University of California

Nitrogen Management Training

for Certified Crop Advisers

MODULE 6

Nitrogen Management and Irrigation

Part 3- Becoming More Efficient-

Leaching and Fertigation

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UC ANR

How Do We Become More Efficient Irrigators?

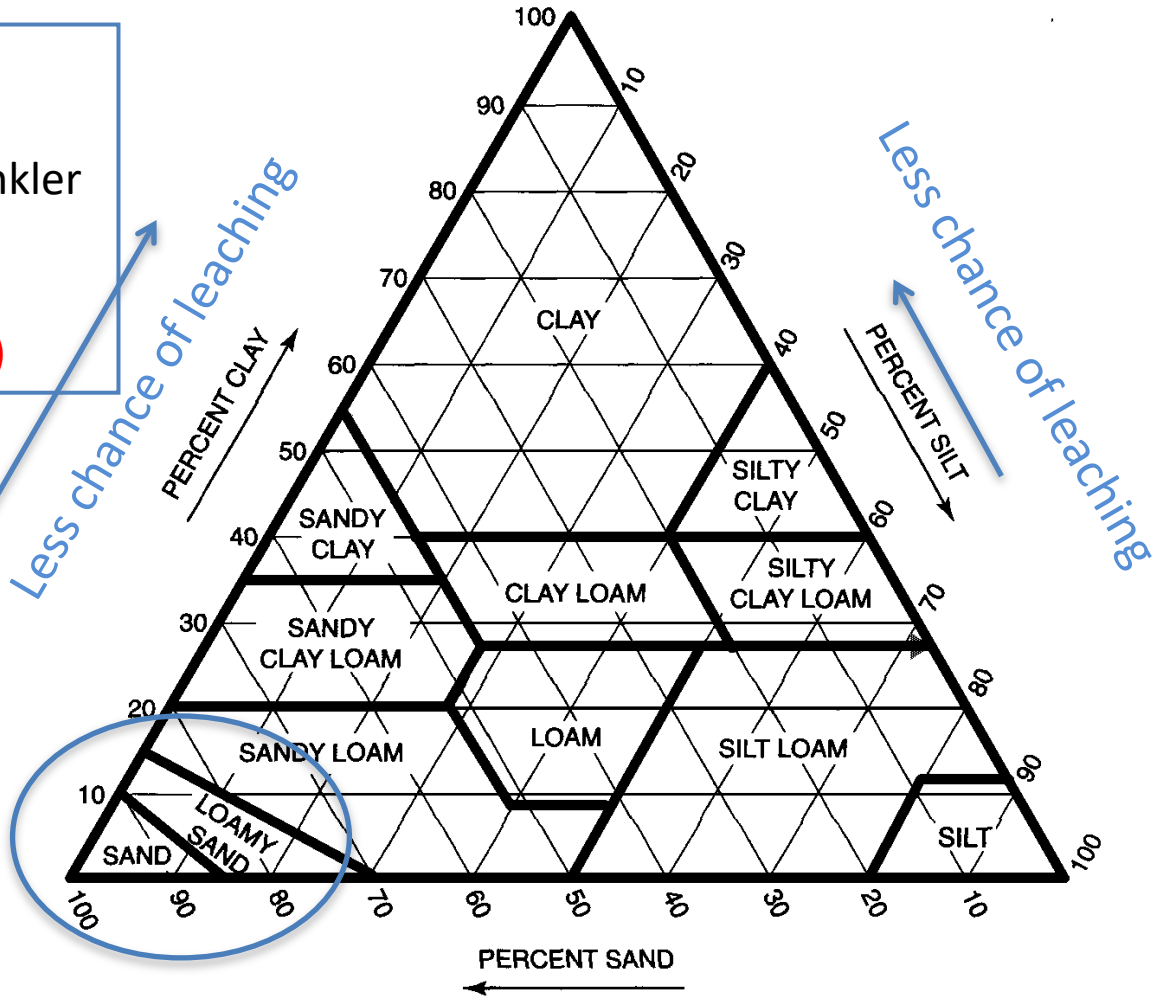
Achieving Efficient Irrigation

Where to begin:

- Use readily available information to look for situations where the choice of crop, soils, and irrigation method do not match up well.
  - Fertilizer bills (compare to crop needs, etc)
  - Electricity, fuel, and water bills (reasonable for the crop)
  - Production history (yield, quality)

Soil texture and its influence on leaching

Irrigation Systems
1. Sprinkler (low risk)
2. Drip and microsprinkler (low risk)
3. Flood (higher risk)
4. Furrow (higher risk)



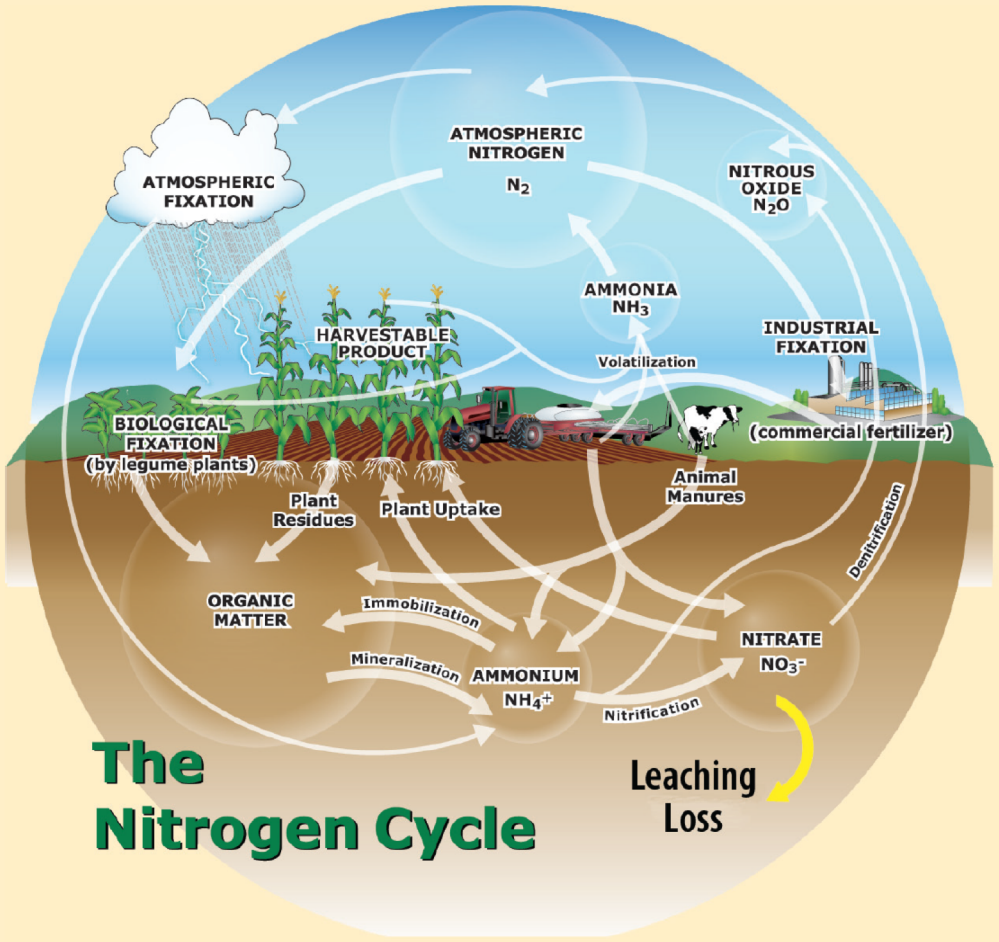
Why Does Nitrate Leach?

- Nitrate (NO_3^-) is negatively charged, so it is not held by the soil particles, also negatively charged.
- Because it is applied in excess
- Because water management is inadequate
- Because timing of application does not match crop demand

Nitrate Leaching Principles

Nitrate Leaching

Nitrate is critical for supporting plant growth, but it is vulnerable to leaching through soil. For nitrate leaching to occur, (1) nitrate must be present in the soil, (2) the soil must be permeable for water movement, and (3) water must be moving through the soil.



(IPNI, Nitrogen Notes #3)

Irrigation Rapidly Moves N into Soil

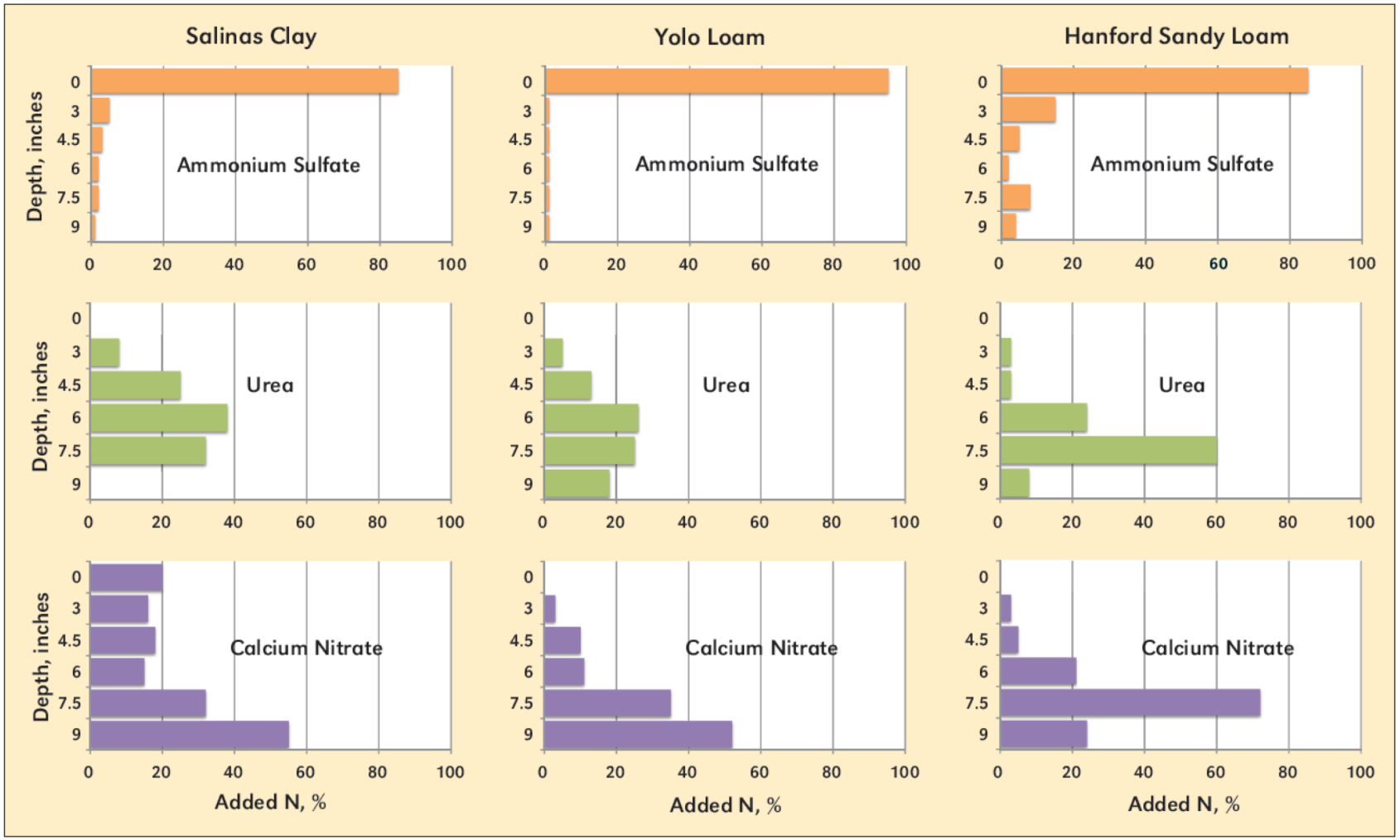
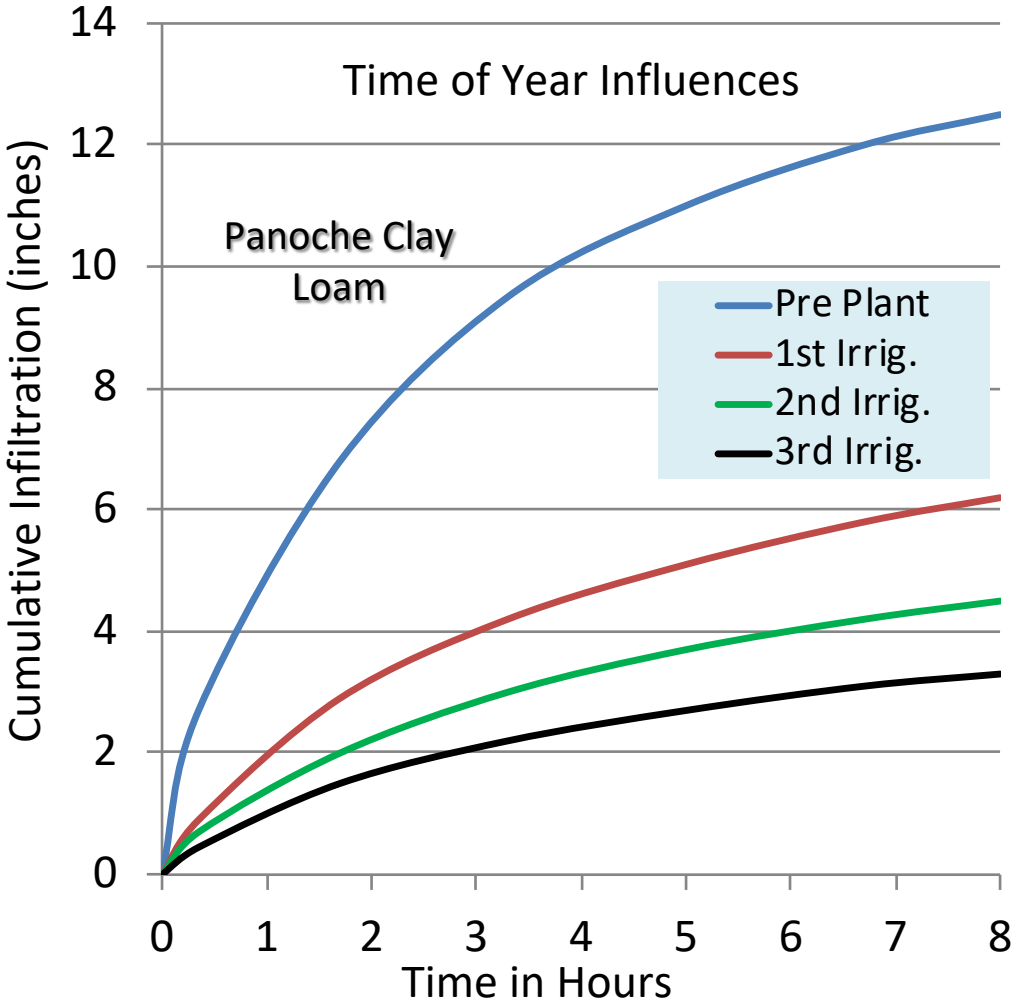


Figure 2. The movement of ammonium, urea, or nitrate in the surface 9 in. of three soils. The urea and calcium nitrate were applied to the soil surface and irrigated with a uniform amount of water. The ammonium sulfate was added as a solution. The soils were sampled 90 minutes after fertilizer and water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

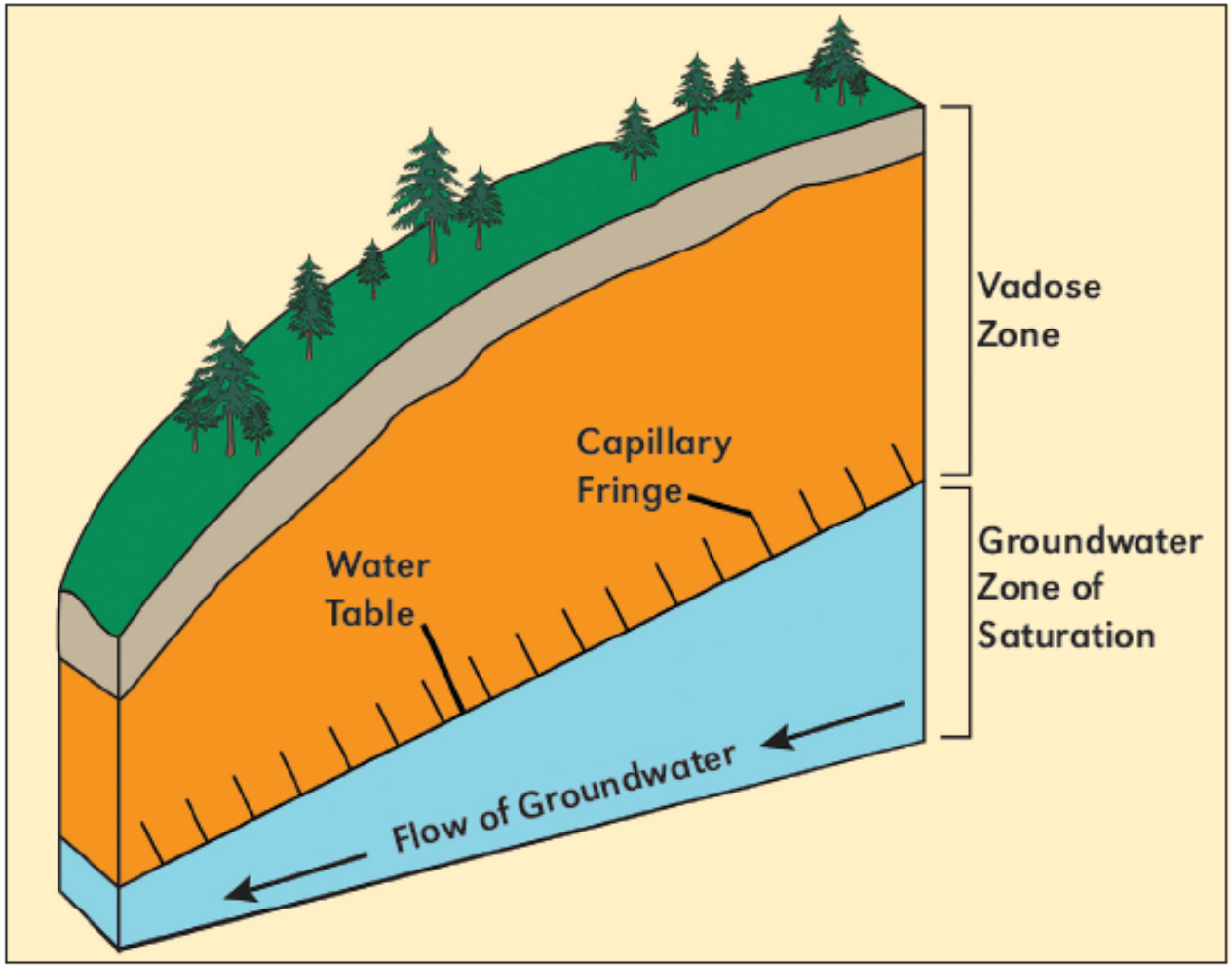
(Courtesy www.IPNI.org)

Infiltration and N Leaching

- Both “light” and “heavy” soil types can have a wide range of soil intake rates.
- Soil moisture, soil mineralogy, soil structure, and tillage are key elements.



What Happens Once Nitrate Moves Below the Rootzone?



Nitrate moves with water through the "Vadose Zone" until it reaches groundwater.

Irrigation and Salinity

Salinity

- It is a fact that leaching is necessary to sustain crop production where salinity approaches crop tolerance. This is considered a beneficial water use.
- How do we leach to manage root zone salinity without leaching nitrogen fertilizers?

Salinity: Tips for Leaching Salts and Not Nitrate

- Leaching is not necessary every irrigation or perhaps even every season but only when crop tolerances are approached.
- Periodic soil and irrigation water testing will help determine when and how much leaching is needed.
- The amount of applied water must exceed ET, and the soil water content must exceed field capacity for leaching to occur.
- Leaching is most efficient in the winter when land is fallow or crops are dormant and should not coincide with critical periods of nitrogen uptake and fertilization.

Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS)

Program Goals

1. Ensure safe drinking water (short and long-term supply)
2. Achieve balanced salt and nitrate loading
3. Implement long-term, managed restoration of impaired water bodies

Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS)

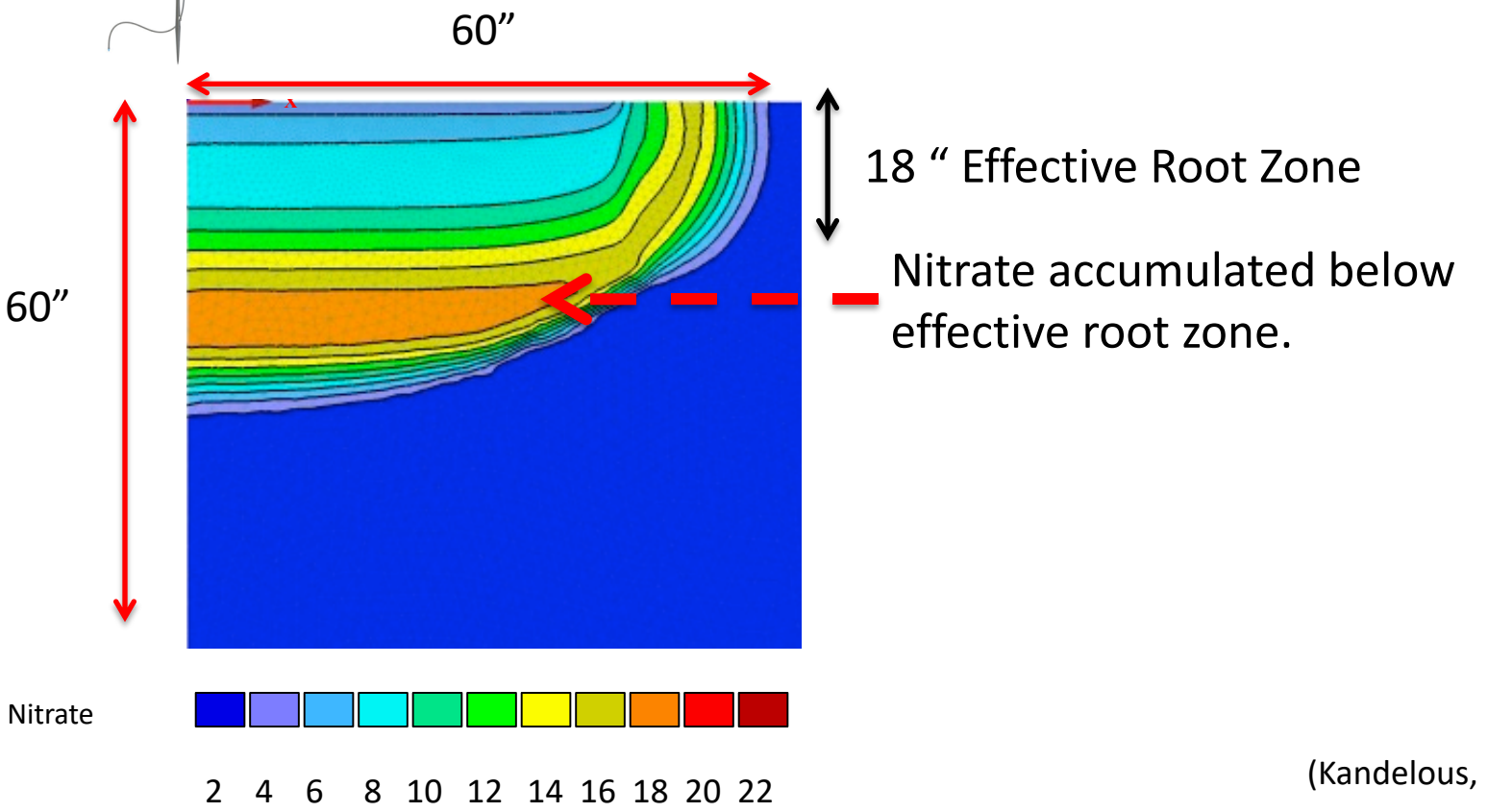
Affects on Irrigated Lands Program

- Coalitions will elect compliance pathways
  - Individual vs collaborative efforts to control discharges
- Likely formation of Management Zones
  - Multi-discharger strategy for addressing drinking water needs and achieving balanced nitrate loading/restoration
- Likely participation in a Prioritization and Optimization (P&O) Study
  - Tasked with developing long-term strategy for addressing salt loads

Fertigation

Right Place: Impact of Fertigation Timing on Nitrate Uptake

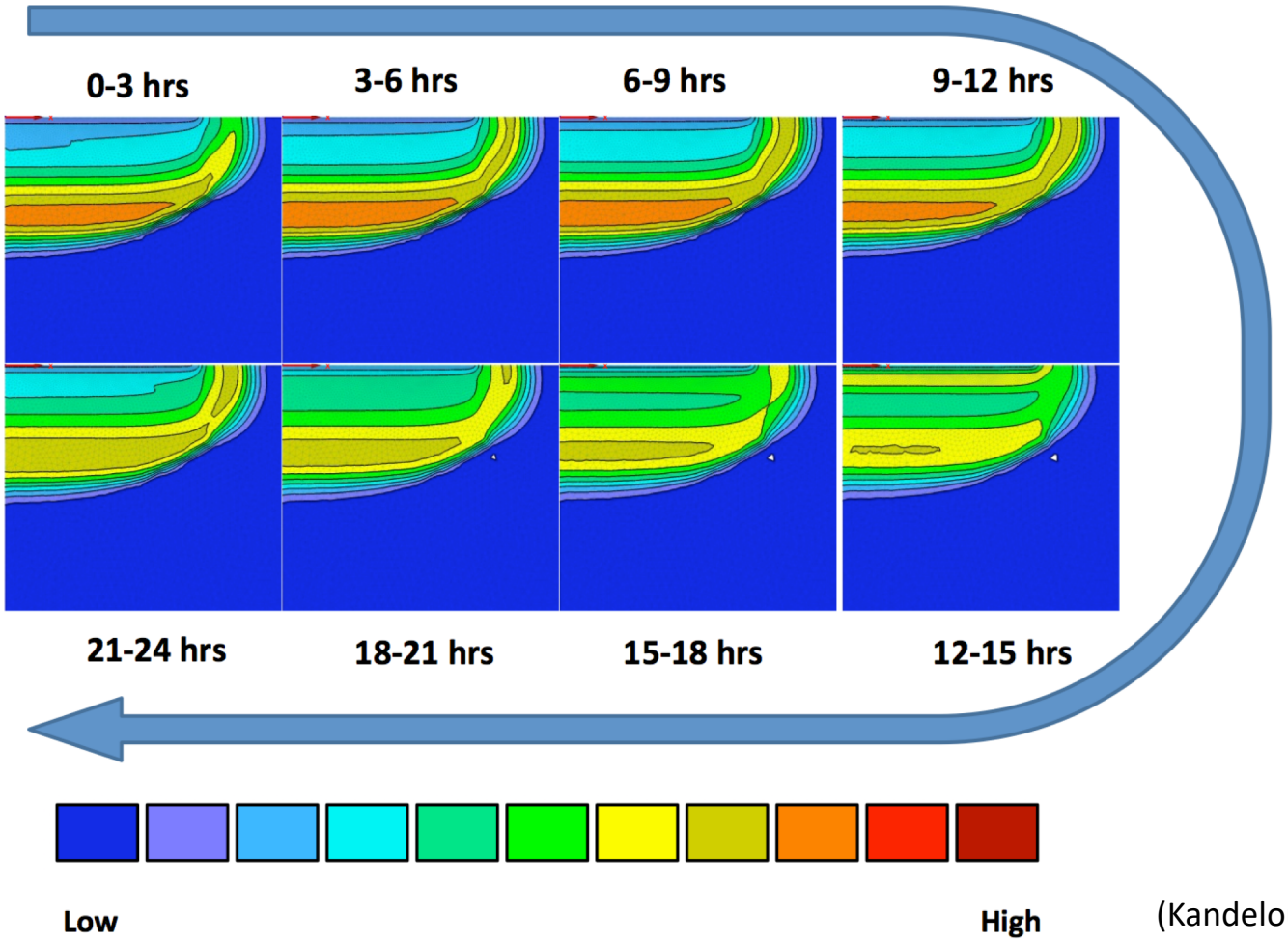
At what point during an irrigation event should nitrogen be applied?



(Kandelous, Unpublished)

Right Place: Impact of Fertigation Timing on Nitrate Uptake

Each of these 8 images represents a 3-hour fertilizer injection event (day 0) that occurred during a 24 hour 1.5” irrigation event. This was followed by two additional irrigation only events on days 7 and 14 for 4.5” total. The images show nitrate in the profile at 21 days after the fertigation, prior to the subsequent fertigation.



(Kandelous, Unpublished)

Legislative Response: Mandated N Management Planning

- Application rates will be based on field specific N budget estimates, accounting for all applied N x efficiency factor (60-80%).
- Trained Certified Crop Advisor sign-off required
- Post season verification and reporting, collated and managed by local water coalitions
- Self-reported, industry driven activity in the short term
  - However, if improvements in groundwater resources are not realized, a tightening of regulations can be expected.

Achieving optimal productivity with restricted nitrogen will REQUIRE enhanced efficiency of N use.

Irrigation and Nitrogen Management Planning

The worksheet can help improve N management

- Compiled data from an entire region can help evaluate your N management.
  - Comparison with other growers
  - Long-term trends

Important to keep in mind:

- N applied/N removed ratio is crop specific
- N removed per ton of yield can vary from one year to the next ⇨ Average of several years should be used.

Irrigation and Nitrogen Management Planning

IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET

IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET

Member ID: _____ INMP Field or MU: _____ Crop: _____ Total Acres: _____

IRRIGATION MANAGEMENT

1. Irrigation Method* (check one for Primary; if applicable, check one for Secondary)		Pre-Season Planning	
Primary	Secondary[1]		
☐	☐ Drip	2. Crop Evapotranspiration (ET, inches)	
☐	☐ Micro Sprinkler	3. Anticipated Crop Irrigation (inches)	
☐	☐ Furrow		
☐	☐ Sprinkler	4. Irrigation Water N Concentration (ppm or mg/L, as NO_3-N)	
☐	☐ Border Strip		
☐	☐ Flood		

5. Irrigation Efficiency Practices* (Check all that apply)

☐ Laser Leveling	☐ Soil Moisture Neutron Probe
☐ Use of ET in scheduling irrigations	☐ Pressure Bomb
☐ Water application schedule to need	☐ Other _____
☐ Use of moisture probe (e.g. tensiometer)	☐ Other _____

HARVEST / YIELD INFORMATION

Harvest / Yield Information			Expected (A)	Actual (B)
6. Production Unit (lbs, tons, etc.)		7. Harvested Yield*		

NITROGEN MANAGEMENT

8. Nitrogen Efficiency Practices* (Check all that apply)	Nitrogen Sources	Recommended/ Planned N (A)	Actual N (B)
☐ Split Fertilizer Applications	9. Soil – Available N in Root Zone (Annualized, lbs/ac)		
☐ Irrigation Water N Testing	10. N in Irrigation Water* (Annualized, lbs/ac)		
☐ Soil Testing	11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)		
☐ Tissue/Petiole Testing			
☐ Fertigation	12. Dry/Liquid Fertilizer N* (lbs/ac)		
☐ Foliar N Application			
☐ Cover Crops	13. Foliar Fertilizer N* (lbs/ac)		
☐ Variable Rate Applications using GPS			
☐ Other: _____	14. TOTAL NITROGEN (lbs/ac)		
☐ Other: _____			

[1] A secondary irrigation system could be used for crop germination, frost protection, crop cooling, etc.
***(Bold Text)** Data to be reported to the Coalition on the INMP Summary Report, based on Actual Yield and Actual N.

Plan Certifier Initials ☐

IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) SUMMARY REPORT

IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) SUMMARY REPORT

Refer to your Irrigation and Nitrogen Management Plan (INMP) Worksheet and Parcel Inventory for information to complete an INMP Summary. Report for each field or Management Unit.

STEP 1: GENERAL INFORMATION	STEP 2: OUTLIER NOTIFICATION RECEIPT	STEP 3: INMP CERTIFICATION METHOD
Member ID: _____ Forms Completed By: _____ Crop Year (Harvested): _____ Submittal Date: _____	On (Date) _____, the Coalition provided information about this membership's nitrogen efficiency for the previous crop year and identified management units that were considered outliers compared to other Coalition members growing the same crop. Please check the box below if you were identified as an outlier by the Coalition. ☐	☐ Certified INMP Specialist (e.g. certified crop adviser who has completed the CDFA training program) ☐ Self-Certified (CDFA training program) ☐ Self-Certified (follows NRCS or UC Cooperative Extension site-specific recommendations) ☐ Self-Certified (No fertilizers applied)

STEP 4: INMP SUMMARY REPORT

Complete the table below for each field or management unit for this membership. ***All values should be on a per acre basis.***

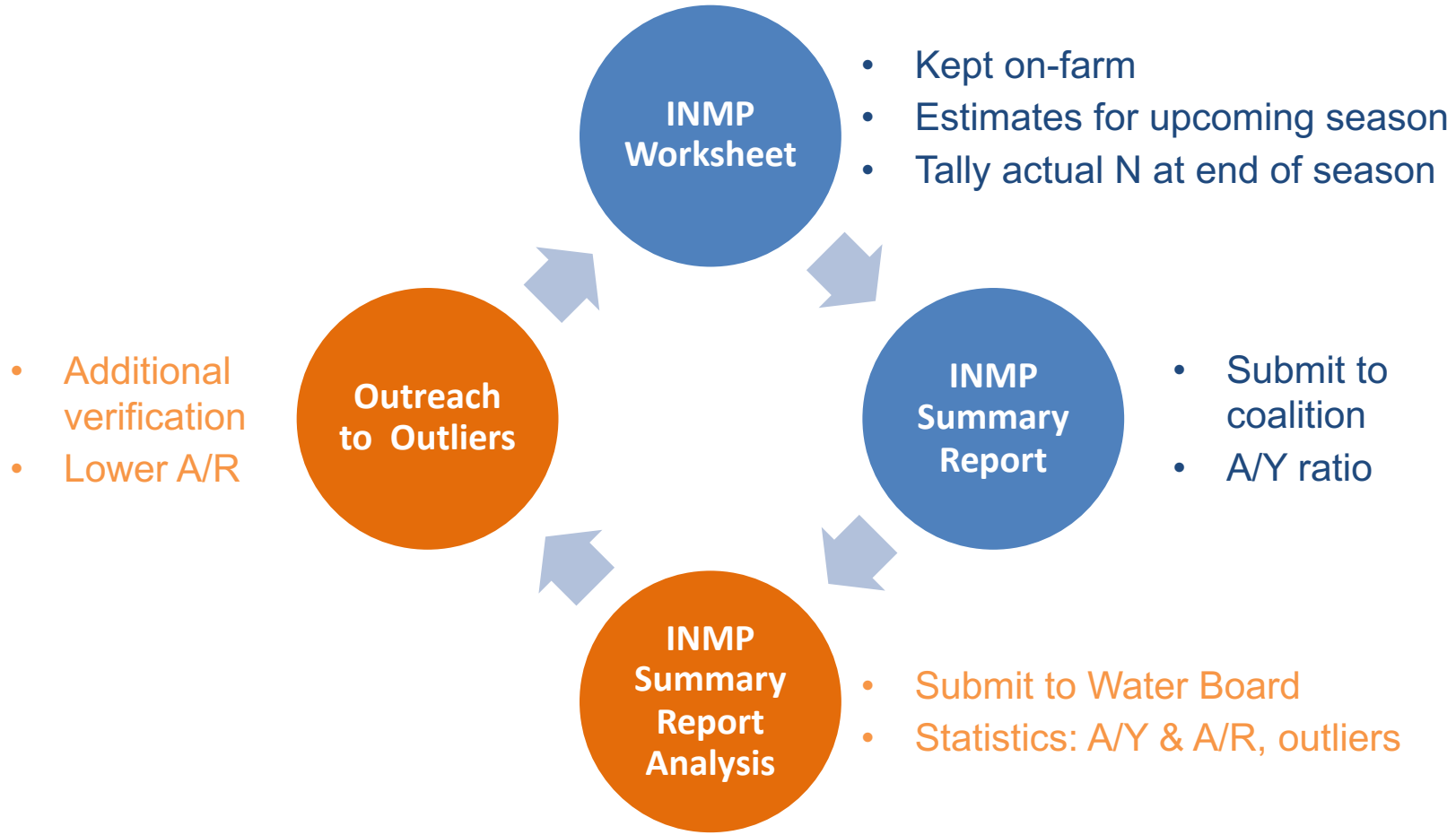
Field or Management Unit	Crop	Crop Age	Total Irrigated Acres	Total N Applied Lbs/acre				Yield	Prod. Unit	Yield Info*
Refer to Parcel Inventory		Perennial only (years)	(acres)	N in Irrigation Water (lbs/acre)	Organic Amendments (lbs/acre)	Dry/Liquid Fertilizers (lbs/acre)	Foliar Fertilizers (lbs/acre)	Harvested Yield (lbs/acre or tons/acre)	(lbs or tons)	

***Use this column to provide information about yield i.e. nonbearing; crop not harvested; type of harvest (e.g. silage, grain). If you harvest straw, please contact your Coalition.**

Irrigation and Nitrogen Management Plan Template

- Required of all Members
- Must be kept on-farm
- Summary submitted at end of season
- Some plans must be certified
  - High Vulnerability Areas
  - Outliers
- Can be certified by a qualified individual (e.g., INMP Specialist) or self-certified by growers who attend approved training

Irrigation and Nitrogen Management Plan Annual Process



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	☐	☐	Border Strip		
	☐	☐	Flood		

5. Irrigation Efficiency Practices* (Check all that apply)

- ☐ Laser Leveling
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- ☐ Use of moisture probe (e.g. tensiometer)
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- ☐ Other _____
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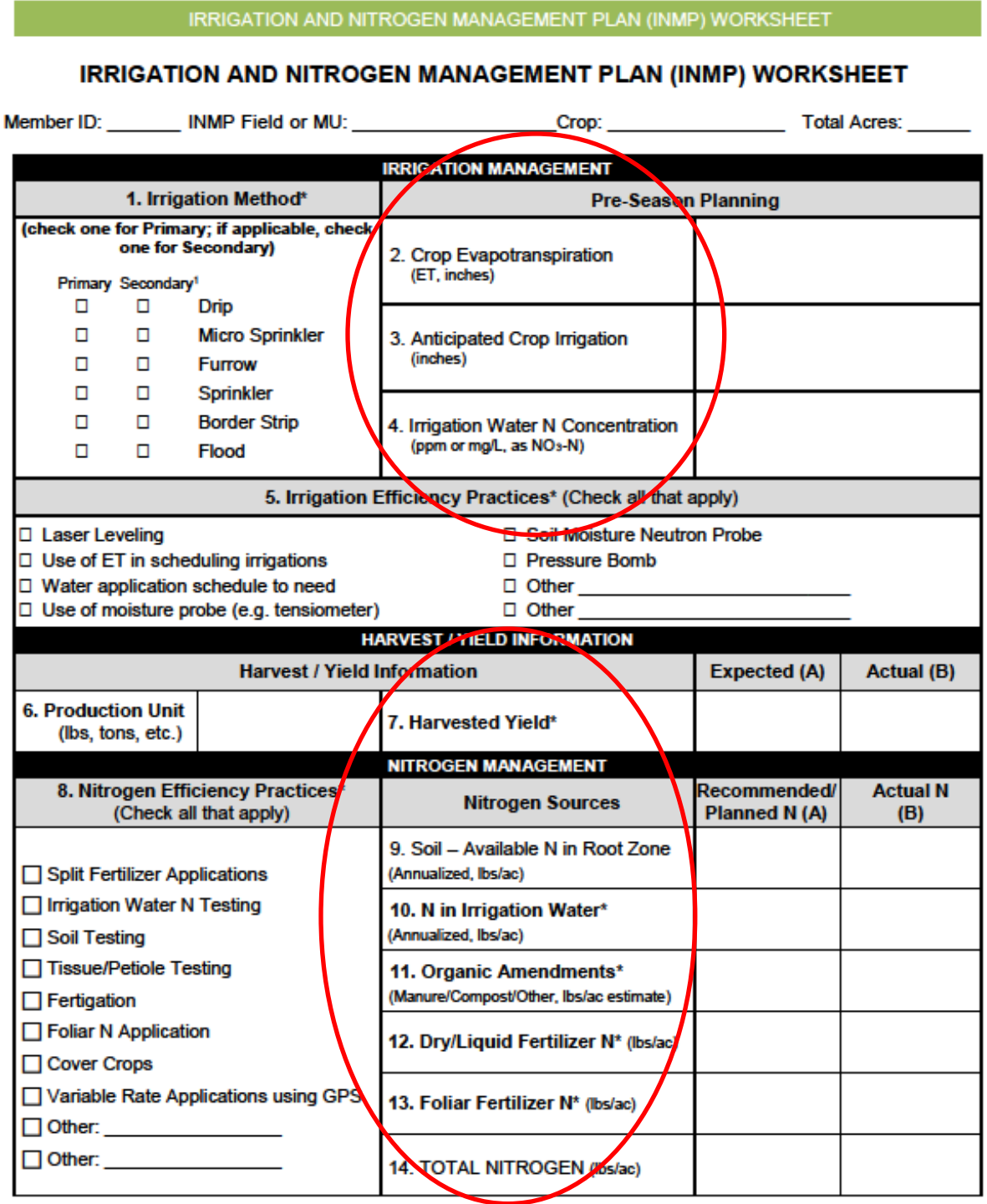

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INMP Summary Report

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Irrigation Management

UC Cooperative Extension Irrigation Management

http://ucanr.edu/sites/irrmgm/

Go here for:

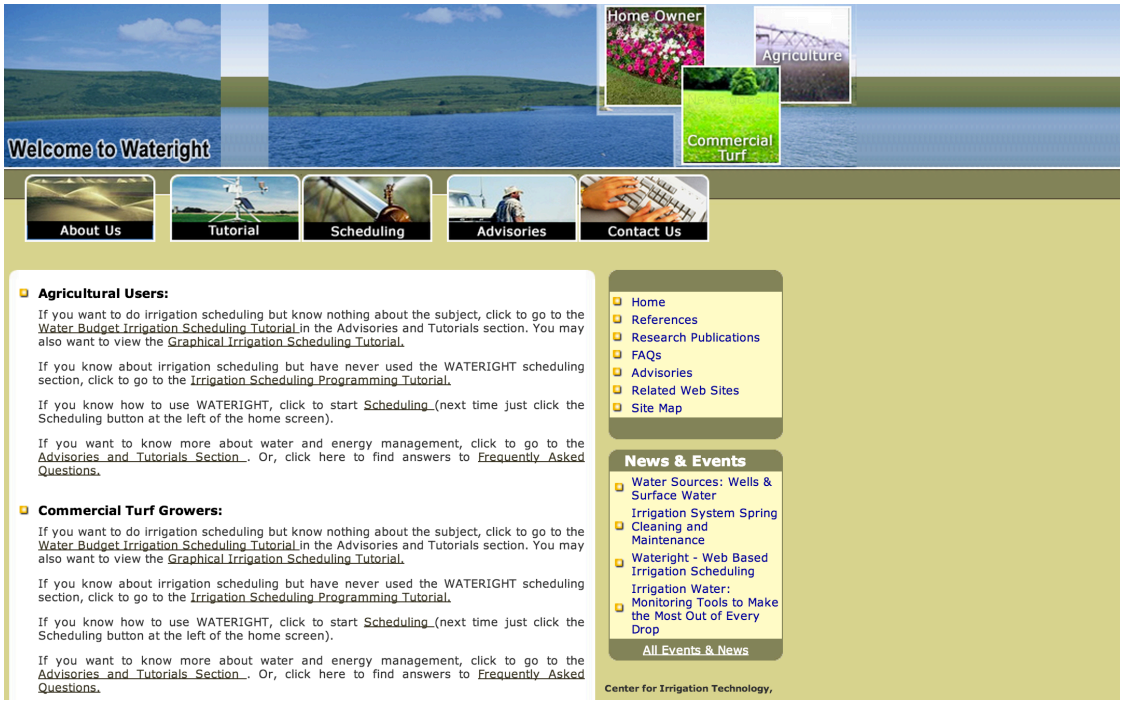
- Introduction to irrigation management

WATERIGHT

http://www.wateright.net/

Go here for:

- How to get started with irrigation scheduling
- Irrigation scheduling planning tools
- Water and energy management



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Course materials available at:

ciwr.ucanr.edu/NitrogenManagement

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California Department of Food & Agriculture (CDFA)
Fertilizer Research and Education Program
web: www.cdfa.ca.gov
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California Association of Pest Control Advisers (CAPCA)
web: capca.com

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