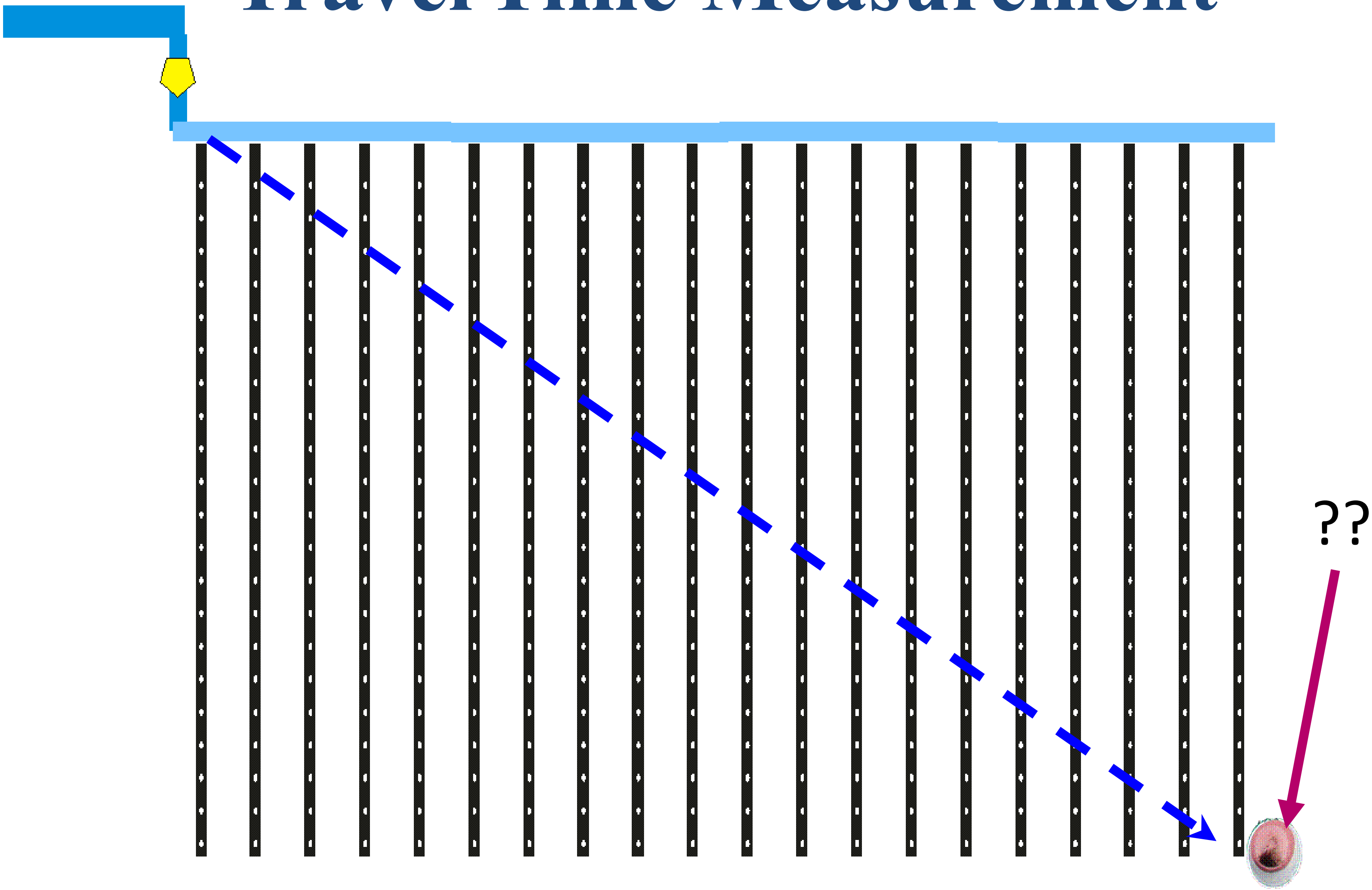
Micro-Irrigation

- Industry recommendations
  - Inject during middle 50% of irrigation cycle
  - Inject during middle third of irrigation cycle
- Observed practices
  - short injection times at various times during the irrigation cycle

<u>Inefficient</u> fertigation practices

- Injecting before system fully pressurizes
- Injecting too quickly
- Stop irrigating before fertilizer is completely flushed out of the drip system

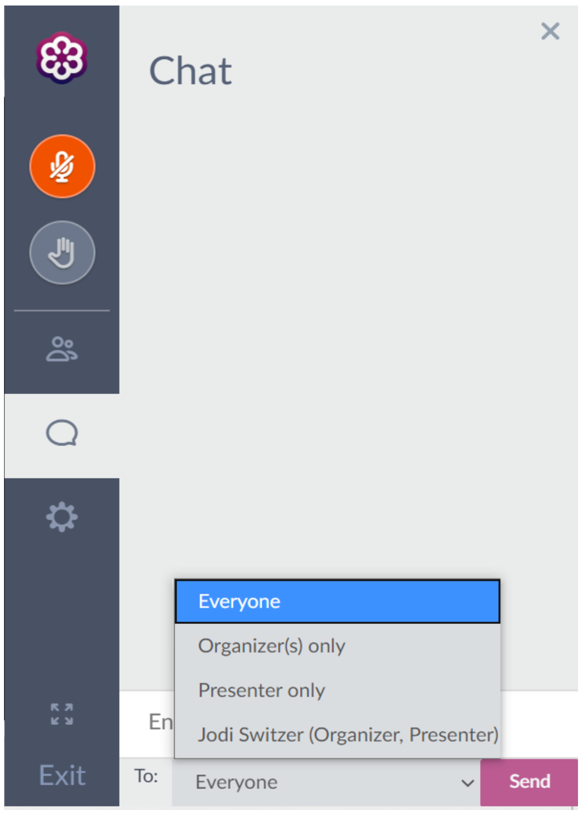
Travel Time Measurement



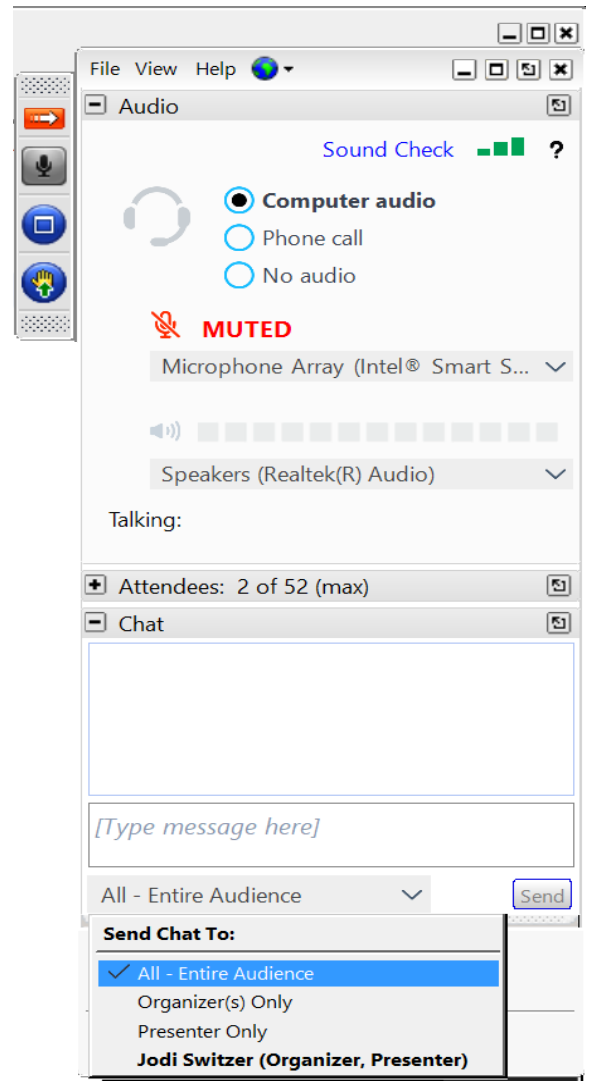
Welcome to the
Nitrogen Management Plan Self-Certification
Training Program

Training presentation to begin at 9:00 am

Web browser



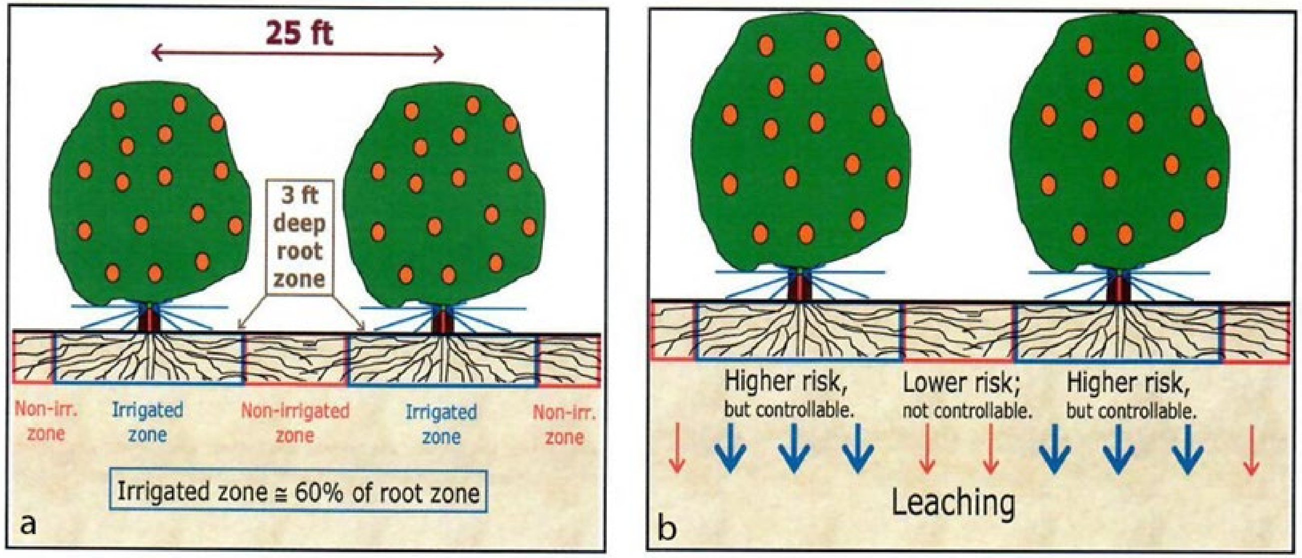
Desktop application



Application Efficiency –
How much water is applied according to plant need

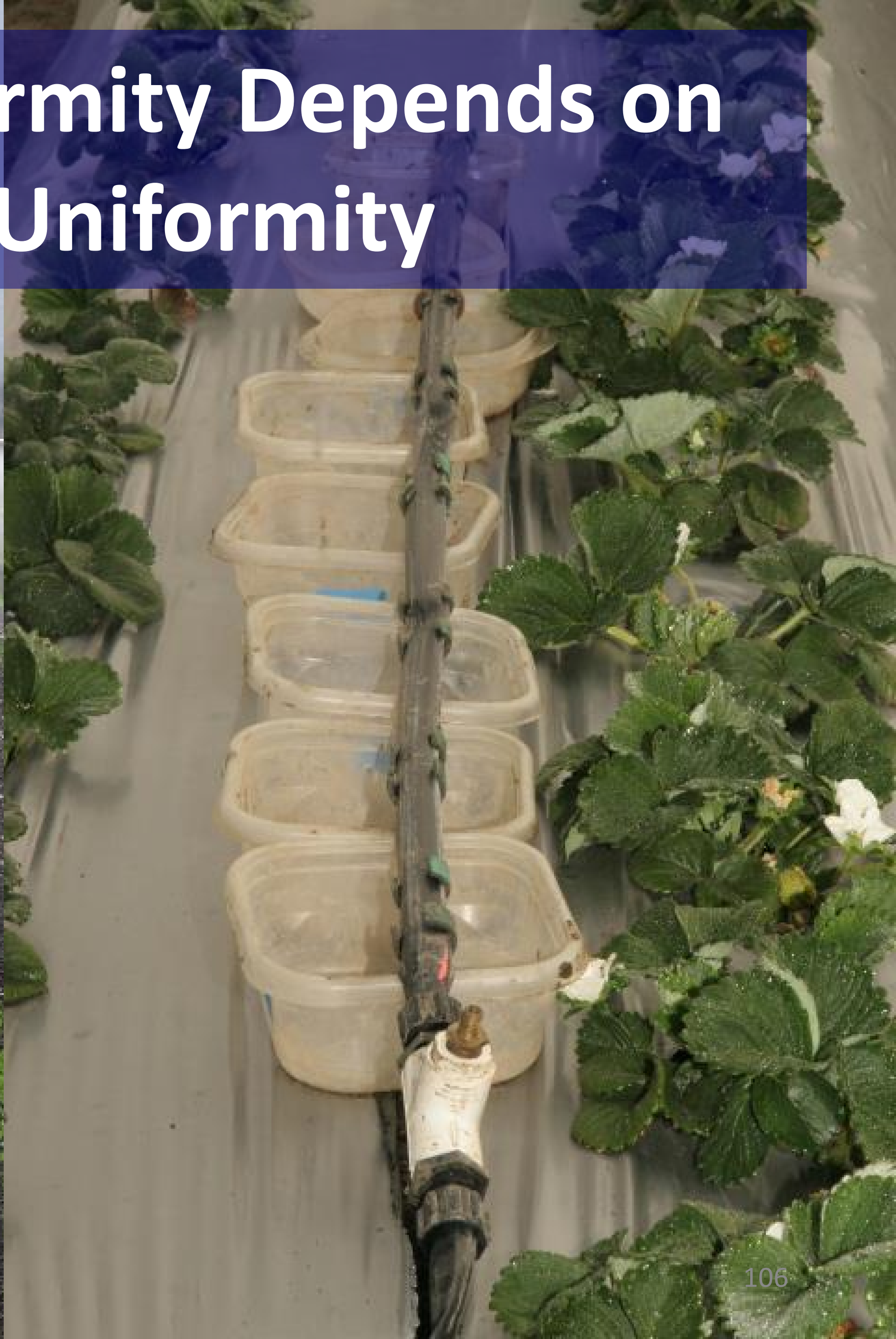
Exceeding Plant Need, the Efficiency Decreases

$$AE = \frac{Need}{Applied}$$



But you can't have AE without DU

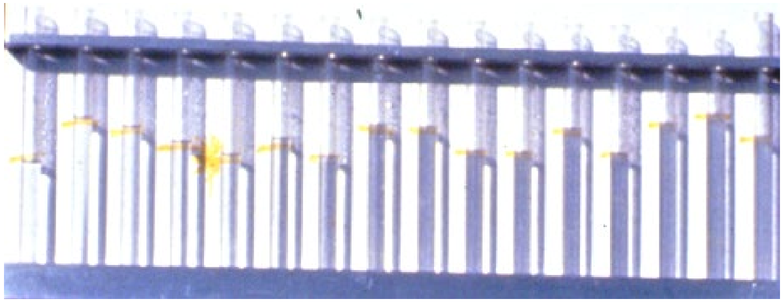
Fertigation Uniformity Depends on Irrigation Uniformity



Assess Irrigation System Efficiency

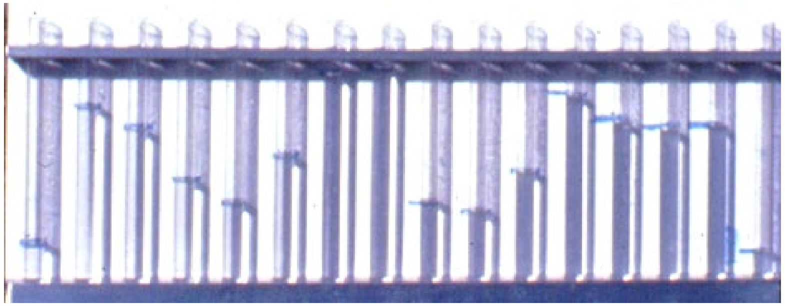
Utilize Mobile Irrigation Lab Programs through RCD

Good Uniformity

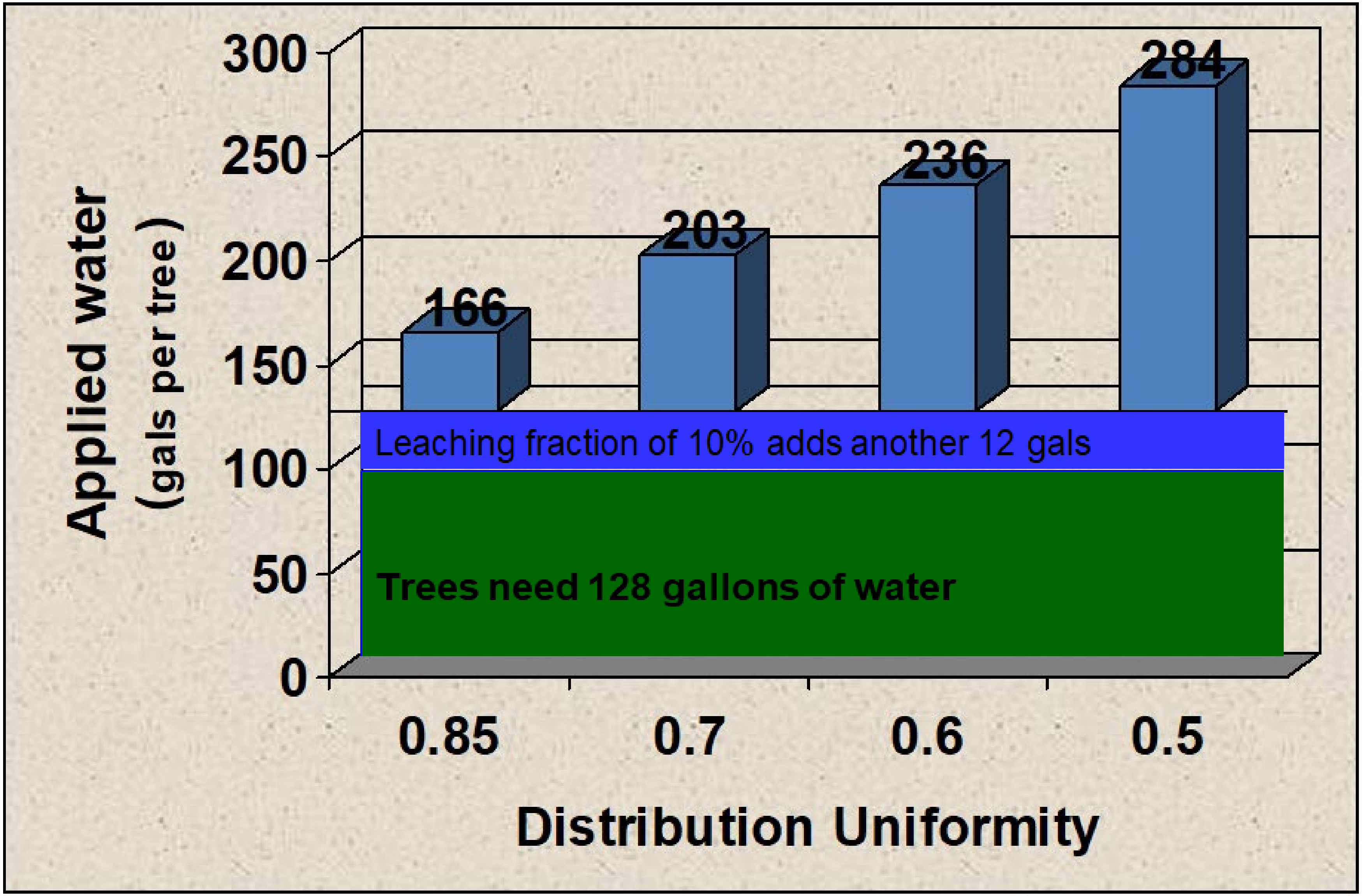


90% DU

Low Uniformity



60% DU



Applied water
(gals per tree)
300
250
200
150
100
50
0
166
203
236
284
Leaching fraction of 10% adds another 12 gals
Trees need 128 gallons of water
0.85
0.7
0.6
0.5
Distribution Uniformity

Other Best Practices

- Maintain records
- Periodically assess Distribution Uniformity (DU)
- Design and maintain high performing irrigation systems
  - Periodic maintenance
  - Address pressure differences

Maintain Records

- Maintain good records on irrigation and nutrient management practices
  - How much are you applying? When?
- Use readily available info
  - Fertilizer bills
  - Electricity, fuel, water bills
  - Production history

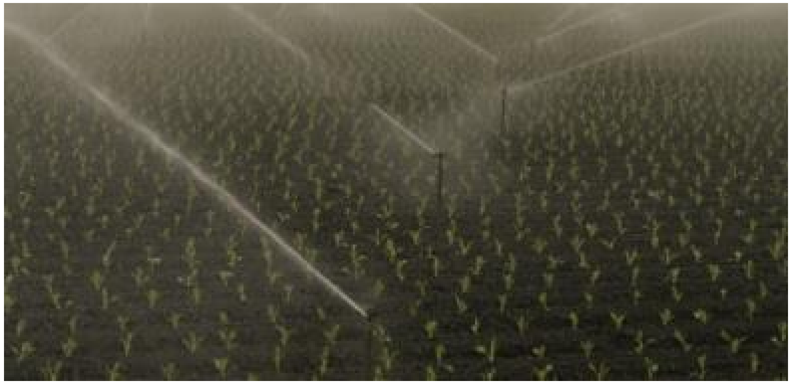
Options for Measuring Applied Water

- Measure gallons applied with a flow meter
- Use emitter flow rate
  - emitter flow rate × emitters/acre × hours of operation = gallons applied*
- Use a Pump test
  - gal / min × hours of operation = gallons applied *
- Use Manufacturers flow rates
  - Flow rate at operational pressure × hours of operation = gallons applied *

*****_Gallons applied_ per acre / 27,154 = _inches applied_
Inches applied / hours of operation = _inches per hour_

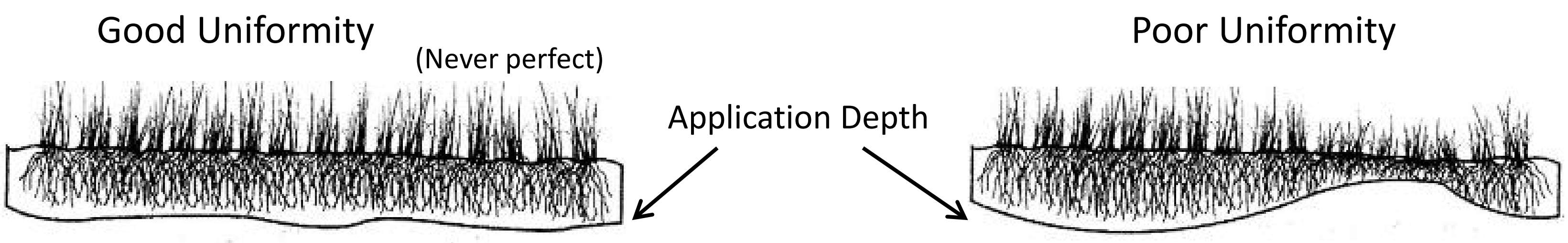
Irrigation System Evaluation

- An irrigation system evaluation can help determine average application rate and distribution uniformity



Irrigation System Evaluation

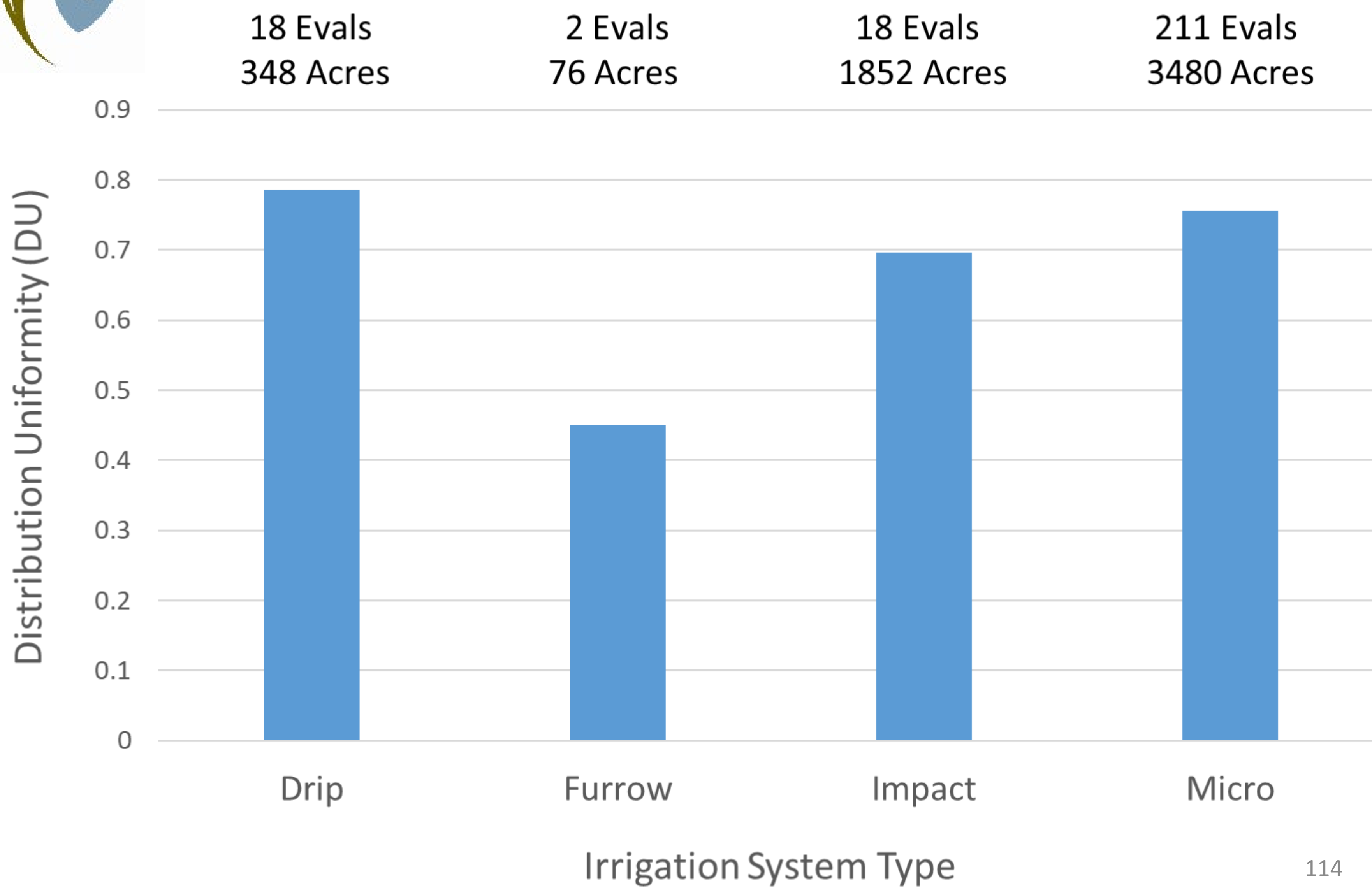
Irrigation Uniformity: A measure of how evenly water is applied to the field



- Poor uniformity means that portions of the field are getting less water/fertilizer than others.
  - Causes poor plant performance due to water logging and nitrate leaching.

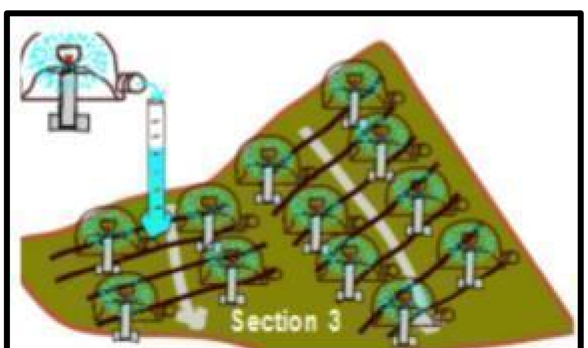
Average Distribution Uniformity (DU)

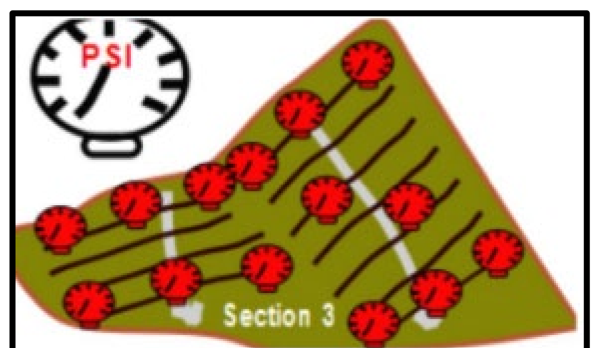
of Irrigation Systems Evaluated in Ventura County 2013-2018



Measuring DU

- Mobile irrigation lab
  - Several RCDs offer DU testing
- DIY
  - Use a graduated cylinder and stopwatch to measure emitter/sprinkler flow at various points in the system
  - Use a pressure gauge to measure uniformity of pressure across the field





Using a Distribution Uniformity

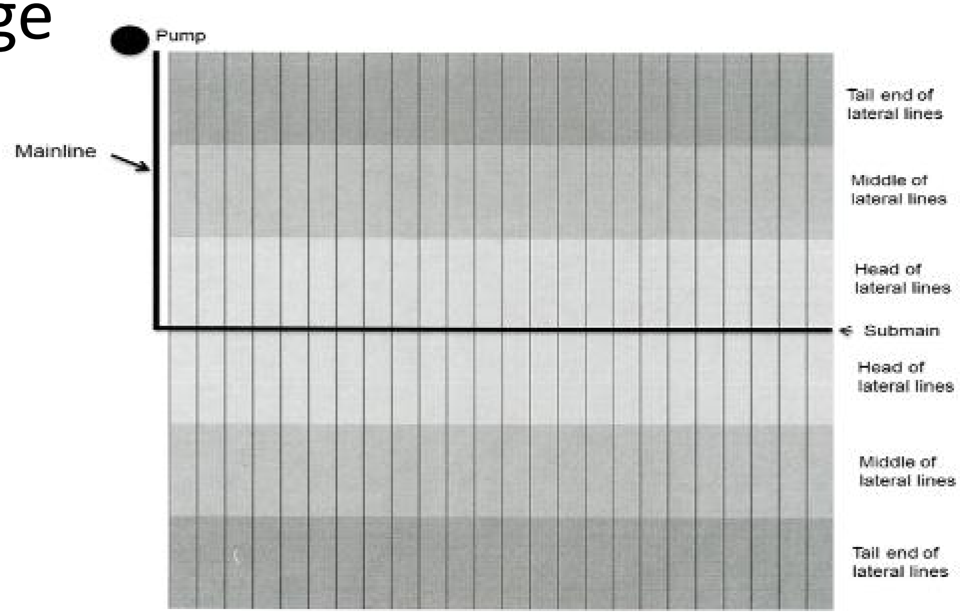
- The solution lies in improving DU to a point where there is minimal difference in the over and under-irrigation levels
- A DU of about 90% or higher is ideal for drip systems, 75-80% for overhead sprinklers
- Fields with lower DU should be assessed to determine the problem and solutions to improve DU

What Causes Non-Uniformity

- Pressure Differences
- Poor Irrigation System Maintenance

Addressing Non-uniformity

- Friction loss from the pump to the tail end cause pressure change at the emitter or sprinkler
  - Other pressure differences can be due to elevation change



Addressing Non-uniformity

- Pressure differences
  - The discharge rate (gph) of drippers and microsprinklers changes with the operating pressure
  - For example, a 1 gph dripper is only 1 gph at a certain pressure (e.g. 15 psi). If operated at a higher pressure, the discharge rate will be higher

Addressing Non-uniformity

- Addressing pressure differences
  - Use in-field line pressure regulators on sub-mains
  - Use pressure-compensating (PC) drip tape
  - Consider pipe sizing and how that affects water delivery and friction loss

Addressing Non-uniformity

- Maintenance problems
  - Clogging of emitters or microsprinklers
  - Leaks and breaks

Addressing Non-uniformity

- Maintenance
  - Clean and flush filters, mainlines, submains and lateral lines regularly
  - Walk the field and monitor for leaks and breaks frequently
  - Check emitters for biological and chemical clogging at least twice per season

Need to protect water sources from contamination

Backflow valve

Managing Salinity

Leaching salts and not nitrate

- Periodic soil and irrigation water testing will help determine when leaching is needed
  - Leaching is not necessary every irrigation or perhaps even every season but only when soil salinity crop tolerances are approached

- Leaching is most efficient in the winter and should not coincide with critical periods of nitrogen uptake and fertilization

Rainfall

- Rainfall isn't predictable, but we can minimize N available in the soil to reduce leaching by:
  - Applying N fertilizer rates according to expected crop uptake rate
  - Monitor soil N
  - Keep soil N to reasonable levels going into rainy season

Section 4 Summary

- Efficient irrigation practices are critical to good nitrogen management
- How to improve irrigation scheduling?
  - Use weather station and soil moisture information to understand irrigation needs
  - Measure applied water
  - Design and maintain high performing irrigation systems

Questions?

Efficient Nitrogen Management

Section 5

Ben Waddell,
Director of Agricultural Services
Fruit Growers Laboratory

Section 5 Learning Objectives

- Identify the 4R principles
- Calculate crop N demand
- Recall the components needed to calculate N contribution of organic materials
- Interpret lab reports to determine N contribution of irrigation water

POLL

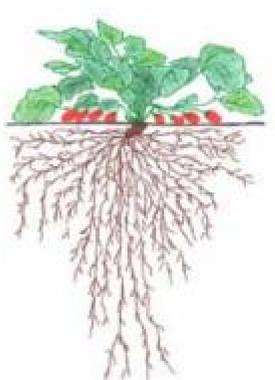
Applying the 4R Principle

Right Rate	• Match supply with crop demand
Right Time	• Apply coincident with crop demand and uptake
Right Place	• Ensure delivery to active root zone
Right Source	• Match fertilizer type to crop and environmental needs

Apply the Right Rate

Right Rate Equation

Demand



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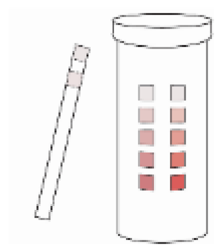
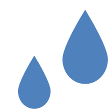
Supply



Residual N in Soil

N mineralized in soil



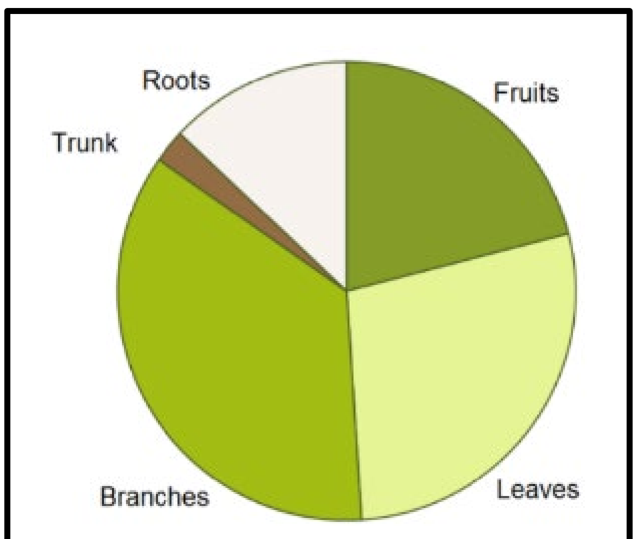
Irrigation water

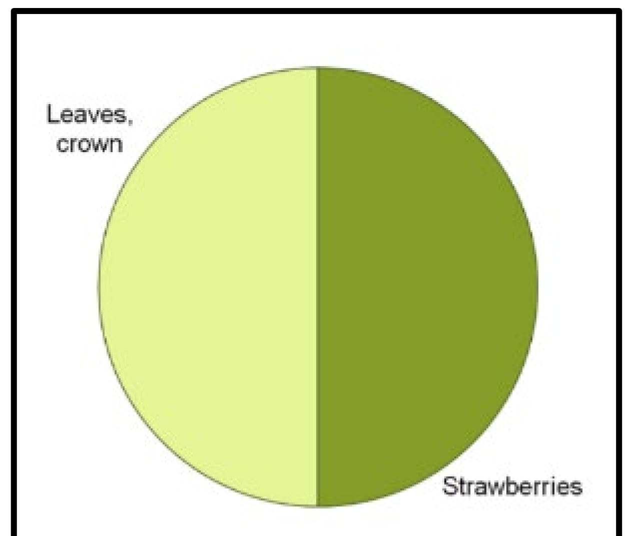
Fertilizer

Use the right rate equation to avoid excess N, increase nitrogen use efficiency, and increase profitability by accounting for all N inputs.

Calculated Demand

- Approach depends on proportion of N removed from the field with harvest and N left in the field as crop residues or perennial tissue
- Example citrus vs. strawberry





Calculated Demand

- Example: citrus
  - Demand is based on N removed in the harvested crop + N in perennial tissue

Calculated Demand

Example: Citrus

N Demand = (N removed per unit of crop yield × Estimated Yield) + N needed for tree maintenance

Calculated Demand

- Example: Strawberry
  - Demand is based on N removed in the harvested crop + N in the plant residue
  - Or total N uptake

Calculated Demand

Example: Strawberry

N Demand = (N removed per unit of crop yield × Estimated Yield) + N needed for crop residue

Calculated Demand

Example: Strawberry

N Demand = (Total N uptake × Estimated Yield)

POLL

Nitrogen Removal Rates

Nitrogen concentrations in harvested plant parts - A literature overview

Daniel Geisseler

2016

Provides an overview of N removed in harvested plant parts for field crops, vegetables, and tree and vine crops.

https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Geisseler_Report_2016_12_02.pdf

Methods for Setting Realistic Yield Goals

- Use experience of the potential of a field, and then consider environmental conditions.
  - For annuals, weather at planting can have a major effect.
  - For perennials, the past year’s yield plus winter and spring weather can be critical.

- Estimate yield using field’s 3-5 year average, excluding years with unusual negative conditions
  - Caution: Estimating too high of a yield can result in over application

Nitrogen Use Efficiency (NUE)

- NUE is the portion of nitrogen applied that is used by the plant
- What is a reasonable NUE?
  - 70-90% (More of a target)
- The highest efficiency is achieved through a combination of right rate, right time, right place and right source.

Calculating N Recommended

Example: Lemons

- N removed with harvest 2.5 lbs. N /ton yield
- 20-25 lbs. N for perennial tissue growth
- Estimated yield 22,000 lbs.
- Target NUE 75%

Calculating N Recommended

Example: Lemon

N Recommended = (N removed per unit of crop yield × Estimated Yield) + N needed for tree maintenance
/ Nitrogen Use Efficiency

Calculating N Recommended

Example: Lemon

$$\frac{70 \text{ lbs. N}}{\text{acre}} = \frac{\left(\frac{2.5 \text{ lbs. N}}{2{,}000 \text{ lb yield}} \times 22{,}000 \text{ lbs.}\right) + 25 \text{ lbs. N}}{0.75 \text{ NUE}}$$

Calculating N Recommended

Example: Strawberries

- N removed with harvest 2.8 lbs. N /ton yield
- 90-100 lbs. N for crop residue
- Estimated yield 34 tons
- Target NUE 80%

Strawberry source: http://ciwr.ucanr.edu/files/283985.pdf

Calculating N Recommended

Example: Strawberry

N Recommended = (N removed per unit of crop yield × Estimated Yield) + N needed for crop residue / Nitrogen Use Efficiency

Calculating N Recommended

Example: Strawberry

$$\frac{238 \text{ lbs. N}}{\text{acre}} = \frac{\left(\frac{2.8 \text{ lbs. N}}{\text{ton yield}} \times 34 \text{ tons}\right) + 95 \text{ lbs. N}}{0.80 \text{ NUE}}$$

Calculating N Recommended

Strawberries

- N <u>uptake</u> 5.6 lbs. N /ton yield
- Estimated yield 34 tons
- Target NUE 80%

Strawberry source: http://ciwr.ucanr.edu/files/283985.pdf

Calculating N Recommended

Example: Strawberry

N Recommended = (Total N uptake × Estimated Yield) / Nitrogen Use Efficiency

Calculating N Recommended

Example: Strawberry

$$\frac{238\ \text{lbs. N}}{\text{acre}} = \frac{\left(\frac{5.6\ \text{lbs. N}}{\text{ton yield}} \times 34\ \text{tons}\right)}{0.80\ \text{NUE}}$$

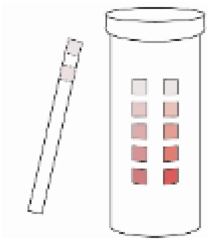
POLL

Apply the Right N Rate

The right rate equation

Supply

$$\frac{238\ \text{lbs. N}}{\text{acre}} = \text{Residual N in Soil} \quad \text{N mineralized in soil} \quad \text{Irrigation water} \quad \text{Fertilizer}$$



Residual N in Soil

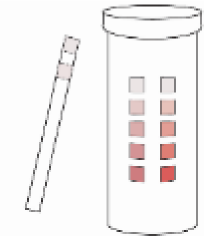
N mineralized in soil

Irrigation water

Fertilizer

POLL

Right Rate: N Supply



N in the Soil

✓ A practical and simple tool for improving N use-efficiency

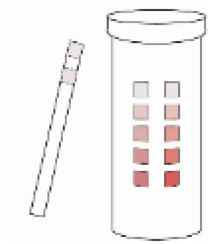
Right Rate: Supply

N in the Soil

- Soil Nitrate testing should be performed prior to planting or before side dress applications
  - Important in annual crop production
- Challenges with testing
  - Spatial variability
  - Turn around time from lab
  - Will the nitrate be there after irrigation?
  - If nitrate is coming from mineralization of an organic source, how much and how quickly will more nitrate be available?

Right Rate: N Supply

N in the Soil



- Example
  - Results = 20ppm NO_3-N in dry soil
  - 20 x 4* = 80 lbs. N/ac available in top foot of soil

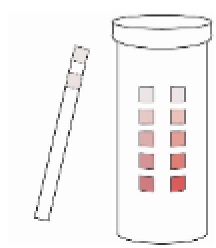
*4 is a constant used to convert units from ppm to pounds per acre foot. One acre foot of soil weights approximately 4 million pounds.

Apply the Right N Rate

The right rate equation

$$\frac{238 \text{ lbs. N}}{\text{acre}} =$$

Supply



80 lbs. N /acre

N mineralized in soil

Irrigation water

Fertilizer

Right Rate: Supply

N Mineralized in the Soil

- Soil organic matter when a single application of organic matter is made
  - N credits= dry lbs OM x %N × % decomposition in 1st year

First year decomposition Rates	
Cured compost	5-10%
Dried manure	20-30%
Cover crop	10-35%

Right Rate: Supply

N Mineralized in the Soil

- Consistent application each year of OM or the growing of a cover crop
  - N Contribution = Dry lbs. OM × % N × 70%*

*If incorporated the efficiency of decomposition and uptake is about 70% over time. Therefore 70% of the total N content of the application is available that year

Right Rate: N Supply

N Mineralized in the Soil

- Example
  - 1st year applying cured compost @ 5 tons/ac
    - Expected 1st year decomposition rate 7.5%
    - % N estimated from lab report 2%

N credit = 10,000 lbs compost /ac x 0.02 x 0.075

N credit = 15 lbs N /ac

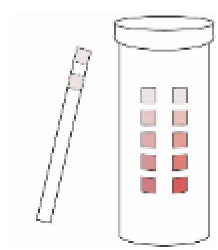
POLL

Apply the Right N Rate

The right rate equation

Supply

$$\frac{238 \text{ lbs. N}}{\text{acre}} =$$



80 lbs. N /acre

15 lbs. N /acre

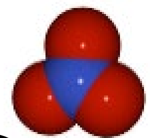
Irrigation water

Fertilizer

Right Rate: Supply

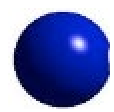
N in irrigation water

- Formula for Nitrate



Nitrate concentration (ppm) X Inches irrigation applied X 0.052 = lbs. N

- Formula for Nitrate-N



Nitrate-N concentration (ppm) X Inches irrigation applied X 0.23 = lbs. N

Right Rate: N Supply

N in irrigation water

- Example
  - 2.3 ppm Nitrate-N and you apply 36 in. of water
    - 2.3 x 36 x 0.23 =
    - 19 lb N per 36 inches of water applied
    - recall Application Efficiency and Distribution Uniformity

POLL

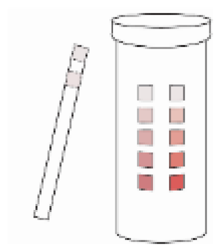
Apply the Right N Rate

The right rate equation

238 lbs. N / acre

=

Supply



80 lbs. N /acre

15 lbs. N /acre

19 lbs. N /acre

Fertilizer

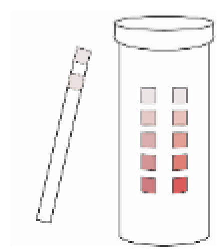
Apply the Right N Rate

The right rate equation

Supply

238 lbs. N
acre

=



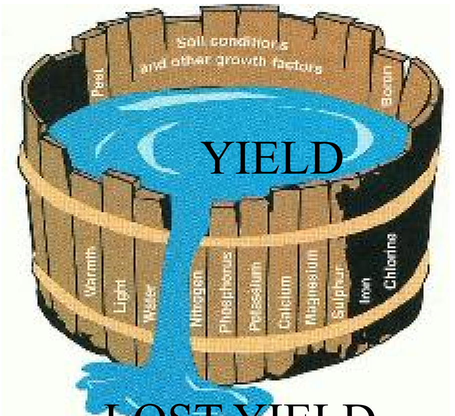
80 lbs. N /acre	15 lbs. N /acre	19 lbs. N /acre	124 lbs. N /acre

Recommendation – Residual N in soil - N mineralized – N in water =

Right Rate

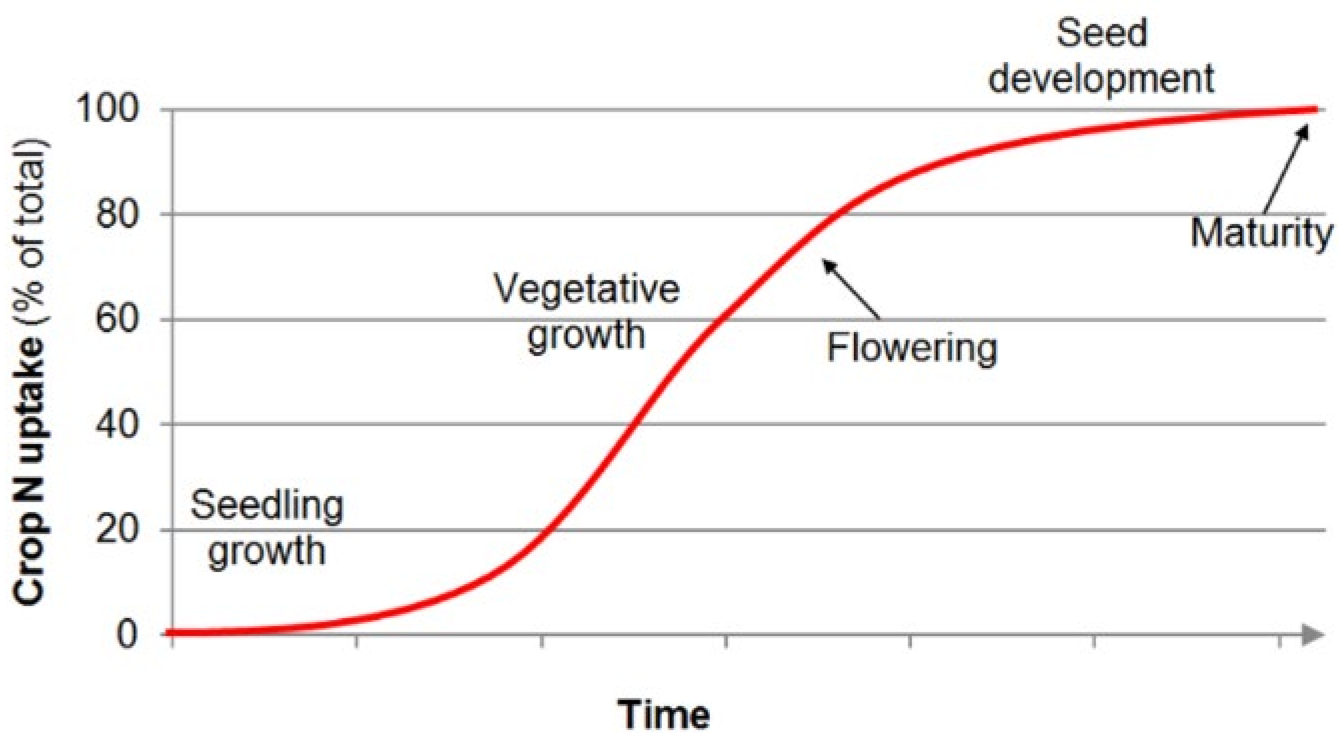
Nutrient Balance: Law of the Minimum

- The efficiency of nitrogen depends on the adequacy of all essential elements and growth conditions
  - If a nutrient is inadequate, yield can be lost and response to other elements will be limited
  - If a nutrient is oversupplied, money, time, and energy is wasted



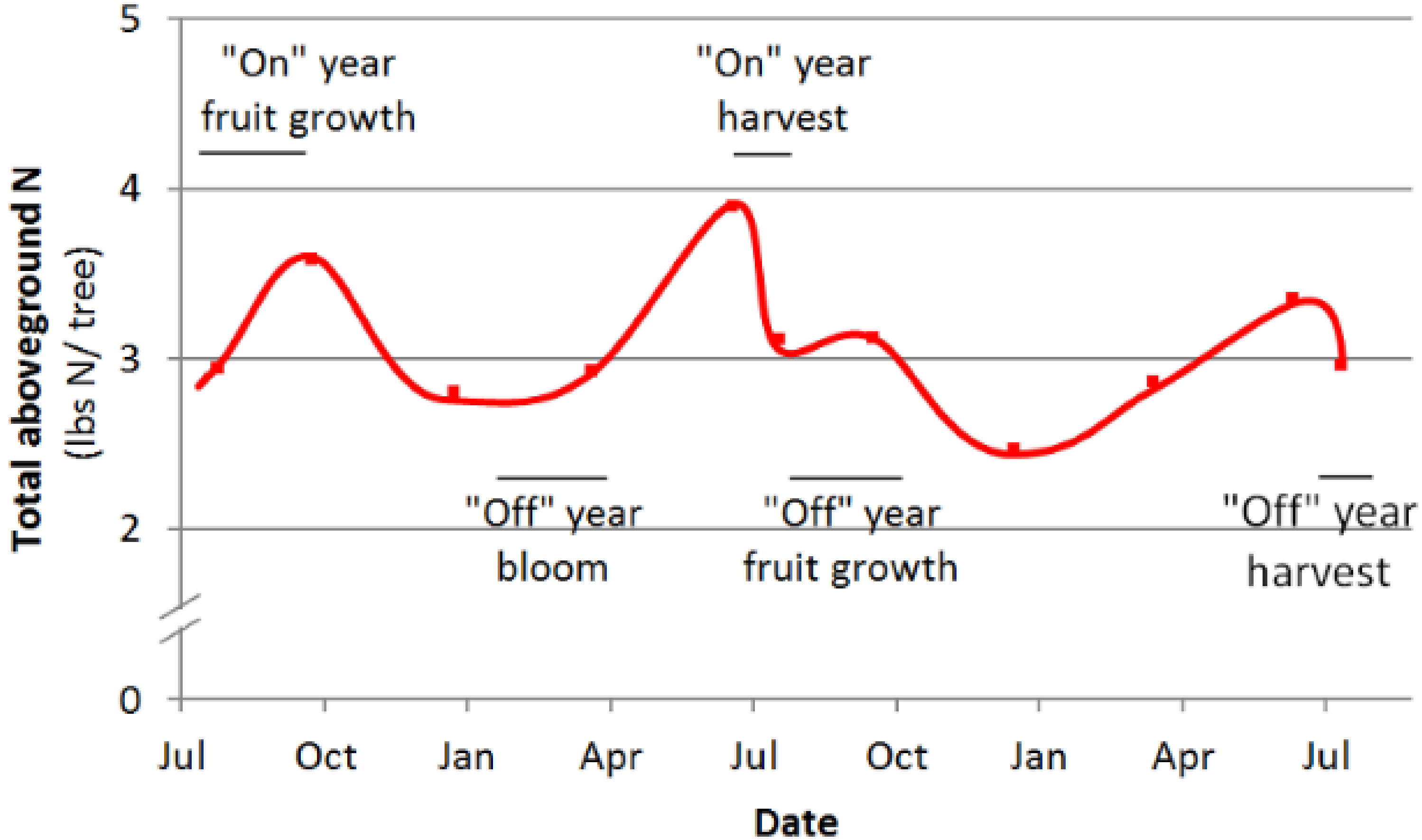
The Right Time

- Match the delivery of nitrogen with crop use
- General N Uptake Curve of Annual Crops



The Right Time

- Uptake Curve for Avocados



The Right Time

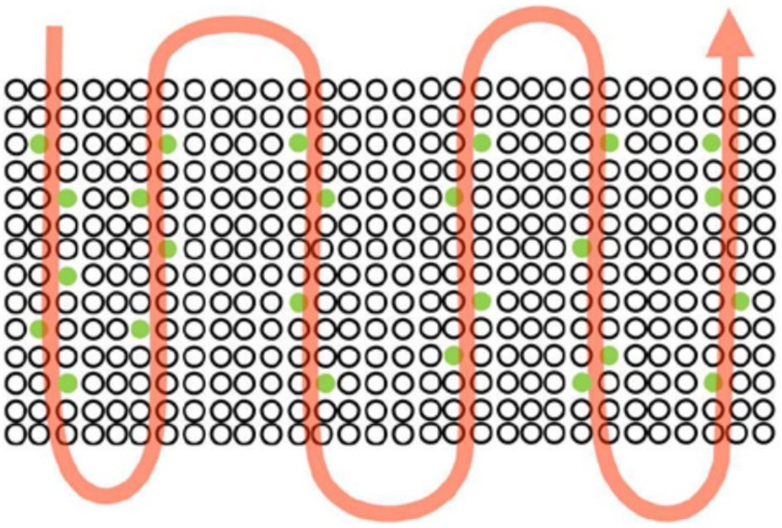
- Match the delivery of nitrogen with the tree use
  - Research finds uptake to be steady over the season

- Application Timing
  - Avocados - 20.0 % per month, July-November
  - Citrus – 12.5 % per month, March-October

- *Prior to Fertilization – N use is from tree storage

The Right Time

- Leaf tissue samples can offer information on how well you are meeting nitrogen demand

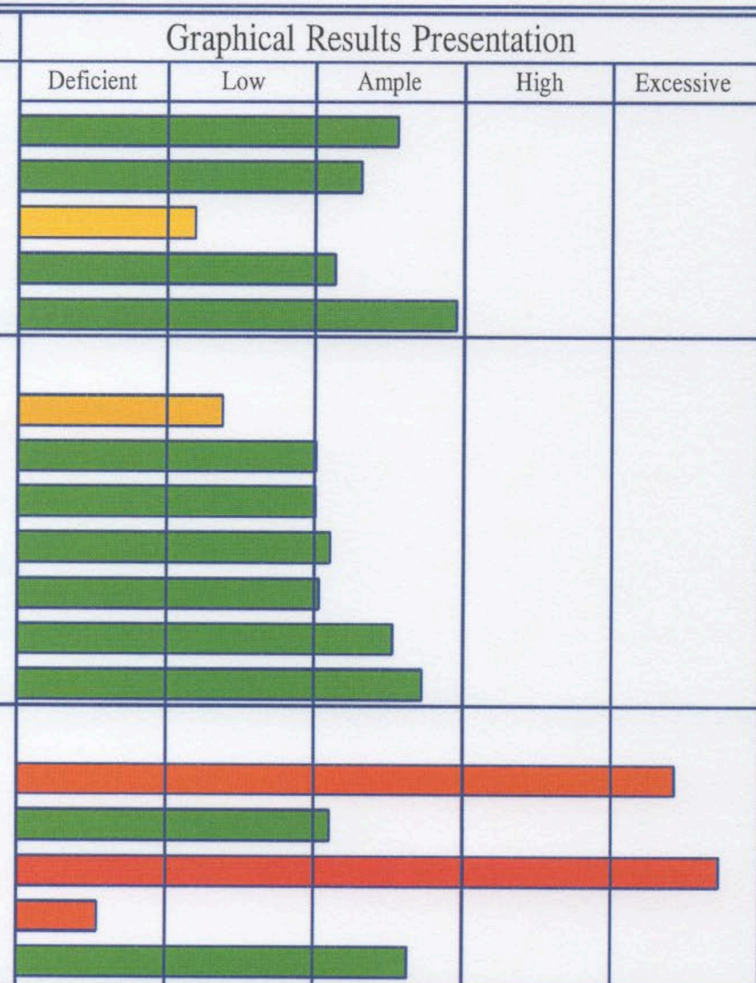


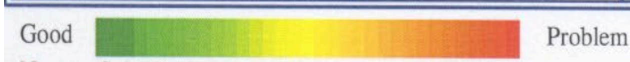
https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Orchard_Tissue_Sampling.pdf

- Interpreting a leaf analysis

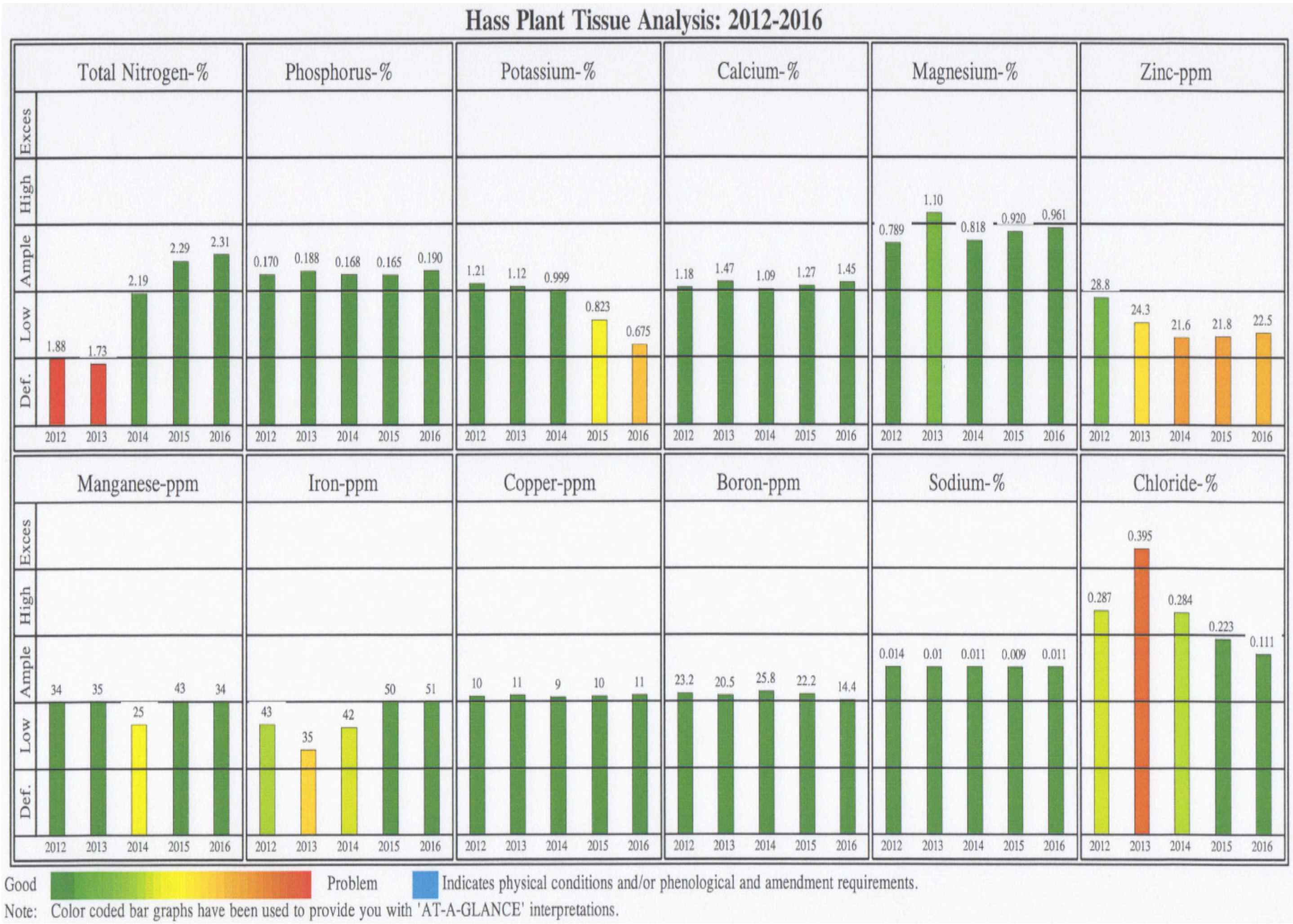
HASS PLANT TISSUE ANALYSIS

Test Description	Result	Units	Optimum Range
Macro Nutrients			
Total Nitrogen (Leaf)	2.31	%	2.2 - 2.4
Phosphorus (Leaf)	0.19	%	0.080 - 0.44
Potassium (Leaf)	0.675	%	1.0 - 3.0
Calcium (Leaf)	1.45	%	1.0 - 4.5
Magnesium (Leaf)	0.96	%	0.25 - 1.0
Micro Nutrients			
Zinc (Leaf)	22.5	ppm	30 - 250
Manganese (Leaf)	34	ppm	30 - 700
Iron (Leaf)	51	ppm	50 - 300
Copper (Leaf)	11	ppm	5.0 - 65
Boron (Leaf)	14.4	ppm	12 - 100
Sodium (Leaf)	0.011	%	0.0 - 0.25
Chloride (Leaf)	0.111	%	0.0 - 0.25
Nutrient Ratios			
Nitrogen:Potassium	3.42		1.7 - 2.2
Nitrogen:Phosphorus	12.2		11 - 23
Phosphorus:Zinc	84.4		20 - 50
Potassium:Magnesium	0.702		1.5 - 3.5
Nitrogen:Calcium	1.59		0.90 - 2.0





- Leaf analysis history



- There is a debate about optimum ranges,
- They should be used as guidelines until you have developed a history for your grove
- Crowley's based on 20 year's data from 450 trees which includes yield and analyses

Nutrient	UC Range	Crowley Range*	Fruit Growers Lab
N%	1.6 – 2.3	2.25 – 2.5	2.2 – 2.4
P%	0.10 – 0.25	0.1 – 0.15	0.08 – 0.44
K%	0.75 – 2.0	0.7 – 0.9	1.0 – 3.0
Ca%	1.0 – 3.0	1.8 – 2.0	1.0 – 4.5
Mg%	0.25 – 0.80	0.6 – 0.9	0.25 – 1.0
S%	0.20 – 0.60	0.45 – 0.53	***
Cl%	< 0.25	**	< 0.25
Na%	< 0.25	**	< 0.25
B ppm	50 – 100	38 – 60	12 – 100
Zn ppm	30 – 150	50 – 80	30 – 250
Mn ppm	30 – 500	110 – 145	30 – 700
Fe ppm	50 – 200	55 – 80	50 – 300
Cu ppm	5 – 15	4 – 7	5 – 65

* See the Fall 2015 issue of *From the Grov*magazine,
www.californiaavocadogrowers.com/publications

The Right Place

- Manage irrigation systems to ensure N is delivered in the root zone
  - Apply irrigation evenly across the orchard
  - Apply the correct amount of irrigation water to prevent leaching and saturated soil conditions
  - Irrigate after dry fertilization to minimize NH_3 volatilization
  - Inject liquid fertilizers at a time to position the fertilizer where the roots are located

POLL

The Right Place

Where are the roots? Where does N uptake occur?

- Soil and irrigation practices will influence this greatly

	Depth of Main Root Zone (inches)
Avocado	0-8
Celery	0-18
Citrus	0-18
Peppers	0-12
Raspberries	0-24
Strawberries	0-12

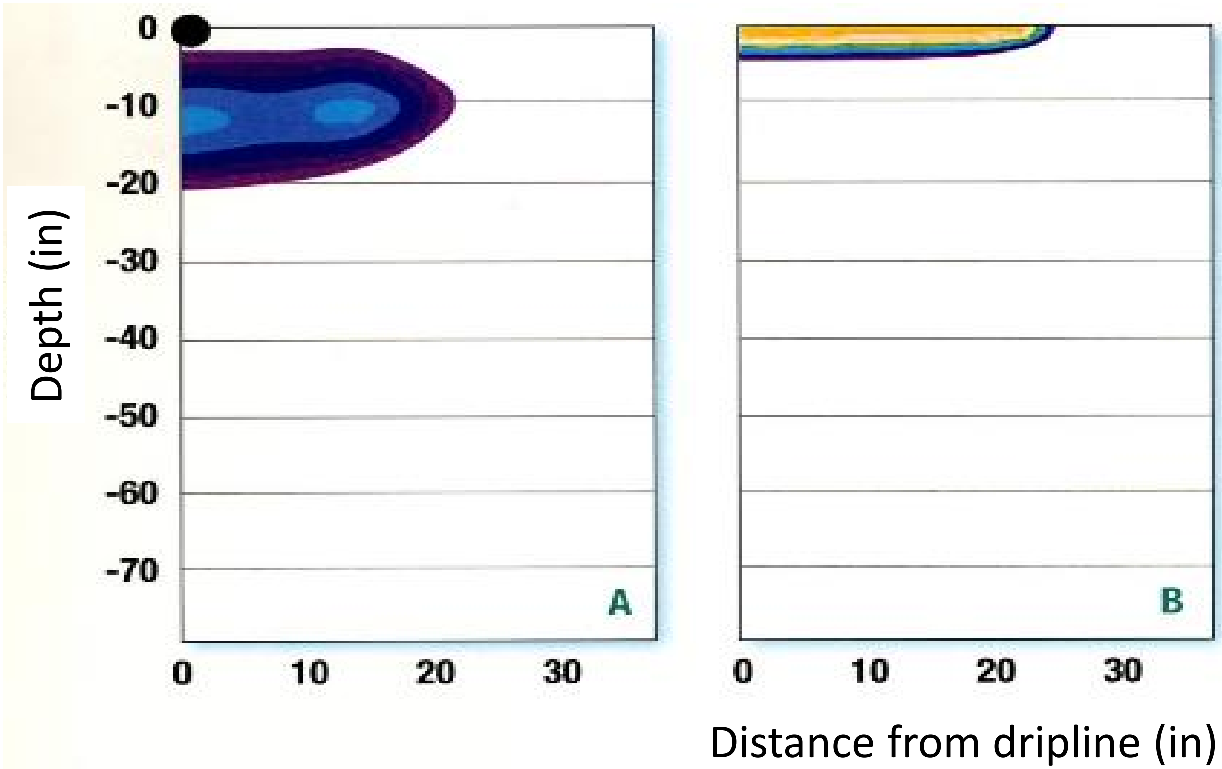
Right Place

Fertigation in Pressurized Systems

- Time injection so that material stays in crop root zone
  - Inject N during the middle to near end of an irrigation event.

Right Place

Surface Drip Example



2 hour injection near **start** of 27 to 36 hour Irrigation

2 hour injection near **end** of 27 to 36 hour Irrigation

(Blaine Hanson, “Fertigation with Microirrigation”)

The Right Source

- There is no evidence to suggest that any type of N fertilizer delivering the same amount of N can produce higher yields.

- Material selection should be made on costs, application equipment available, and effect on soil chemistry.

Section 5 Summary

Farm Practices and Nitrogen Use Efficiency

- The highest nitrogen use efficiency is achieved by: the best combination of right rate, right time, right place and right source.
  - This requires understanding the dynamics of nitrogen in the soil and the plant and irrigation system performance to reduce nitrogen losses

- <u>Use Leaf/Tissue Analysis to monitor the effectiveness of your fertilizer applications</u>

POLL

Questions?

NITROGEN MANAGEMENT PLAN

Section 6

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Strawberry 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)				
2. VCAILG ID#				
3. Name:				

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop		17. Nitrogen Fertilizers		
7. Production Unit		18. Dry/Liquid N (lbs/ac)		
8. Projected Yield (units/ac)		19. Foliar N (lbs/ac)		
9. N Recommended (lbs/ac)		20. Organic Material N		
10. Acres		21. Available N in Manure/Compost (lbs/ac estimate)		
Post Production Actuals				
11. Actual Yield (units/ac)		22. Total Available N Applied (lbs/ac) (18+19+21)		
12. Total N Applied (lbs/ac) (22+26)		23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*		24. Available N carryover in soil (annualized, lbs/ac)		
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)		
		Irrigation sources		
		Irrigation amount applied (ac/ft)		
		26. Total N Credits (lbs/ac) (24+25)		
		27. Total N Recommended & Applied (22+26)		
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

1. Crop Year (Harvested) 2021

2. VCAILG ID# 123456

3. Name: John Doe
ABC Farms

1. Enter the calendar year in which crop is harvested
2. Enter your VCAILG ID #
3. Enter the name of the person certifying the plan and the farm or landowner name.

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Strawberry 1

1. Crop Year (Harvested)	2021	4. APN(s):	5. Field(s) ID	Acres
2. VCAILG ID#	123456			
3. Name:	John Doe ABC Farms 1234 Street Ventura, CA 93003			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop		17. Nitrogen Fertilizers		
7. Production Unit		18. Dry/Liquid N (lbs/ac)		
8. Projected Yield (units/ac)		19. Foliar N (lbs/ac)		
9. N Recommended (lbs/ac)		20. Organic Material N		
10. Acres		21. Available N in Manure/Compost (lbs/ac estimate)		
Post Production Actuals				
11. Actual Yield (units/ac)		22. Total Available N Applied (lbs/ac) (18+19+21)		
12. Total N Applied (lbs/ac) (22+26)		23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*		24. Available N carryover in soil (annualized, lbs/ac)		
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)		
		Irrigation sources		
		Irrigation amount applied (ac/ft)		
		26. Total N Credits (lbs/ac) (24+25)		
		27. Total N Recommended & Applied (22+26)		
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

4. APN(s):	5. Field(s) ID	Acres
123-4-567-891	Field 1	39.5
123-4-567-892	Field 2	23.0

4. Enter the Assessor's Parcel Number (APN). If field has more than one APN enter both
5. Enter the Field Identification (ID) for each unique management unit. Also include field acreage.

Practice Scenario

Crop Nitrogen Management Planning

- 62.5 acres of strawberries
- Projected yield 35 tons /ac

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Strawberry 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-891	Field 1	39.5
2. VCAILG ID#	123456	123-4-567-892	Field 2	23.0
3. Name:	John Doe ABC Farms 1234 Street Ventura, CA 93003			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop		17. Nitrogen Fertilizers		
7. Production Unit		18. Dry/Liquid N (lbs/ac)		
8. Projected Yield (units/ac)		19. Foliar N (lbs/ac)		
9. N Recommended (lbs/ac)		20. Organic Material N		
10. Acres		21. Available N in Manure/Compost (lbs/ac estimate)		
Post Production Actuals				
11. Actual Yield (units/ac)		22. Total Available N Applied (lbs/ac) (18+19+21)		
12. Total N Applied (lbs/ac) (22+26)		23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*		24. Available N carryover in soil (annualized, lbs/ac)		
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)		
		Irrigation sources		
		Irrigation amount applied (ac/ft)		
		26. Total N Credits (lbs/ac) (24+25)		
		27. Total N Recommended & Applied (22+26)		
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

CROP NITROGEN MANAGEMENT PLANNING	
6. Crop	Strawberry
7. Production Unit	tons
8. Projected Yield (units/ac)	35
9. N Recommended (lbs/ac)	
10. Acres	

6. Enter crop name
7. Enter the standard production unit (tons, lbs., cartons, etc.)
8. Enter your projected yield per acre

Crop Nitrogen Management Planning

Box 9

$$\frac{231\text{ lbs. N}}{\text{acre}} = \frac{\left(\frac{2.8\text{ lbs. N}}{\text{ton yield}} \times 35\text{ tons}\right) + 98\text{ lbs. N}}{0.85\text{ NUE}}$$

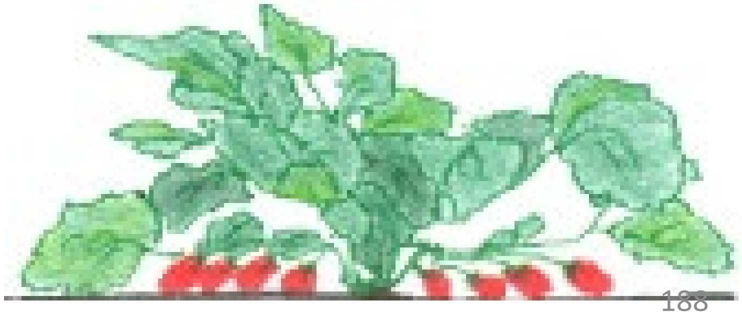
CROP NITROGEN MANAGEMENT PLANNING	
6. Crop	Strawberry
7. Production Unit	tons
8. Projected Yield (units/ac)	35
9. N Recommended (lbs/ac)	231
10. Acres	62.5

9. Enter the amount of Nitrogen recommended per acre
10. Enter total irrigated acres for the management unit covered

Practice Scenario

N Application / Credits

- Pre-plant soil test showed 10ppm Nitrate-N
- Irrigation water has 4.0ppm Nitrate-N
  - 24 ac-in applied over season
- No Organic Matter Applications



Practice Scenario

Box 24

- Results = 10ppm NO3-N in dry soil
- 10 x 4 = 40 lbs. N/ac available in top foot of soil

Practice Scenario

Box 25

- Formula for Nitrate-N

Nitrate-N concentration (ppm)	x	Inches irrigation applied	x	0.23	=	lbs. N
4.0ppm	x	24	x	0.23	=	22 lbs. N

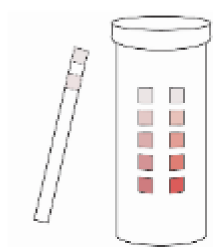
Practice Scenario

Box 18

Supply

231 lbs. N / acre

=



40 lbs. N /acre

0 lbs. N /acre

22 lbs. N /acre

169 lbs. N /acre

Recommended – Residual N in soil - N mineralized – N in water =

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Strawberry 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-891	Field 1	39.5
2. VCAILG ID#	123456	123-4-567-892	Field 2	23.0
3. Name:	John Doe ABC Farms 1234 Street Ventura, CA 93003			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop	Strawberry	17. Nitrogen Fertilizers		
7. Production Unit	tons	18. Dry/Liquid N (lbs/ac)		
8. Projected Yield (units/ac)	35	19. Foliar N (lbs/ac)		
9. N Recommended (lbs/ac)	231	20. Organic Material N		
10. Acres	62.5	21. Available N in Manure/Compost (lbs/ac estimate)		
Post Production Actuals				
11. Actual Yield (units/ac)		22. Total Available N Applied (lbs/ac) (18+19+21)		
12. Total N Applied (lbs/ac) (22+26)		23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*		24. Available N carryover in soil (annualized, lbs/ac)		
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)		
		Irrigation sources		
		Irrigation amount applied (ac/ft)		
		26. Total N Credits (lbs/ac) (24+25)		
		27. Total N Recommended & Applied (22+26)		
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	169	
19. Foliar N (lbs/ac)	0	
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	
22. Total Available N Applied (lbs/ac) (18+19+21)		
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	40	
25. N in Irrigation water (annualized, lbs/ac)	22	
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2	
26. Total N Credits (lbs/ac) (24+25)		
27. Total N Recommended & Applied (22+26)		

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	169	
19. Foliar N (lbs/ac)	0	
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	
22. Total Available N Applied (lbs/ac) (18+19+21)	169	
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	40	
25. N in Irrigation water (annualized, lbs/ac)	22	
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2	
26. Total N Credits (lbs/ac) (24+25)	62	
27. Total N Recommended & Applied (22+26)	231	

Practice Scenario

Post Production Actuals

- 150 lbs. Dry/liquid N
- N credits same as predicted

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	169	150
19. Foliar N (lbs/ac)	0	0
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	0
22. Total Available N Applied (lbs/ac) (18+19+21)	169	
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	40	40
25. N in Irrigation water (annualized, lbs/ac)	22	22
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2	2
26. Total N Credits (lbs/ac) (24+25)	62	
27. Total N Recommended & Applied (22+26)	231	

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	169	150
19. Foliar N (lbs/ac)	0	0
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	0
22. Total Available N Applied (lbs/ac) (18+19+21)	169	150
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	40	40
25. N in Irrigation water (annualized, lbs/ac)	22	22
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2	2
26. Total N Credits (lbs/ac) (24+25)	62	62
27. Total N Recommended & Applied (22+26)	231	212

Practice Scenario

Post Production Actuals

- Actual Yield 35.5 tons (Box 11)
  - vs 35 tons predicted
- Total N Applied 212 lbs. /acre (Box 12)
  - vs 231 lbs. /acre planned

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Strawberry 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-891	Field 1	39.5
2. VCAILG ID#	123456	123-4-567-892	Field 2	23.0
3. Name:	John Doe ABC Farms 1234 Street Ventura, CA 93003			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop	Strawberry	17. Nitrogen Fertilizers		
7. Production Unit	tons	18. Dry/Liquid N (lbs/ac)	169	150
8. Projected Yield (units/ac)	35	19. Foliar N (lbs/ac)	0	0
9. N Recommended (lbs/ac)	231	20. Organic Material N		
10. Acres	62.5	21. Available N in Manure/Compost (lbs/ac estimate)	0	0
Post Production Actuals				
11. Actual Yield (units/ac)		22. Total Available N Applied (lbs/ac) (18+19+21)	169	150
12. Total N Applied (lbs/ac) (22+26)		23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*		24. Available N carryover in soil (annualized, lbs/ac)	40	40
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)	22	22
		Irrigation sources	Well #1	
		Irrigation amount applied (ac/ft)	2	2
		26. Total N Credits (lbs/ac) (24+25)	62	62
		27. Total N Recommended & Applied (22+26)	231	212
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

Practice Scenario

Box 11 & 12

Post Production Actuals	
11. Actual Yield (units/ac)	35.5
12. Total N Applied (lbs/ac) (22+26)	212
13. N Removed (lbs N/ac)*	

Practice Scenario

N Removed with harvest Box 13

- In most crops only a portion of the N taken up by the crop is removed from the field with harvest
- Applied N that is not removed from the field with harvest can:
  - Remain in the field as crop residue which will decompose
  - Be incorporated into perennial tissue
  - Remain in the soil and be available to the next crop
  - Be lost to the environment or groundwater

Practice Scenario

N Removed with harvest Box 13

$$\left(\text{N removed per unit of crop yield} \times \text{Estimated Yield} \right) = \boxed{\text{N Removed with Harvest}}$$

$$\frac{2.8 \text{ lbs. N}}{\text{ton yield}} \times \frac{35.5 \text{ tons yield}}{\text{acre}} = \boxed{\frac{99 \text{ lbs. N}}{\text{acre}}}$$

Practice Scenario

Box 13

Post Production Actuals	
11. Actual Yield (units/ac)	35.5
12. Total N Applied (lbs/ac) (22+26)	212
13. N Removed (lbs N/ac)*	99

Practice Scenario

Actual Applied vs. Removed

$$\frac{212 \text{ lbs. N}}{\text{acre}} - \frac{99 \text{ lbs. N}}{\text{acre}} = \boxed{\frac{+\,113 \text{ lbs. N}}{\text{acre}}}$$

Actual N Applied

Box 12

Actual N Removed

Box 13

Left in the field post-harvest as residue or residual N

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Strawberry 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-891	Field 1	39.5
2. VCAILG ID#	123456	123-4-567-892	Field 2	23.0
3. Name:	John Doe ABC Farms 1234 Street Ventura, CA 93003			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop	Strawberry	17. Nitrogen Fertilizers		
7. Production Unit	tons	18. Dry/Liquid N (lbs/ac)	169	150
8. Projected Yield (units/ac)	35	19. Foliar N (lbs/ac)	0	0
9. N Recommended (lbs/ac)	231	20. Organic Material N		
10. Acres	62.5	21. Available N in Manure/Compost (lbs/ac estimate)	0	0
Post Production Actuals				
11. Actual Yield (units/ac)	35.5	22. Total Available N Applied (lbs/ac) (18+19+21)	169	150
12. Total N Applied (lbs/ac) (22+26)	212	23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*	99	24. Available N carryover in soil (annualized, lbs/ac)	40	40
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)	22	22
		Irrigation sources	Well #1	
		Irrigation amount applied (ac/ft)	2	2
		26. Total N Credits (lbs/ac) (24+25)	62	62
		27. Total N Recommended & Applied (22+26)	231	212
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING

28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

CROP NITROGEN MANAGEMENT PLANNING	
6. **Crop**	Strawberry
7. **Production Unit**	tons
8. **Projected Yield** (units/ac)	35
9. N Recommended (lbs/ac)	231
10. **Acres**	62.5
Post Production Actuals	
11. **Actual Yield** (units/ac)	35.5
12. **Total N Applied** (lbs/ac) (22+26)	212
13. **N Removed** (lbs N/ac)*	99
14. **Notes:**	

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	169	150
19. Foliar N (lbs/ac)	0	0
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	0
22. **Total Available N Applied** (lbs/ac) (18+19+21)	169	150
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	40	40
25. N in Irrigation water (annualized, lbs/ac)	22	22
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2	2
26. **Total N Credits** (lbs/ac) (24+25)	62	62
27. **Total N Recommended & Applied** (22+26)	231	212
Actual N Applied (12) vs **Actual N Removed** (13)		+113

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Strawberry 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-891	Field 1	39.5
2. VCAILG ID#	123456	123-4-567-892	Field 2	23.0
3. Name:	John Doe ABC Farms 1234 Street Ventura, CA 93003			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop	Strawberry	17. Nitrogen Fertilizers		
7. Production Unit	tons	18. Dry/Liquid N (lbs/ac)	169	150
8. Projected Yield (units/ac)	35	19. Foliar N (lbs/ac)	0	0
9. N Recommended (lbs/ac)	231	20. Organic Material N		
10. Acres	62.5	21. Available N in Manure/Compost (lbs/ac estimate)	0	0
Post Production Actuals				
11. Actual Yield (units/ac)	35.5	22. Total Available N Applied (lbs/ac) (18+19+21)	169	150
12. Total N Applied (lbs/ac) (22+26)	212	23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*	99	24. Available N carryover in soil (annualized, lbs/ac)	40	40
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)	22	22
		Irrigation sources	Well #1	
		Irrigation amount applied (ac/ft)	2	2
		26. Total N Credits (lbs/ac) (24+25)	62	62
		27. Total N Recommended & Applied (22+26)	231	212
		Actual N Applied (12) vs Actual N Removed (13)		+113

CROP NITROGEN MANAGEMENT PLANNING

28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

28. CERTIFIED BY:	29. CERTIFICATION METHOD	
John Doe	30. Self-Certified, approved training program attended	X
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	
12/31/2021		

28. Signature of certifier and date of plan certification
29. Place an X in the box signifying the method used for certification

Questions?

Nitrogen Management Plan

Section 7

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Avocado 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)				
2. VCAILG ID#				
3. Name:				

CROP NITROGEN MANAGEMENT PLANNING	
6. Crop	
7. Production Unit	
8. Projected Yield (units/ac)	
9. N Recommended (lbs/ac)	
10. Acres	
Post Production Actuals	
11. Actual Yield (units/ac)	
12. Total N Applied (lbs/ac) (22+26)	
13. N Removed (lbs N/ac)*	
14. Notes:	

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)		
19. Foliar N (lbs/ac)		
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)		
22. Total Available N Applied (lbs/ac) (18+19+21)		
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)		
25. N in Irrigation water (annualized, lbs/ac)		
Irrigation sources		
Irrigation amount applied (ac/ft)		
26. Total N Credits (lbs/ac) (24+25)		
27. Total N Recommended & Applied (22+26)		
Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING

28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Avocado 1

1. Crop Year (Harvested) 2021

2. VCAILG ID# 12345

3. Name: John Doe
ABC Farms

4. APN(s):	5. Field(s) ID	Acres
123-4-567-890	Field 10	10

Practice Scenario

Crop Nitrogen Management Planning

- 10 acres of mature avocados
- Projected yield 10,000 lbs. /acre

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Avocado 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-890	Field 10	10
2. VCAILG ID#	12345			
3. Name:	John Doe ABC Farms			

CROP NITROGEN MANAGEMENT PLANNING	
6. Crop	
7. Production Unit	
8. Projected Yield (units/ac)	
9. N Recommended (lbs/ac)	
10. Acres	
Post Production Actuals	
11. Actual Yield (units/ac)	
12. Total N Applied (lbs/ac) (22+26)	
13. N Removed (lbs N/ac)*	
14. Notes:	

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)		
19. Foliar N (lbs/ac)		
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)		
22. Total Available N Applied (lbs/ac) (18+19+21)		
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)		
25. N in Irrigation water (annualized, lbs/ac)		
Irrigation sources		
Irrigation amount applied (ac/ft)		
26. Total N Credits (lbs/ac) (24+25)		
27. Total N Recommended & Applied (22+26)		
Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING

28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

CROP NITROGEN MANAGEMENT PLANNING	
6. Crop	Avocado
7. Production Unit	lbs
8. Projected Yield (units/ac)	10,000
9. N Recommended (lbs/ac)	
10. Acres	

Fruit Growers Laboratory - Avocado
Nitrogen Management Plan – Calculating Nitrogen Demand

Yield Method (based on fruit removal) = **2.50 lbs. of N per 1000 lbs. of fruit**

*Percent Canopy	Tree Maintenance N (lbs.)	Approximate Tree Age (Years)
100	30	8+
80	27	6-7
60	24	5-6
40	21	4-5
20	18	3-4
10 or less	15	1-2

http://www.farmbureauvc.com/_literature_177395/Nitrogen_Demand_Avocados

Crop Nitrogen Management Planning

N Recommended Box 9

$$\frac{79 \text{ lbs. N}}{\text{acre}} = \frac{\left(\frac{2.5 \text{ lbs. N}}{1{,}000 \text{ lbs yield}} \times 10{,}000 \text{ lbs.}\right) + 30 \text{ lbs. N}}{0.70 \text{ NUE}}$$

CROP NITROGEN MANAGEMENT PLANNING	
6. Crop	Avocado
7. Production Unit	lbs
8. Projected Yield (units/ac)	10,000
9. N Recommended (lbs/ac)	79
10. Acres	10

Practice Scenario

N Application / Credits

- Pre-plant soil test showed 5ppm Nitrate-N in top foot of soil
- Irrigation water has 2.0 ppm Nitrate-N
  - 30 in/ac applied over season

Practice Scenario

Box 24

- Results = 5ppm NO3-N in dry soil
- 5 x 4 = 20 lbs. N/ac available in top foot of soil

Practice Scenario

Box 25

- Formula for Nitrate-N

Nitrate-N concentration (ppm)	x	Inches irrigation applied	x	0.23	=	lbs. N
2.0ppm	x	30	x	0.23	=	14 lbs. N

Practice Scenario

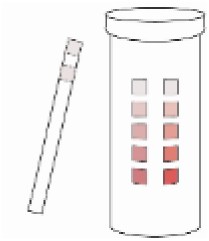
Box 18

Supply

$\frac{\text{79 lbs. N}}{\text{acre}}$

$\frac{\text{79 lbs. N}}{\text{acre}}$

=



20 lbs. N /acre

0 lbs. N /acre

14 lbs. N /acre

45 lbs. N /acre

Recommended – Residual N in soil - N mineralized – N in water =

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Avocado 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-890	Field 10	10
2. VCAILG ID#	12345			
3. Name:	John Doe ABC Farms			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop	Avocado	17. Nitrogen Fertilizers		
7. Production Unit	lbs	18. Dry/Liquid N (lbs/ac)		
8. Projected Yield (units/ac)	10,000	19. Foliar N (lbs/ac)		
9. N Recommended (lbs/ac)	79	20. Organic Material N		
10. Acres	10	21. Available N in Manure/Compost (lbs/ac estimate)		
Post Production Actuals				
11. Actual Yield (units/ac)		22. Total Available N Applied (lbs/ac) (18+19+21)		
12. Total N Applied (lbs/ac) (22+26)		23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*		24. Available N carryover in soil (annualized, lbs/ac)		
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)		
		Irrigation sources		
		Irrigation amount applied (ac/ft)		
		26. Total N Credits (lbs/ac) (24+25)		
		27. Total N Recommended & Applied (22+26)		
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	45	
19. Foliar N (lbs/ac)	0	
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	
22. Total Available N Applied (lbs/ac) (18+19+21)		
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	20	
25. N in Irrigation water (annualized, lbs/ac)	14	
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2.5	
26. Total N Credits (lbs/ac) (24+25)		
27. Total N Recommended & Applied (22+26)		

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	45	
19. Foliar N (lbs/ac)	0	
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	
22. Total Available N Applied (lbs/ac) (18+19+21)	45	
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	20	
25. N in Irrigation water (annualized, lbs/ac)	14	
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2.5	
26. Total N Credits (lbs/ac) (24+25)	34	
27. Total N Recommended & Applied (22+26)	79	

Practice Scenario

Post Production Actuals

- 35 lbs. Dry/liquid N actual
  - Vs 45 lbs. Dry/liquid N planned

- N credits same as predicted

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	45	35
19. Foliar N (lbs/ac)	0	0
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	0
22. Total Available N Applied (lbs/ac) (18+19+21)	45	
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	20	20
25. N in Irrigation water (annualized, lbs/ac)	14	14
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2.5	2.5
26. Total N Credits (lbs/ac) (24+25)	34	
27. Total N Recommended & Applied (22+26)	79	

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	45	35
19. Foliar N (lbs/ac)	0	0
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	0
22. Total Available N Applied (lbs/ac) (18+19+21)	45	35
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	20	20
25. N in Irrigation water (annualized, lbs/ac)	14	14
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2.5	2.5
26. Total N Credits (lbs/ac) (24+25)	34	34
27. Total N Recommended & Applied (22+26)	79	69

Practice Scenario

Post Production Actuals

- Actual Yield 10,000 lbs. /acre (Box 11)
  - Vs predicted yield 10,000 lbs. acre
- Total N Applied 69 lbs. N (Box 12)
  - Vs 79 lbs. N planned

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Avocado 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-890	Field 10	10
2. VCAILG ID#	12345			
3. Name:	John Doe ABC Farms			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop	Avocado	17. Nitrogen Fertilizers		
7. Production Unit	lbs	18. Dry/Liquid N (lbs/ac)	45	35
8. Projected Yield (units/ac)	10,000	19. Foliar N (lbs/ac)	0	0
9. N Recommended (lbs/ac)	79	20. Organic Material N		
10. Acres	10	21. Available N in Manure/Compost (lbs/ac estimate)	0	0
Post Production Actuals				
11. Actual Yield (units/ac)		22. Total Available N Applied (lbs/ac) (18+19+21)	45	35
12. Total N Applied (lbs/ac) (22+26)		23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*		24. Available N carryover in soil (annualized, lbs/ac)	20	20
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)	14	14
		Irrigation sources	Well #1	
		Irrigation amount applied (ac/ft)	2.5	2.5
		26. Total N Credits (lbs/ac) (24+25)	34	34
		27. Total N Recommended & Applied (22+26)	79	68
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

Post Production Actuals	
11. Actual Yield (units/ac)	10,000
12. Total N Applied (lbs/ac) (22+26)	69
13. N Removed (lbs N/ac)*	

Practice Scenario

N Removed with Harvest Box 13

$$\left(\text{N removed per unit of crop yield} \times \text{Estimated Yield} \right) = \boxed{\text{N Removed with Harvest}}$$

$$\frac{2.5 \text{ lbs. N}}{1{,}000 \text{ lbs yield}} \times \frac{10{,}000 \text{ lbs yield}}{\text{acre}} = \boxed{\frac{25 \text{ lbs. N}}{\text{acre}}}$$

Post Production Actuals	
11. Actual Yield (units/ac)	10,000
12. Total N Applied (lbs/ac) (22+26)	69
13. N Removed (lbs N/ac)*	25

Practice Scenario

Actual Applied vs. Removed

$$\frac{69 \text{ lbs. N}}{\text{acre}} - \frac{25 \text{ lbs. N}}{\text{acre}} = \frac{+\,44 \text{ lbs. N}}{\text{acre}}$$

Actual N Applied

Box 12

Actual N Removed

Box 13

N left in field after harvest in perennial tissue or as residual soil N

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Avocado 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-890	Field 10	10
2. VCAILG ID#	12345			
3. Name:	John Doe ABC Farms			

CROP NITROGEN MANAGEMENT PLANNING		N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
6. Crop	Avocado	17. Nitrogen Fertilizers		
7. Production Unit	lbs	18. Dry/Liquid N (lbs/ac)	45	35
8. Projected Yield (units/ac)	10,000	19. Foliar N (lbs/ac)	0	0
9. N Recommended (lbs/ac)	79	20. Organic Material N		
10. Acres	10	21. Available N in Manure/Compost (lbs/ac estimate)	0	0
Post Production Actuals				
11. Actual Yield (units/ac)	10,000	22. Total Available N Applied (lbs/ac) (18+19+21)	45	35
12. Total N Applied (lbs/ac) (22+26)	69	23. Nitrogen Credits(est)		
13. N Removed (lbs N/ac)*	25	24. Available N carryover in soil (annualized, lbs/ac)	20	20
14. Notes:		25. N in Irrigation water (annualized, lbs/ac)	14	14
		Irrigation sources	Well #1	
		Irrigation amount applied (ac/ft)	2.5	2.5
		26. Total N Credits (lbs/ac) (24+25)	34	34
		27. Total N Recommended & Applied (22+26)	79	68
		Actual N Applied (12) vs Actual N Removed (13)		

CROP NITROGEN MANAGEMENT PLANNING

28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

CROP NITROGEN MANAGEMENT PLANNING	
6. Crop	Avocado
7. Production Unit	lbs
8. Projected Yield (units/ac)	10,000
9. N Recommended (lbs/ac)	79
10. Acres	10
Post Production Actuals	
11. Actual Yield (units/ac)	10,000
12. Total N Applied (lbs/ac) (22+26)	69
13. N Removed (lbs N/ac)*	25
14. Notes:	

N APPLICATIONS/CREDITS	15. Recommended / Planned N	16. Actual N
17. Nitrogen Fertilizers		
18. Dry/Liquid N (lbs/ac)	45	35
19. Foliar N (lbs/ac)	0	0
20. Organic Material N		
21. Available N in Manure/Compost (lbs/ac estimate)	0	0
22. Total Available N Applied (lbs/ac) (18+19+21)	45	35
23. Nitrogen Credits(est)		
24. Available N carryover in soil (annualized, lbs/ac)	20	20
25. N in Irrigation water (annualized, lbs/ac)	14	14
Irrigation sources	Well #1	
Irrigation amount applied (ac/ft)	2.5	2.5
26. Total N Credits (lbs/ac) (24+25)	34	34
27. Total N Recommended & Applied (22+26)	79	69
Actual N Applied (12) **vs Actual N Removed** (13)		+44

VENTURA COUNTY
Agricultural Irrigated Lands Group

NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: Avocado 1

		4. APN(s):	5. Field(s) ID	Acres
1. Crop Year (Harvested)	2021	123-4-567-890	Field 10	10
2. VCAILG ID#	12345			
3. Name:	John Doe ABC Farms			

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6. Crop	Avocado	17. Nitrogen Fertilizers		
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Post Production Actuals				
11. Actual Yield (units/ac)	10,000	22. Total Available N Applied (lbs/ac) (18+19+21)	45	35
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		26. Total N Credits (lbs/ac) (24+25)	34	34
		27. Total N Recommended & Applied (22+26)	79	68
		Actual N Applied (12) vs Actual N Removed (13)		+44

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	29. CERTIFICATION METHOD	
	30. Self-Certified, approved training program attended	
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	

* Note: N Removed is only required if information is available for your crop type. Check for available values at: www.ipni.net/app/calculator/home or https://plants.usda.gov/npk/main

CROP NITROGEN MANAGEMENT PLANNING		
28. CERTIFIED BY:	**29. CERTIFICATION METHOD**	
John Doe	30. Self-Certified, approved training program attended	X
	31. Self-Certified, UC or NRCS site recommendation	
DATE:	32. Certified Crop Advisor	
12/31/2021		

Questions?

Test Review

Nitrogen Management Grower Certification Program Exam

- 30 question, multiple choice exam. Have copy of NMP Worksheet handy
- A link to access the test will be emailed to you approximately 1 hour after today's training session
- You must take the test individually
- You will have until Thursday at 5:00 pm to complete the test
- Test results will be given immediately. Certification letters to follow next week via email
- Need a score of 70% or greater to pass the test

Nitrogen Management Grower Certification Program Exam

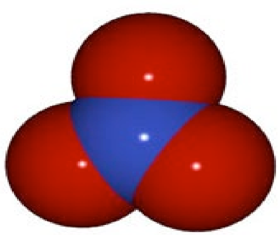
- The pass rate for more than 3,600 Central Valley growers through 2018 is over 80%.
- If you do not pass (70%), you may take a re-test by contacting VCAILG.
  - The retake pass rate is near 100%
- You can elect not to take the test and work with any of the following to create a certified plan:
  - Certified Crop Advisor
  - Self-certify a plan created with site-specific recommendations from the NRCS-approved TSP
- Please also take the time to fill out our evaluation that will launch at the end of this session.

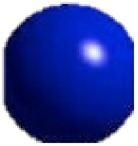
Ventura Nitrogen Management Training Review

Nitrogen and Groundwater Quality Issues

- Nitrate ($N0_3$) is an anion (__________charged) and is not retained by the soil. It moves with water.

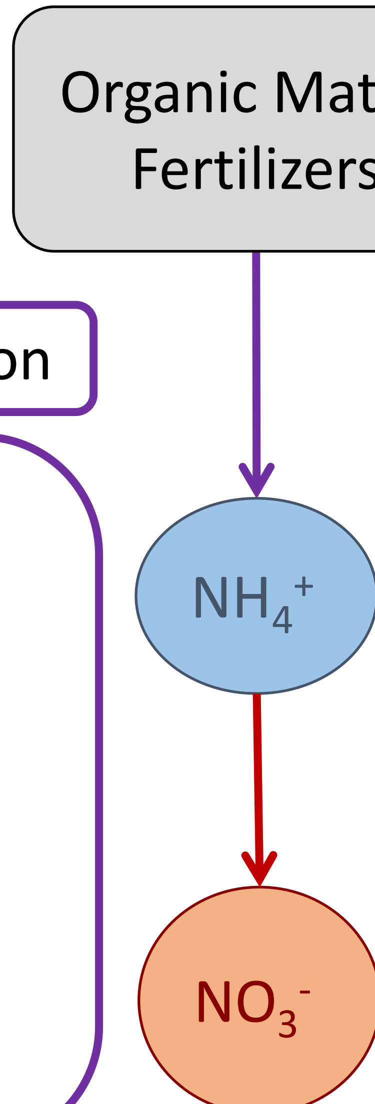
- Areas with shallow groundwater and intensive irrigated agriculture are vulnerable to nitrate contamination
  - Maximum Contaminant Level
  - 45ppm Nitrate = 10 ppm Nitrate-N





POLL

The Nitrogen Cycle



Mineralization

Organic N → Mineral N

Rate affected by C:N, tillage, temperature and moisture

C:N < 20:1 increases mineralization rate

Ammonium → Nitrate

Governed by temperature and moisture

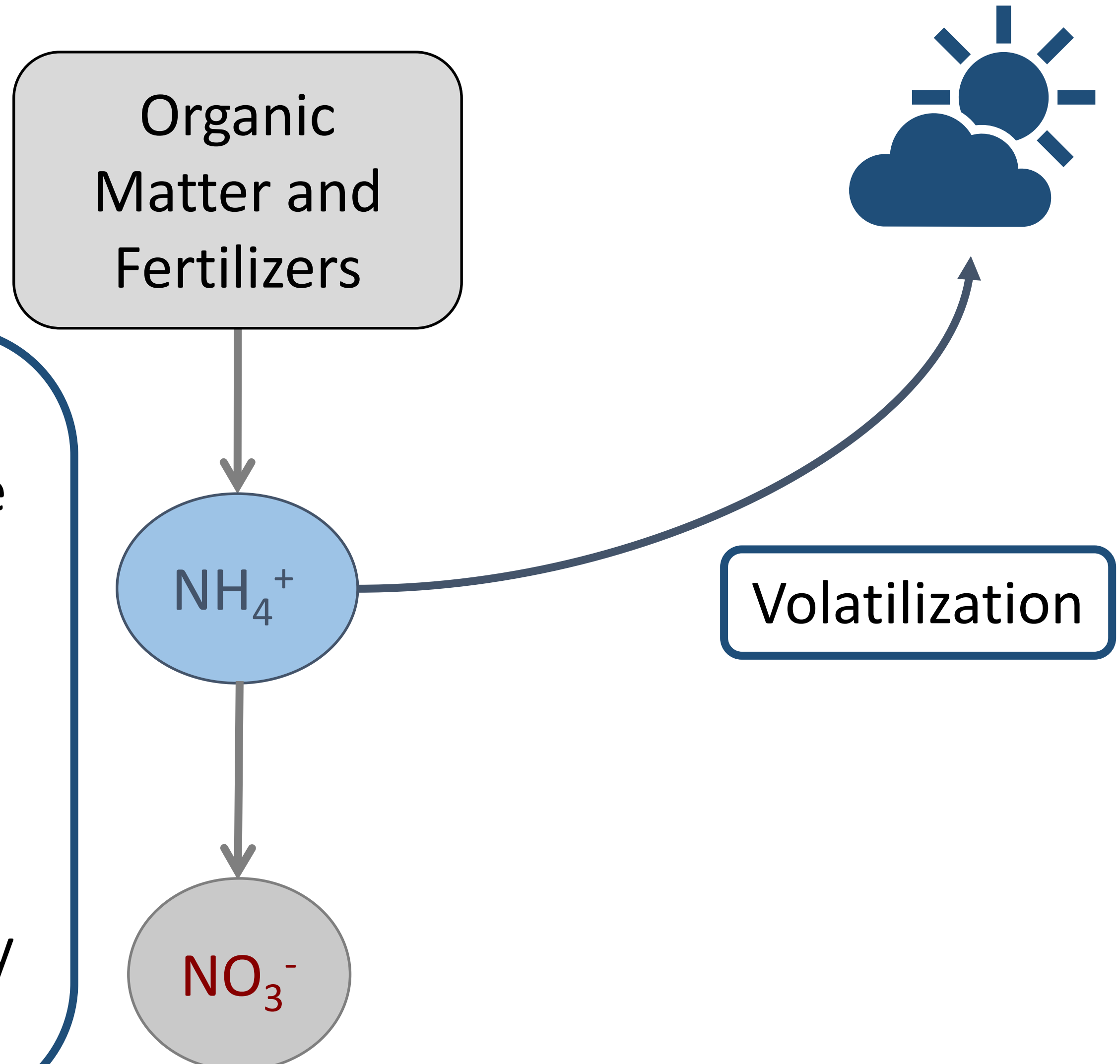
POLL

The Nitrogen Cycle

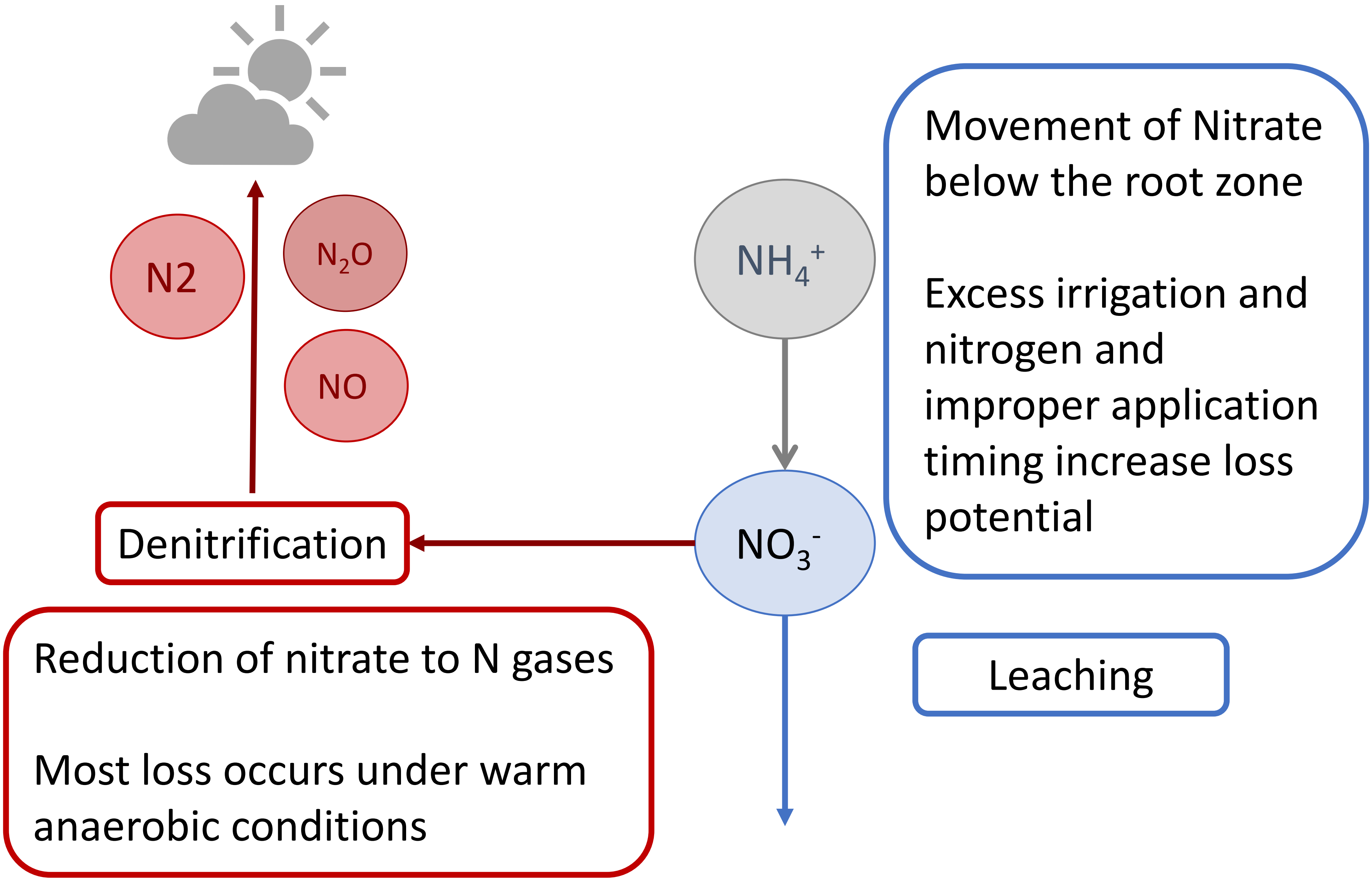
Loss of gaseous ammonia to atmosphere

Results from materials such as manure, urea, UAN

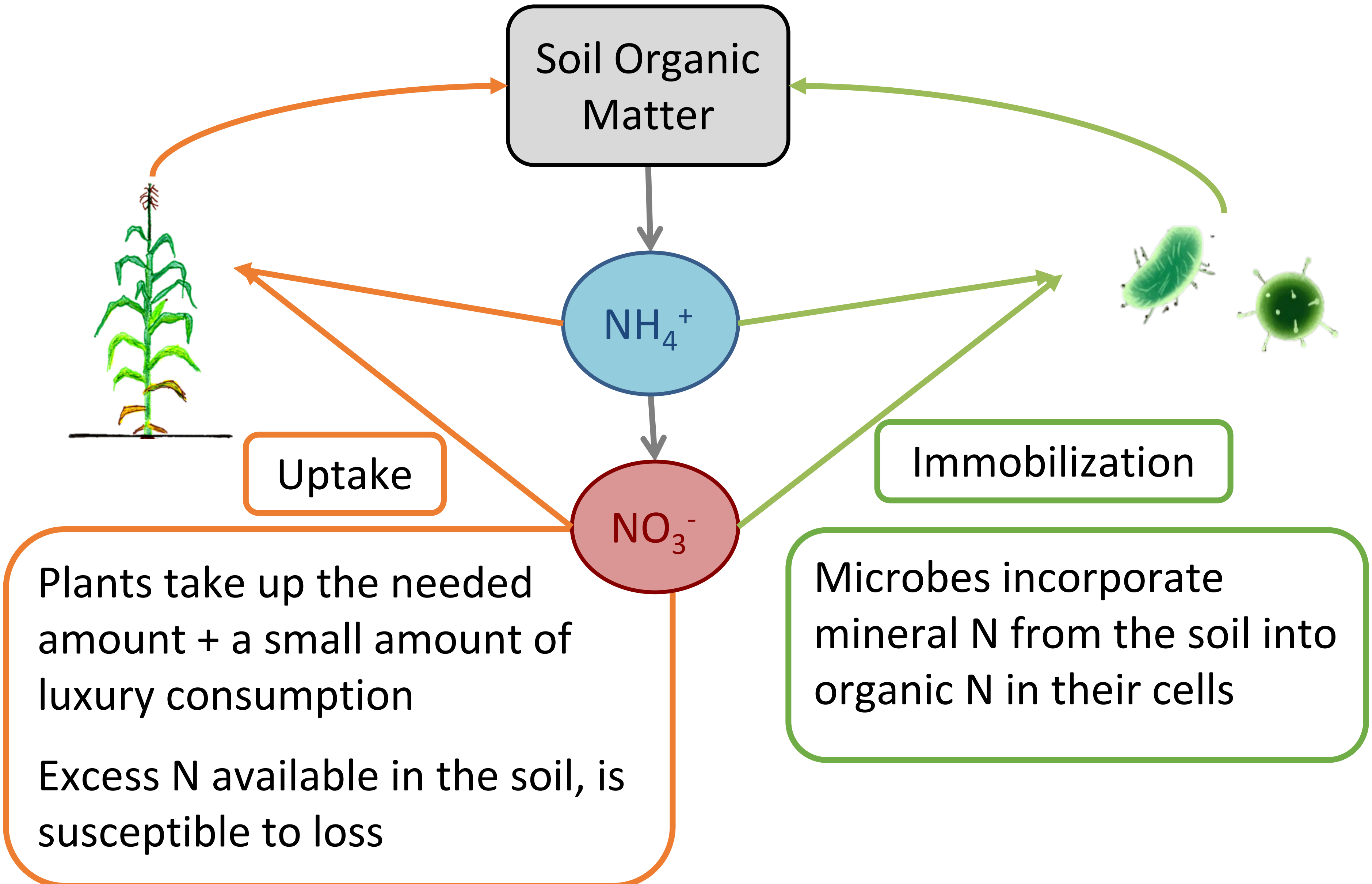
Increases with dry, sandy soil, and high pH



The Nitrogen Cycle



The Nitrogen Cycle



Nitrogen Fertilizers

Ammonium Fertilizers

- Temporarily resistant to leaching until converted to nitrate

Ammonium-forming Fertilizers: Urea

- Enzymatic breakdown of urea in the soil produces NH_4^+
  - Highly soluble, can increase soil pH
  - Prone to volatilization (30% loss over 14 days w/o rain or irrigation)

Nitrogen Fertilizers

Nitrate Fertilizers

- Move easily through soil with water.
- Most susceptible to leaching.

Combination Fertilizers

- Combo fertilizers can rapidly provide nitrate initially and provide continued supply as the ammonium is converted to nitrate.

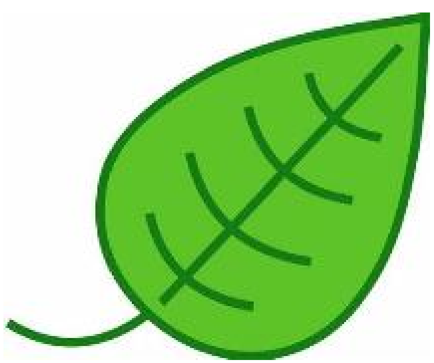
Organic Materials

- Manure, cover crops, compost, and crop residue
- Contain both mineral (ammonium and nitrate) and organic N

Irrigation Scheduling

- Aside from costs and availability of water there are three main factors to consider

Plant



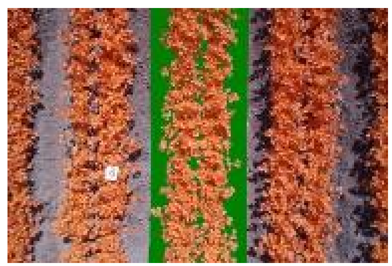
Soil

Weather

Weather Based Scheduling (ET)

ETo x Kc = ETc

20%



60%

90%

POLL

https://cimis.water.ca.gov/

Soil Moisture Based Scheduling

Electrical Resistance Blocks

Tensiometer

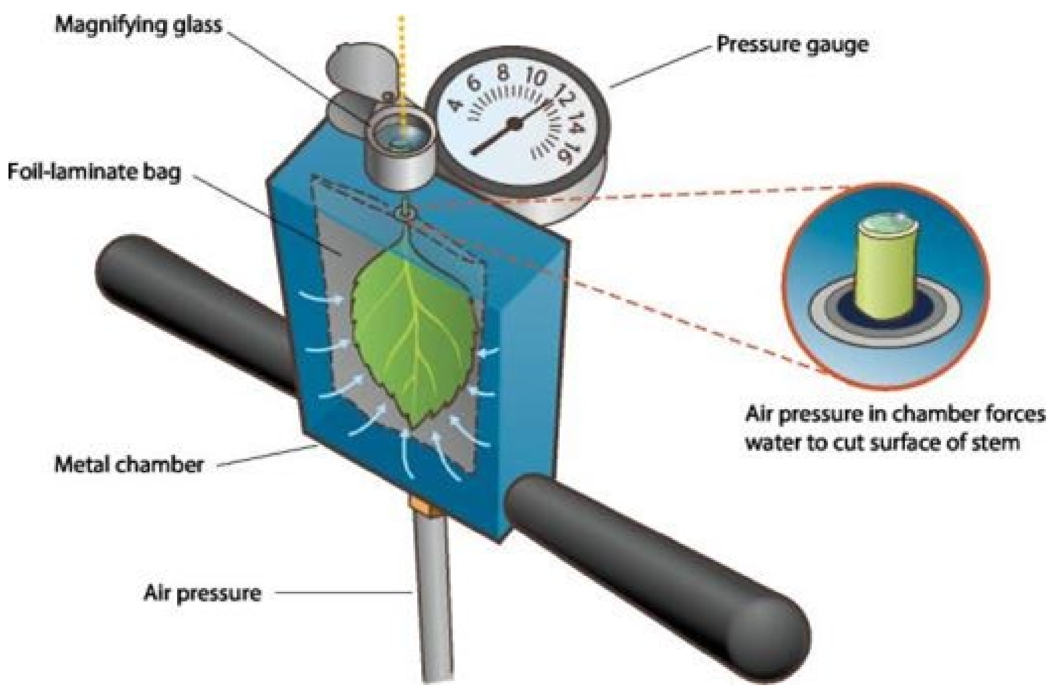
Neutron Probe

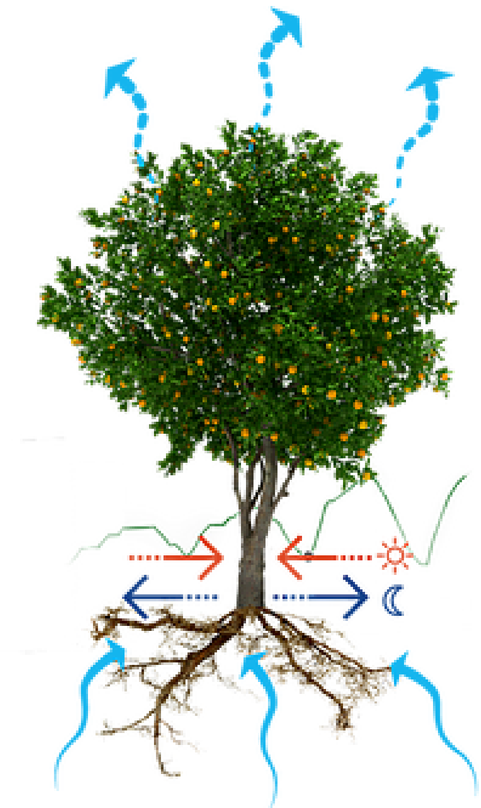
Dielectric Sensors

Measure Water Tension

Estimate Water Content

Plant Based Scheduling





Irrigation Management

Causes for non-uniform distribution

- Pressure differences causing changes in discharge rate
- Maintenance issues
- Mis-matched emitters or sprinkler nozzles

How to improve distribution uniformity

Maintenance

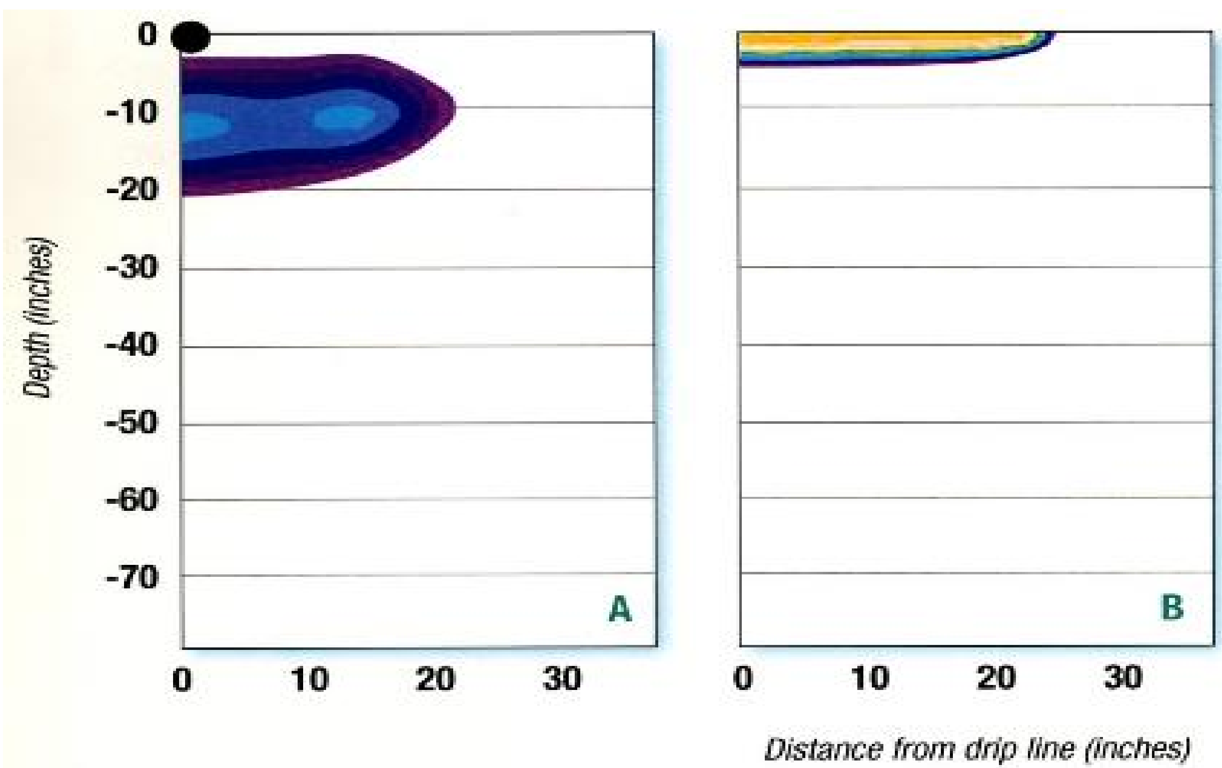
- Clean and flush filters and lines
- Monitor field for leaks and breaks
- Check emitters for clogging

Pressure

- In-line pressure regulators
- Pressure compensating (PC) drippers and microsprinklers

Fertigation

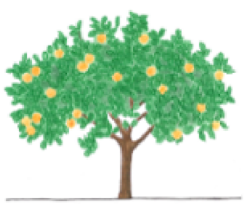
Proper timing of injection during an irrigation event is important to keep fertilizer in the root zone



Nutrient Management

Right Rate	• Match supply with crop demand
Right Time	• Apply coincident with crop demand and uptake
Right Place	• Ensure delivery to active root zone
Right Source	• Match fertilizer type to crop and environmental needs

Right Rate: N Recommended



N Recommended

$$\text{N Recommended} = \frac{\left(\text{N removed per unit of crop yield} \times \text{Estimated Yield}\right) + \text{N needed for tree maintenance}}{\text{Nitrogen Use Efficiency}}$$

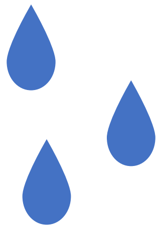
Right Rate: N Recommended

$$\text{N Recommended} = \frac{\left(\text{N removed per unit of crop yield} \times \text{Estimated Yield}\right) + \text{N needed for crop residue}}{\text{Nitrogen Use Efficiency}}$$

$$\text{N Recommended} = \frac{\left(\text{Total N uptake} \times \text{Estimated Yield}\right)}{\text{Nitrogen Use Efficiency}}$$

Right Rate: Supply

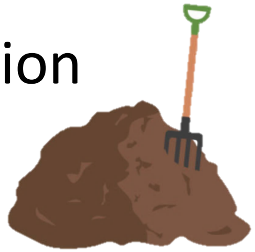
N in irrigation water



- Nitrate (ppm) x inches irrigation x 0.052
- Nitrate-N (ppm) x inches irrigation x 0.23

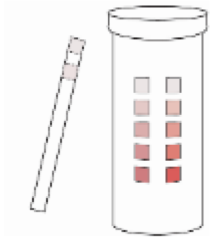
N mineralized in the soil

- N contribution = Dry lbs. OM x % N x % decomposition
- N Contribution = Dry lbs. OM × % N × 70%*



Residual N in the soil

- Determined through soil nitrate testing
- ppm NO_3-N x 4 = lbs. N /acre in top foot of soil



POLL

Self-Certification Exam

- Complete by Thursday November 19 @ 5 pm
- 30 Multiple Choice Questions
- Passing score 70%
- Retakes available through the Farm Bureau jodi@farmbureauvc.com or 805-289-0155