

# Nitrogen and Water Budgeting for Fun and Profit 2.0

WENDY RASH

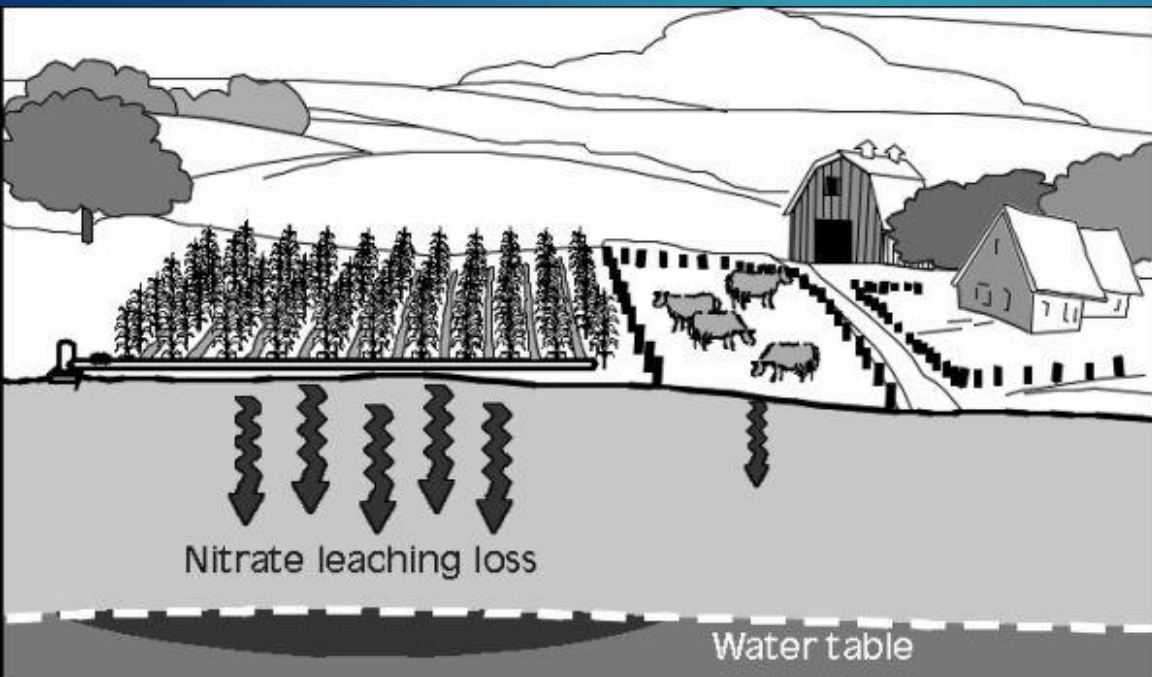
DISTRICT CONSERVATIONIST

USDA-NRCS



# Why is N fertilizer an issue?

- ▶ Agriculture uses a lot of N fertilizer
- ▶ Nitrate moves through soil in water
- ▶ Agricultural nitrates end up in drinking water wells
- ▶ Nitrate in drinking water causes “blue baby syndrome”



# Why does nitrate ( $\text{NO}_3$ ) leach?

- ▶  $\text{NO}_3$  is a negatively-charged ion (or “anion”)
  - ▶ Does not “stick” to soil (also negatively charged)
  - ▶ Goes anywhere water goes
- ▶  $\text{NO}_3$  is applied in excess of crop needs
- ▶ Excess irrigation water moves  $\text{NO}_3$  past the root zone into water table
- ▶ Timing of application does not match crop demand

# What can you do to prevent nitrate leaching?

Goal: Don't let nitrate leave the root zone

- ▶ Create a budget for nitrogen
  - ▶ Right material
  - ▶ Right amount
  - ▶ Right time
  - ▶ Right place
- ▶ Manage water better



# Unintended Consequences

- ▶ Not enough N = Crop stress, Profit loss
- ▶ Too much N + Loss = Environmental impact to drinking water and aquatic life in our waterways



# NMP-Nitrogen Management Plan worksheet (The “old one”)

Used through  
crop year 2019

## NITROGEN MANAGEMENT PLAN WORKSHEET

NMP Management Unit: \_\_\_\_\_

1. Crop Year (Harvested):		4. APN(s):	5. Field(s) ID	Acres
2. Member 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/Acre)		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/Acre)		22. Total Available N Applied (lbs per acre)		
12. Total N Applied (lbs/ac)		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)		
		26. Total N Credits (lbs per acre)		
		27. Total N Applied & Available		
		PLAN CERTIFICATION		
28. CERTIFIED BY:		29. CERTIFICATION METHOD		
		30. Low Vulnerability Area, No Certification Needed		
		31. Self-Certified, approved training program attended		
DATE:		32. Self-Certified, UC or NRCS site recommendation		
		33. Nitrogen Management Plan Specialist		

\*\*Your Coalition will provide the method to be used to estimate N Removed.  
Approved by the Central Valley Water Board 23 December 2014.

Instruction numbering in this document differs slightly from the NMP template approved by the Water Board to accommodate this publication design.

# INMP- Irrigation and Nitrogen Management Plan worksheet (The “new one”)

Start using crop year 2020

Irrigated Lands Program Requirement

## 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 <sup>1</sup>	2. Crop Evapotranspiration (ET, inches)		
<input type="checkbox"/>	<input type="checkbox"/>	3. Anticipated Crop Irrigation (inches)		
<input type="checkbox"/>	<input type="checkbox"/>	4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)		
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
5. Irrigation Efficiency Practices* (Check all that apply)				
<input type="checkbox"/> Laser Leveling		<input type="checkbox"/> Soil Moisture Neutron Probe		
<input type="checkbox"/> Use of ET in scheduling irrigations		<input type="checkbox"/> Pressure Bomb		
<input type="checkbox"/> Water application schedule to need		<input type="checkbox"/> Other _____		
<input type="checkbox"/> Use of moisture probe (e.g. tensiometer)		<input type="checkbox"/> 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)
<input type="checkbox"/> Split Fertilizer Applications		9. Soil – Available N in Root Zone (Annualized, lbs/ac)		
<input type="checkbox"/> Irrigation Water N Testing		10. N in Irrigation Water* (Annualized, lbs/ac)		
<input type="checkbox"/> Soil Testing		11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)		
<input type="checkbox"/> Tissue/Petiole Testing		12. Dry/Liquid Fertilizer N* (lbs/ac)		
<input type="checkbox"/> Fertigation		13. Foliar Fertilizer N* (lbs/ac)		
<input type="checkbox"/> Foliar N Application		14. TOTAL NITROGEN (lbs/ac)		
<input type="checkbox"/> Cover Crops				
<input type="checkbox"/> Variable Rate Applications using GPS				
<input type="checkbox"/> Other: _____				
<input type="checkbox"/> Other: _____				

<sup>1</sup> 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.

# The 4 W's of the INMP Worksheet

► What? INMP is a planning tool

IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET				
IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET				
Member ID: _____		INMP Field or MU: _____		Crop: _____ Total Acres: _____
<b>IRRIGATION MANAGEMENT</b>				
<b>1. Irrigation Method*</b>		<b>Pre-Season Planning</b>		
(check one for Primary; if applicable, check one for Secondary)		2. Crop Evapotranspiration (ET, inches)		
Primary	Secondary <sup>1</sup>	3. Anticipated Crop Irrigation (inches)		
<input type="checkbox"/>	<input type="checkbox"/> Drip	4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)		
<input type="checkbox"/>	<input type="checkbox"/> Micro Sprinkler			
<input type="checkbox"/>	<input type="checkbox"/> Furrow			
<input type="checkbox"/>	<input type="checkbox"/> Sprinkler			
<input type="checkbox"/>	<input type="checkbox"/> Border Strip			
<input type="checkbox"/>	<input type="checkbox"/> Flood			
<b>5. Irrigation Efficiency Practices* (Check all that apply)</b>				
<input type="checkbox"/> Laser Leveling		<input type="checkbox"/> Soil Moisture Neutron Probe		
<input type="checkbox"/> Use of ET in scheduling irrigations		<input type="checkbox"/> Pressure Bomb		
<input type="checkbox"/> Water application schedule to need		<input type="checkbox"/> Other _____		
<input type="checkbox"/> Use of moisture probe (e.g. tensiometer)		<input type="checkbox"/> Other _____		
<b>HARVEST / YIELD INFORMATION</b>				
<b>Harvest / Yield Information</b>		<b>Expected (A)</b>	<b>Actual (B)</b>	
6. Production Unit (lbs, tons, etc.)		7. Harvested Yield*		
<b>NITROGEN MANAGEMENT</b>				
<b>8. Nitrogen Efficiency Practices* (Check all that apply)</b>		<b>Nitrogen Sources</b>	<b>Recommended/Planned N (A)</b>	<b>Actual N (B)</b>
<input type="checkbox"/> Split Fertilizer Applications		9. Soil – Available N in Root Zone (Annualized, lbs/ac)		
<input type="checkbox"/> Irrigation Water N Testing		10. N in Irrigation Water* (Annualized, lbs/ac)		
<input type="checkbox"/> Soil Testing		11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)		
<input type="checkbox"/> Tissue/Petiole Testing		12. Dry/Liquid Fertilizer N* (lbs/ac)		
<input type="checkbox"/> Fertigation		13. Foliar Fertilizer N* (lbs/ac)		
<input type="checkbox"/> Foliar N Application		14. TOTAL NITROGEN (lbs/ac)		
<input type="checkbox"/> Cover Crops				
<input type="checkbox"/> Variable Rate Applications using GPS				
<input type="checkbox"/> Other: _____				
<input type="checkbox"/> Other: _____				

<sup>1</sup> 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



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- Provide N for crop

- Prevent loss of excess N

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 <sup>a</sup>		Pre-Season Planning		
(check one for Primary; if applicable, check one for Secondary)		2. Crop Evapotranspiration (ET, inches)		
Primary	Secondary <sup>1</sup>	3. Anticipated Crop Irrigation (inches)		
<input type="checkbox"/>	<input type="checkbox"/>	4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)		
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>			
5. Irrigation Efficiency Practices <sup>a</sup> (Check all that apply)				
<input type="checkbox"/>	Laser Leveling		<input type="checkbox"/>	Soil Moisture Neutron Probe
<input type="checkbox"/>	Use of ET in scheduling irrigations		<input type="checkbox"/>	Pressure Bomb
<input type="checkbox"/>	Water application schedule to need		<input type="checkbox"/>	Other _____
<input type="checkbox"/>	Use of moisture probe (e.g. tensiometer)		<input type="checkbox"/>	Other _____
HARVEST / YIELD INFORMATION				
Harvest / Yield Information		Expected (A)	Actual (B)	
6. Production Unit (lbs, tons, etc.)		7. Harvested Yield <sup>a</sup>		
NITROGEN MANAGEMENT				
8. Nitrogen Efficiency Practices <sup>a</sup> (Check all that apply)		Nitrogen Sources	Recommended/Planned N (A)	Actual N (B)
<input type="checkbox"/>	Split Fertilizer Applications	9. Soil – Available N in Root Zone (Annualized, lbs/ac)		
<input type="checkbox"/>	Irrigation Water N Testing	10. N in Irrigation Water <sup>a</sup> (Annualized, lbs/ac)		
<input type="checkbox"/>	Soil Testing	11. Organic Amendments <sup>a</sup> (Manure/Compost/Other, lbs/ac estimate)		
<input type="checkbox"/>	Tissue/Petiole Testing	12. Dry/Liquid Fertilizer N <sup>a</sup> (lbs/ac)		
<input type="checkbox"/>	Fertigation	13. Foliar Fertilizer N <sup>a</sup> (lbs/ac)		
<input type="checkbox"/>	Foliar N Application	14. TOTAL NITROGEN (lbs/ac)		
<input type="checkbox"/>	Cover Crops			
<input type="checkbox"/>	Variable Rate Applications using GPS			
<input type="checkbox"/>	Other: _____			
<input type="checkbox"/>	Other: _____			

<sup>1</sup> A secondary irrigation system could be used for crop germination, frost protection, crop cooling, etc.

<sup>a</sup>(Bold Text) Data to be reported to the Coalition on the INMP Summary Report, based on Actual Yield and Actual N.

Plan Certifier Initials

# The 4 W's of the INMP Worksheet

- When?
- **Planned** portion in the **Spring**, before or at planting
- **Actuals** after harvest in the **Fall/Winter**

IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET			
IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET			
Member ID: _____		INMP Field or MU: _____	
Crop: _____		Total Acres: _____	
<b>IRRIGATION MANAGEMENT</b>			
<b>1. Irrigation Method*</b> (check one for Primary; if applicable, check one for Secondary)  Primary Secondary <sup>1</sup> <input type="checkbox"/> <input type="checkbox"/> Drip <input type="checkbox"/> <input type="checkbox"/> Micro Sprinkler <input type="checkbox"/> <input type="checkbox"/> Furrow <input type="checkbox"/> <input type="checkbox"/> Sprinkler <input type="checkbox"/> <input type="checkbox"/> Border Strip <input type="checkbox"/> <input type="checkbox"/> Flood		<b>Pre-Season Planning</b>	
		2. Crop Evapotranspiration (ET, inches)	
		3. Anticipated Crop Irrigation (inches)	
		4. Irrigation Water N Concentration (ppm or mg/L as NO <sub>3</sub> -N)	
<b>5. Irrigation Efficiency Practices* (Check all that apply)</b>			
<input type="checkbox"/> Laser Leveling <input type="checkbox"/> Soil Moisture Neutron Probe <input type="checkbox"/> Use of ET in scheduling irrigations <input type="checkbox"/> Pressure Bomb <input type="checkbox"/> Water application schedule to need <input type="checkbox"/> Other _____ <input type="checkbox"/> Use of moisture probe (e.g. tensiometer) <input type="checkbox"/> Other _____			
<b>HARVEST / YIELD INFORMATION</b>			
<b>Harvest / Yield Information</b>		<b>Expected (A)</b>	<b>Actual (B)</b>
6. Production Unit (lbs, tons, etc.)			
7. Harvested Yield*			
<b>NITROGEN MANAGEMENT</b>			
<b>8. Nitrogen Efficiency Practices* (Check all that apply)</b>		<b>Recommended Planned N (A)</b>	<b>Actual N (B)</b>
<input type="checkbox"/> Split Fertilizer Applications		9. Soil – Available N in Root Zone (Annualized, lbs/ac)	
<input type="checkbox"/> Irrigation Water N Testing		10. N in Irrigation Water* (Annualized, lbs/ac)	
<input type="checkbox"/> Soil Testing		11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)	
<input type="checkbox"/> Tissue/Petiole Testing		12. Dry/Liquid Fertilizer N* (lbs/ac)	
<input type="checkbox"/> Fertigation		13. Foliar Fertilizer N* (lbs/ac)	
<input type="checkbox"/> Foliar N Application		14. TOTAL NITROGEN (lbs/ac)	
<input type="checkbox"/> Cover Crops			
<input type="checkbox"/> Variable Rate Applications using GPS			
<input type="checkbox"/> Other: _____			
<input type="checkbox"/> Other: _____			

\* 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

# The 4 W's of the INMP Worksheet

► Where? INMP worksheet stays on the farm

► Does not get returned to the Coalition

► Next steps...

IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET				
IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET				
Member ID: _____		INMP Field or MU: _____		Crop: _____ Total Acres: _____
<b>IRRIGATION MANAGEMENT</b>				
<b>1. Irrigation Method*</b> (check one for Primary; if applicable, check one for Secondary)		<b>Pre-Season Planning</b>		
Primary	Secondary <sup>1</sup>	2. Crop Evapotranspiration (ET, inches)		
<input type="checkbox"/>	<input type="checkbox"/> Drip	3. Anticipated Crop Irrigation (inches)		
<input type="checkbox"/>	<input type="checkbox"/> Micro Sprinkler	4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)		
<input type="checkbox"/>	<input type="checkbox"/> Furrow			
<input type="checkbox"/>	<input type="checkbox"/> Sprinkler			
<input type="checkbox"/>	<input type="checkbox"/> Border Strip			
<input type="checkbox"/>	<input type="checkbox"/> Flood			
<b>5. Irrigation Efficiency Practices* (Check all that apply)</b>				
<input type="checkbox"/> Laser Leveling		<input type="checkbox"/> Soil Moisture Neutron Probe		
<input type="checkbox"/> Use of ET in scheduling irrigations		<input type="checkbox"/> Pressure Bomb		
<input type="checkbox"/> Water application schedule to need		<input type="checkbox"/> Other _____		
<input type="checkbox"/> Use of moisture probe (e.g. tensiometer)		<input type="checkbox"/> Other _____		
<b>HARVEST / YIELD INFORMATION</b>				
<b>Harvest / Yield Information</b>		<b>Expected (A)</b>	<b>Actual (B)</b>	
6. Production Unit (lbs, tons, etc.)		7. Harvested Yield*		
<b>NITROGEN MANAGEMENT</b>				
<b>8. Nitrogen Efficiency Practices* (Check all that apply)</b>		<b>Nitrogen Sources</b>	<b>Recommended/Planned N (A)</b>	<b>Actual N (B)</b>
<input type="checkbox"/> Split Fertilizer Applications		9. Soil – Available N in Root Zone (Annualized, lbs/ac)		
<input type="checkbox"/> Irrigation Water N Testing		10. N in Irrigation Water* (Annualized, lbs/ac)		
<input type="checkbox"/> Soil Testing		11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)		
<input type="checkbox"/> Tissue/Petiole Testing		12. Dry/Liquid Fertilizer N* (lbs/ac)		
<input type="checkbox"/> Fertigation		13. Foliar Fertilizer N* (lbs/ac)		
<input type="checkbox"/> Foliar N Application		14. TOTAL NITROGEN (lbs/ac)		
<input type="checkbox"/> Cover Crops				
<input type="checkbox"/> Variable Rate Applications using GPS				
<input type="checkbox"/> Other: _____				
<input type="checkbox"/> Other: _____				

<sup>1</sup> 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

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- [illegible]

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*		Pre-Season Planning	
(check one for Primary; if applicable, check one for Secondary)		2. Crop Evapotranspiration (ET, inches)	
Primary	Secondary <sup>1</sup>	3. Anticipated Crop Irrigation (inches)	
<input type="checkbox"/>	<input type="checkbox"/>	4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)	
<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>		
5. Irrigation Efficiency Practices* (Check all that apply)			
<input type="checkbox"/>	Laser Leveling	<input type="checkbox"/>	Soil Moisture Neutron Probe
<input type="checkbox"/>	Use of ET in scheduling irrigations	<input type="checkbox"/>	Pressure Bomb
<input type="checkbox"/>	Water application schedule to need	<input type="checkbox"/>	Other _____
<input type="checkbox"/>	Use of moisture probe (e.g. tensiometer)	<input type="checkbox"/>	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)
<input type="checkbox"/>	Split Fertilizer Applications	9. Soil – Available N in Root Zone (Annualized, lbs/ac)	
<input type="checkbox"/>	Irrigation Water N Testing	10. N in Irrigation Water* (Annualized, lbs/ac)	
<input type="checkbox"/>	Soil Testing	11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)	
<input type="checkbox"/>	Tissue/Petiole Testing	12. Dry/Liquid Fertilizer N <sup>a</sup> (lbs/ac)	
<input type="checkbox"/>	Fertigation	13. Foliar Fertilizer N <sup>a</sup> (lbs/ac)	
<input type="checkbox"/>	Foliar N Application	14. TOTAL NITROGEN (lbs/ac)	
<input type="checkbox"/>	Cover Crops		
<input type="checkbox"/>	Variable Rate Applications using GPS		
<input type="checkbox"/>	Other: _____		
<input type="checkbox"/>	Other: _____		

<sup>1</sup> 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
- 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.

<b>STEP 1: GENERAL INFORMATION</b>	<b>STEP 2: OUTLIER NOTIFICATION RECEIPT</b>	<b>STEP 3: INMP CERTIFICATION METHOD</b>
Member ID: <div></div>	On (Date) <div></div> , 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. <div></div>	<div><input type="checkbox"/> Certified INMP Specialist (e.g. certified crop adviser who has completed the CDFA training program)</div> <div><input type="checkbox"/> Self-Certified (CDFA training program)</div> <div><input type="checkbox"/> Self-Certified (follows NRCS or UC Cooperative Extension site-specific recommendations)</div> <div><input type="checkbox"/> Self-Certified (No fertilizers applied)</div>

\*The paper copy is ONLY used at Coalitions without an online database.



# Making your Plan: Harvest/Yield

- ▶ #6 Production Unit
- ▶ #7 Harvested Yield
  - ▶ Expected (A) **Fill in with Plan in Spring**
  - ▶ Actual (B) **Fill in with Actuals in Fall/Winter**



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

# Planning for Nitrogen-4-R Stewardship

- ▶ Right Rate  
(How Much)
- ▶ Right Source  
(What material)
- ▶ Right Place
- ▶ Right Time
- ▶ Other practices to  
reduce runoff/leaching  
losses

## 8. Nitrogen Efficiency Practices\*

(Check all that apply)

- ☐ Split Fertilizer Applications
- ☐ Irrigation Water N Testing
- ☐ Soil Testing
- ☐ Tissue/Petiole Testing
- ☐ Fertigation
- ☐ Foliar N Application
- ☐ Cover Crops
- ☐ Variable Rate Applications using GPS
- ☐ Other: \_\_\_\_\_
- ☐ Other: \_\_\_\_\_

# Making your Plan- Building the Budget

- ▶ Column A on worksheet
- ▶ Determine **crop N needs**
- ▶ Measure **N credits**
- ▶ The difference is the **amount of N to apply**

NITROGEN MANAGEMENT	
Nitrogen Sources	Recommended/ Planned N (A)
9. Soil – Available N in Root Zone (Annualized, lbs/ac)	
10. N in Irrigation Water* (Annualized, lbs/ac)	
11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)	
12. Dry/Liquid Fertilizer N* (lbs/ac)	
13. Foliar Fertilizer N* (lbs/ac)	
14. TOTAL NITROGEN (lbs/ac)	

# N requirement of crop

- ▶ Item #14 on worksheet- “TOTAL NITROGEN”  
Recommended/Planned N
- ▶ Includes all the N required to make the crop
  - ▶ Products *and* by-products/residues

NITROGEN MANAGEMENT	
Nitrogen Sources	Recommended/ Planned N (A)
9. Soil – Available N in Root Zone (Annualized, lbs/ac)	
10. N in Irrigation Water* (Annualized, lbs/ac)	
11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)	
12. Dry/Liquid Fertilizer N* (lbs/ac)	
13. Foliar Fertilizer N* (lbs/ac)	
14. TOTAL NITROGEN (lbs/ac)	

# N requirement: Information Sources


- ▶ CDFA Fertilization Guidelines
  - ▶ <https://www.cdfa.ca.gov/is/ffldrs/frep/FertilizationGuidelines/>
  - ▶ These are also offered as paper brochures
- ▶ UC ANR Research and Information Centers
  - ▶ Nutrient Management



# CDFA website

[CDFA Home](#) | [ISD](#) | [FFLDRS](#) | [FREP](#) | [California Fertilization Guidelines](#)

## California Fertilization Guidelines

**i** The fertilization guidelines on this site have been redesigned to be compliant with AB434. The guidelines in the traditional design with the latest updates can be found on the [UC Davis Nutrient Management website](#) .

These guidelines have been written by scientists from the [University of California, Davis](#) with support from [CDFA-FREP](#). The guidelines are based on research results from studies carried out in California and elsewhere. For an optimal fertilization program, site-specific information needs to be taken into account. [Discussion about site-specific adjustments can be found here.](#)

### Field crops and vegetables

Alfalfa



Barley



Dry Beans



Broccoli



Carrot



Cauliflower



Celery



Corn

Cotton

Lettuce

Melons

Onion

Potato

Rice

# CDFA website

## Tree crops

Almonds



Almendros (en Español)

Avocado



Citrus



Grapevines



Olives



Peaches / Nectarines



Pistachio



Prunes / Plums



Walnuts



# UC Agriculture and Natural Resources

► <http://ucanr.org/sites/nm/>



The screenshot displays the homepage of the UC Nutrient Management for Vegetable, Fruit & Nut Crops website. At the top, a navigation bar includes links for "SKIP TO CONTENT", "SITE MAP", and a search box labeled "Enter Search Terms". Below this, a blue banner features the University of California seal and the title "Nutrient Management for Vegetable, Fruit & Nut Crops". A yellow navigation bar below the banner contains two links: "UC Fruit & Nuts Research & Information Center" and "UC Vegetable Research & Information Center". On the left side, a vertical menu lists: "Home", "Contact us", "Information by CROP", "Information by TOPIC", "Learning modules", and "Resources". The main content area has a "Welcome!" heading, followed by a welcome message to the website and a section for "ANNOUNCEMENTS". A "PRINT" button is located in the top right of the main content area. The footer, in a tan box, identifies the "Division of Agriculture and Natural Resources, University of California" and provides copyright information for 2015, along with links for "Nondiscrimination Statement", "Accessibility", "Get PDF Reader", "Get Flash Player", and "Site Information".

SKIP TO CONTENT SITE MAP Enter Search Terms

University of California  
Nutrient Management for Vegetable, Fruit & Nut Crops

UC Fruit & Nuts Research & Information Center UC Vegetable Research & Information Center

Home  
Contact us  
Information by CROP  
Information by TOPIC  
Learning modules  
Resources

Welcome!

Welcome to the **UC Nutrient Management for Vegetable, Fruit and Nut Crops** website.

ANNOUNCEMENTS

PRINT

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University of California

## Nutrient Management for Vegetable, Fruit & Nut Crops

[UC Fruit & Nuts Research & Information Center](#) [UC Vegetable Research & Information Center](#)

[Home](#)  
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### Information by Crop

#### ***Fruit and Nuts***

<a href="#">Almond</a>	<a href="#">Table and raisin grapes</a>	<a href="#">Pear</a>
<a href="#">Apple</a>	<a href="#">Wine grape</a>	<a href="#">Pecan</a>
<a href="#">Avocado</a>	<a href="#">Guava</a>	<a href="#">Pistachio</a>
<a href="#">Blueberry</a>	<a href="#">Kiwifruit</a>	<a href="#">Plum</a>
<a href="#">Caneberries</a>	<a href="#">Nectarine</a>	<a href="#">Strawberry</a>
<a href="#">Cherry</a>	<a href="#">Olive</a>	<a href="#">Walnut</a>
<a href="#">Citrus</a>	<a href="#">Peach</a>	

caneberries: blackberry, raspberry

#### ***Vegetables***

<a href="#">Artichoke</a>	<a href="#">Cilantro</a>	<a href="#">Peas</a>
<a href="#">Asparagus</a>	<a href="#">Corn</a>	<a href="#">Peppers</a>
<a href="#">Beans</a>	<a href="#">Cucumber</a>	<a href="#">Potato</a>
<a href="#">Beet</a>	<a href="#">Eggplant</a>	<a href="#">Pumpkin</a>
<a href="#">Broccoli</a>	<a href="#">Garlic</a>	<a href="#">Spinach</a>
<a href="#">Cabbage</a>	<a href="#">Lettuce</a>	<a href="#">Squash</a>
<a href="#">Carrot</a>	<a href="#">Melons</a>	<a href="#">Sweetpotato</a>
<a href="#">Cauliflower</a>	<a href="#">Okra</a>	<a href="#">Swiss chard</a>
<a href="#">Celery</a>	<a href="#">Onion</a>	<a href="#">Tomato</a>

# Soil and Water Nitrogen

- ▶ Nitrogen “Credits”
- ▶ Soil Test Results
  - ▶ Nitrate-N
- ▶ Irrigation Water Test Results
  - ▶ *Converting ppm to lb/ac*
- ▶ Remember test results are best

NITROGEN MANAGEMENT	
Nitrogen Sources	Recommended/ Planned N (A)
9. Soil – Available N in Root Zone (Annualized, lbs/ac)	
10. N in Irrigation Water* (Annualized, lbs/ac)	
11. Organic Amendments (Manure/Compost/Other, lbs/ac estimate)	
12. Dry/Liquid Fertilizer N* (lbs/ac)	
13. Foliar Fertilizer N* (lbs/ac)	
14. TOTAL NITROGEN (lbs/ac)	



# Soil - Available N in Root Zone

- ▶ Item #9 on worksheet
- ▶ Soil nitrate content: Only use **CURRENT** soil test results (Pre-plant quick test- Using test strips)
- ▶ Test results in ppm  $\text{NO}_3$  or ppm  $\text{NO}_3\text{-N}$

For 12-inch soil sample:

$$\text{Soil } \text{NO}_3\text{-N (ppm)} \times 4 = \text{lb N/ac}$$

$$\text{NO}_3 \times 0.2259 = \text{N}$$

# Side note: Soil sampling

Your plan should consider:

- ▶ Soil types present
- ▶ Management history
- ▶ Size of management unit
- ▶ Depth of active root zone
- ▶ Field configuration and planting/tillage patterns
- ▶ Collect and mix multiple sub-samples to represent zone/area or field

Your sampling plan should be site-specific. Ask for advice if you aren't sure!

# Organic amendments

- ▶ Item #11 on worksheet
- ▶ Includes Compost, Manure, "Green manure" (cover crops)
- ▶ Best: test results

TOTAL NUTRIENT ANALYSIS			
Physical Characteristics			
pH	6.18		
ECe	4.75	mmho/cm	
Tot.Dissolved Salts	3040	ppm	
Percent Moisture	51.4	%	Sample analysis:
Bulk Density (Dry)	579.5	lb/cu.yd.	

Chemical Analysis	Analytical Results	Results in lb.
Total-N	2.50 %	50.00
Ammonia-N	2.59 ppm	< .01
Phosphorus-P	0.34 %	6.80
Phosphorus-P2O5	0.78 %	15.60
Potassium-K	0.82 %	16.40
Potash-K2O	0.98 %	19.60
Sulfur	0.4 %	8.00
Sodium	1461.92 ppm	2.92
Calcium	1.95 %	39.00
Magnesium	1.28 %	25.60
Copper	84.06 ppm	0.17
Iron	8619.68 ppm	17.24
Manganese	437.46 ppm	0.87
Zinc	155.42 ppm	0.31
Organic Matter	47.80 %	
C/N Ratio	9.94	

NITROGEN MANAGEMENT	
Nitrogen Sources	Recommended/ Planned N (A)
9. Soil – Available N in Root Zone (Annualized, lbs/ac)	
10. N in Irrigation Water* (Annualized, lbs/ac)	
11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)	
12. Dry/Liquid Fertilizer N* (lbs/ac)	
13. Foliar Fertilizer N* (lbs/ac)	
14. TOTAL NITROGEN (lbs/ac)	

# Organic amendments

- ▶ Item #11 on worksheet
- ▶ Best: test results
- ▶ OK in a pinch: “book values”
  - ▶ Western Fertilizer Handbook
  - ▶ UCANR Publication: “Organic Soil Amendments and Fertilizers”
  - ▶ Oregon State online calculator
  - ▶ <http://smallfarms.oregonstate.edu/calculator>
  - ▶ Method to estimate cover crop N: “Managing Cover Crops Profitably, Third Ed.” (2012) SARE Handbook Series Book 9.

# Fertilizer N

- ▶ Items #12 and #13 on worksheet
- ▶ Dry, liquid, or foliar formulations
- ▶ Recommendation from crop advisor or PCA (or your own experience)
- ▶ Make up the difference between available N and N requirement of crop

NITROGEN MANAGEMENT		
Nitrogen Sources	Recommended/ Planned N (A)	
9. Soil – Available N in Root Zone (Annualized, lbs/ac)		
10. N in Irrigation Water* (Annualized, lbs/ac)		
11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)		
12. Dry/Liquid Fertilizer N* (lbs/ac)		
13. Foliar Fertilizer N* (lbs/ac)		
14. TOTAL NITROGEN (lbs/ac)		



# Actual N used-

- ▶ Enter the actual totals in column B #9 – 14

NITROGEN MANAGEMENT		
Nitrogen Sources	Recommended/ Planned N (A)	Actual N (B)
9. Soil – Available N in Root Zone (Annualized, lbs/ac)		
10. N in Irrigation Water* (Annualized, lbs/ac)		
11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)		
12. Dry/Liquid Fertilizer N* (lbs/ac)		
13. Foliar Fertilizer N* (lbs/ac)		
14. TOTAL NITROGEN (lbs/ac)		

# Data and Record Keeping

Need to record:

- ▶ Soils and soil test data
- ▶ Irrigation water source test data and amount of water applied
- ▶ Fertilizer applications
- ▶ Organic material applications
- ▶ Crop yield

# NRCS assistance available

- ▶ Nutrient Management practice-
  - ▶ Similar, but includes NPK
- ▶ Irrigation water management practice
- ▶ Technical assistance
  - ▶ Spreadsheets for data records
  - ▶ Soil maps, advice on soil sampling
  - ▶ Resources, questions
- ▶ Financial assistance: Environmental Quality Incentives Program (EQIP)
  - ▶ Competitive process

# EQIP

## Environmental Quality Incentives Program



The Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, increased soil health and reduced soil erosion and sedimentation, improved or created wildlife habitat, and mitigation against increasing weather volatility.

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/>

# To contact me:

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[Wendy.Rash@ca.usda.gov](mailto:Wendy.Rash@ca.usda.gov)

810 Vaca Valley Parkway, Suite 104

Vacaville, CA 95688





# Irrigation Water Management

(also for fun and profit)

AMY KING

WATERSHED PROJECT MANAGER

SOLANO RCD



# Irrigation Management

- Back to the INMP worksheet
- Pre-season planning

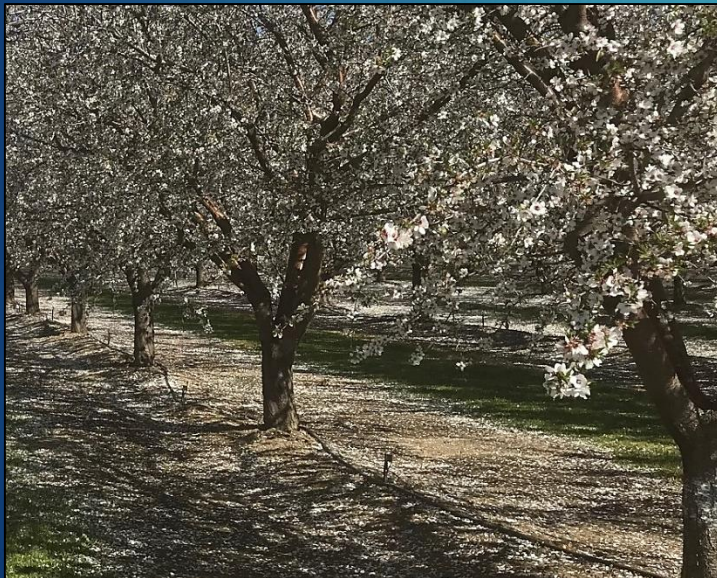
IRRIGATION AND NITROGEN MANAGEMENT PLAN (INMP) WORKSHEET				
Member ID: _____		INMP Field or MU: _____		Crop: _____ Total Acres: _____
IRRIGATION MANAGEMENT				
1. Irrigation Method* (check one for Primary; if applicable, check one for Secondary)		Pre-Season Planning		
Primary Secondary <sup>1</sup> <input type="checkbox"/> <input type="checkbox"/> Drip <input type="checkbox"/> <input type="checkbox"/> Micro Sprinkler <input type="checkbox"/> <input type="checkbox"/> Furrow <input type="checkbox"/> <input type="checkbox"/> Sprinkler <input type="checkbox"/> <input type="checkbox"/> Border Strip <input type="checkbox"/> <input type="checkbox"/> Flood		2. Crop Evapotranspiration (ET, inches)		
		3. Anticipated Crop Irrigation (inches)		
		4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)		
5. Irrigation Efficiency Practices* (Check all that apply)				
<input type="checkbox"/> Laser Leveling <input type="checkbox"/> Use of ET in scheduling irrigations <input type="checkbox"/> Water application schedule to need <input type="checkbox"/> Use of moisture probe (e.g. tensiometer)				
<input type="checkbox"/> Soil Moisture Neutron Probe <input type="checkbox"/> Pressure Bomb <input type="checkbox"/> Other _____ <input type="checkbox"/> 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)
<input type="checkbox"/> Split Fertilizer Applications <input type="checkbox"/> Irrigation Water N Testing <input type="checkbox"/> Soil Testing <input type="checkbox"/> Tissue/Petiole Testing <input type="checkbox"/> Fertigation <input type="checkbox"/> Foliar N Application <input type="checkbox"/> Cover Crops <input type="checkbox"/> Variable Rate Applications using GPS <input type="checkbox"/> Other: _____ <input type="checkbox"/> Other: _____		9. Soil – Available N in Root Zone (Annualized, lbs/ac)		
		10. N in Irrigation Water* (Annualized, lbs/ac)		
		11. Organic Amendments* (Manure/Compost/Other, lbs/ac estimate)		
		12. Dry/Liquid Fertilizer N* (lbs/ac)		
		13. Foliar Fertilizer N* (lbs/ac)		
		14. TOTAL NITROGEN (lbs/ac)		

<sup>1</sup> 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 Method

- ▶ Choose one primary method
- ▶ Check a secondary method only if applicable



1. Irrigation Method*		
(check one for Primary; if applicable, check one for Secondary)		
Primary	Secondary <sup>1</sup>	
<input type="checkbox"/>	<input type="checkbox"/>	Drip
<input type="checkbox"/>	<input type="checkbox"/>	Micro Sprinkler
<input type="checkbox"/>	<input type="checkbox"/>	Furrow
<input type="checkbox"/>	<input type="checkbox"/>	Sprinkler
<input type="checkbox"/>	<input type="checkbox"/>	Border Strip
<input type="checkbox"/>	<input type="checkbox"/>	Flood

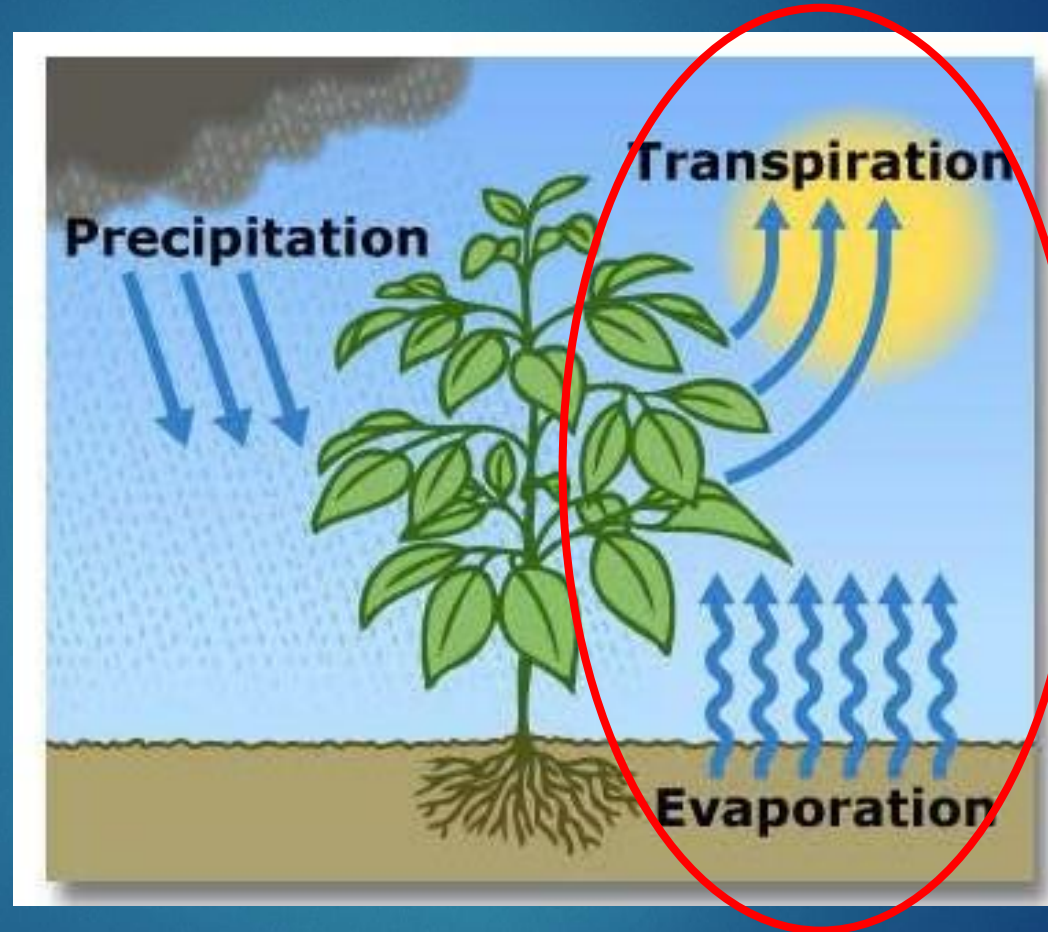
# Crop Evapotranspiration

- ▶ For ET Reports and Calculator, visit:
  - ▶ <http://www.sacvalleyorchards.com/et-reports/>
  - ▶ If you are part of a Coalition that has a database, a link will be provided for ET calculations by crop type. Revise the data, if needed.

IRRIGATION MANAGEMENT	
Pre-Season Planning	
2. Crop Evapotranspiration (ET, inches)	
3. Anticipated Crop Irrigation (inches)	
4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)	



# Evapotranspiration

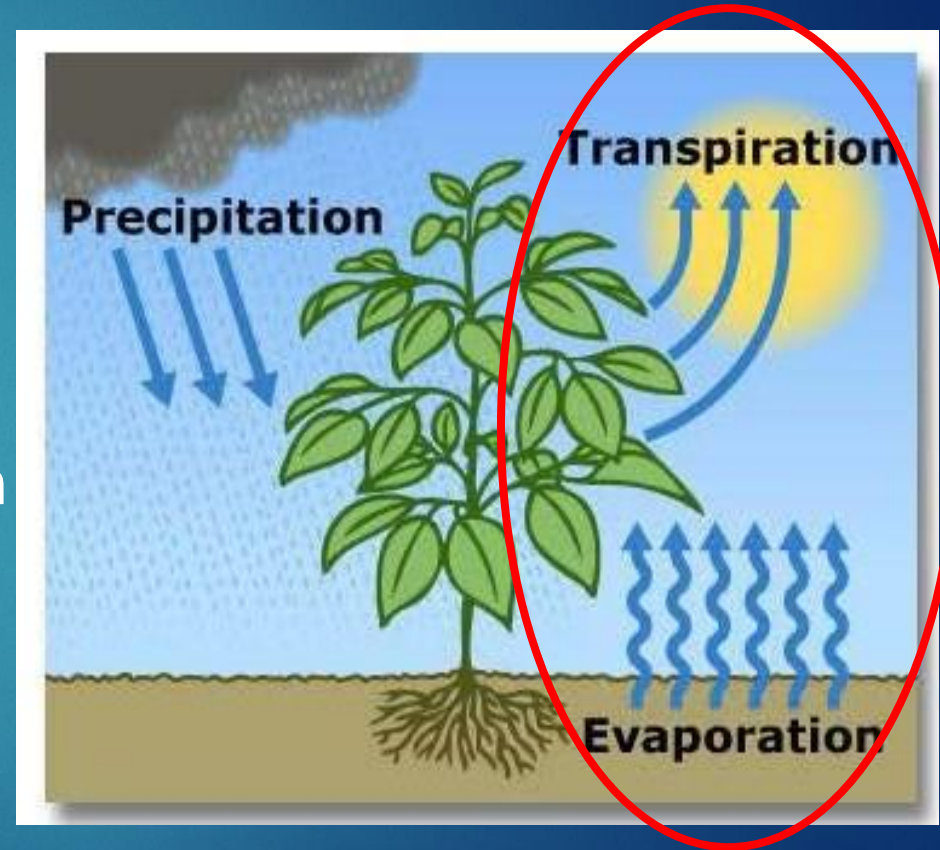


- Evapotranspiration is the sum of evaporation from the land surface plus transpiration from plants



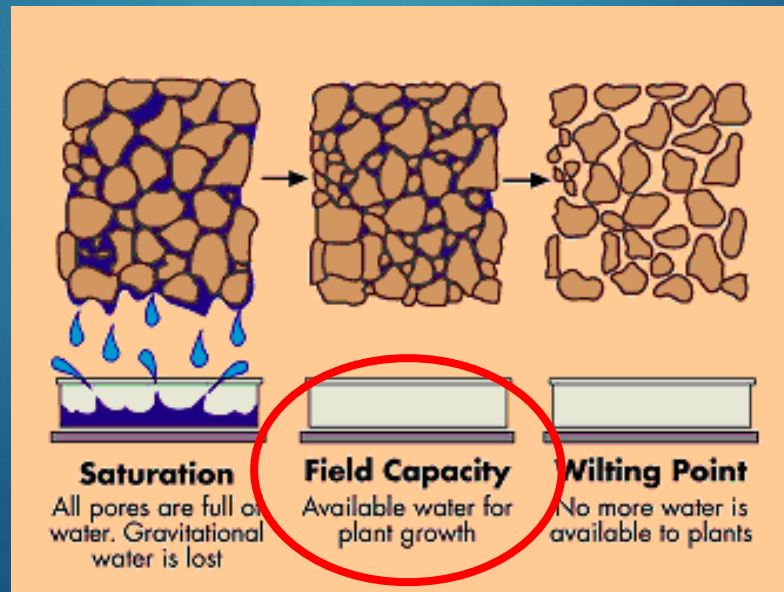
# Evapotranspiration

- Why is it important in agriculture?
  - Knowing the ET of the crop can help prevent crop stress and water loss through the leaves
  - not managing for ET can result in lower yields, particularly in drought years
  - Can help save scarce water



# Anticipated Crop Irrigation

- ▶ Note that the planning form is in inches
- ▶ We want to irrigate to restore ET losses
  - ▶ Ideally the anticipated and actual irrigation numbers will be pretty close
  - ▶ Watering to field capacity is a reasonable goal



# Anticipated Crop Irrigation

One formula for inches applied=

► 
$$\frac{(\text{Flow in gpm}/450) \times (\text{Irrigation set time in hours})}{(\text{Irrigated Acres})}$$

*450 converts gals per min  
to ac-inches per hour*

IRRIGATION MANAGEMENT	
Pre-Season Planning	
2. Crop Evapotranspiration (ET, inches)	
3. Anticipated Crop Irrigation (inches)	
4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)	

For assistance, contact  
your Coalition

# Irrigation Water Nitrogen Concentration

- ▶ Allows you to estimate N you will be applying via irrigation water alone
- ▶ Part of your pre-season planning
- ▶ N in water can be estimated by several methods (averages reported by water districts, lab testing, and/or your own field testing)

IRRIGATION MANAGEMENT	
Pre-Season Planning	
2. Crop Evapotranspiration (ET, inches)	
3. Anticipated Crop Irrigation (inches)	
4. Irrigation Water N Concentration (ppm or mg/L, as NO <sub>3</sub> -N)	

When reporting your Actuals, some online INMPs will require a number – enter 0 if you do not have data, but indicate that it is a lack of data rather than a zero for N concentration

# Irrigation Water Nitrogen Concentration

- ▶ Best practice: Take water samples to a lab for testing!
- ▶ Other methods:
  - ▶ Test strips – can indicate if lab testing is warranted
  - ▶ Direct measurement with a field instrument
- ▶ Measurements are in ppm or mg/L, as  $\text{NO}_3\text{-N}$ 
  - ▶ Drinking water limit = 10 ppm  $\text{NO}_3\text{-N}$





# Irrigation Efficiency Practices

► Check one or more that apply to your operation

5. Irrigation Efficiency Practices* (Check all that apply)	
<input type="checkbox"/> Laser Leveling	<input type="checkbox"/> Soil Moisture Neutron Probe
<input type="checkbox"/> Use of ET in scheduling irrigations	<input type="checkbox"/> Pressure Bomb
<input checked="" type="checkbox"/> Water application schedule to need	<input type="checkbox"/> Other _____
<input type="checkbox"/> Use of moisture probe (e.g. tensiometer)	<input type="checkbox"/> Other _____



That completes the irrigation portion of the INMP.....

# Irrigation Water Management

- ▶ Using field-specific data to make irrigation decisions

## Goals:

1. Provide adequate water for crop
  - ▶ Optimize production
  - ▶ Potentially reduce costs (water, energy)
2. Eliminate excess watering
  - ▶ Prevent erosion and excess runoff (sediment)
  - ▶ Prevent excess deep percolation (nutrients)
  - ▶ Uniform distribution of water on field

# Irrigation Water Management

- ▶ **Irrigation Water Management (IWM)** is applying water according to crop needs in an amount that can be stored in the plant root zone of the soil.
- ▶ **Available Water Capacity (AWC)** is the portion of water in a soil that can be readily absorbed by the roots of most crops.
- ▶ **Soil Moisture Deficit (SMD) or Depletion** is the amount of water required to raise the soil-water content of the crop root zone to field capacity.

# To keep in mind regarding **Irrigation Water Management** and **Nitrogen**

How much?

When?

How uniformly is it applied?



# Irrigation Efficiency: how much?

*Reasonable estimates use crop-specific ET ( $Et_c$ ), or soil moisture meters that measure the loss of soil moisture over time*



$$\text{Irrigation efficiency} = \frac{\text{amount of water required by crop}}{\text{amount of water applied to field}}$$



*Can be measured via your water order, or a flow meter that logs water throughout the irrigation event. This will be your TOTAL water applied. To get it on a per acre basis (like ET), divide by the acres it was applied to*

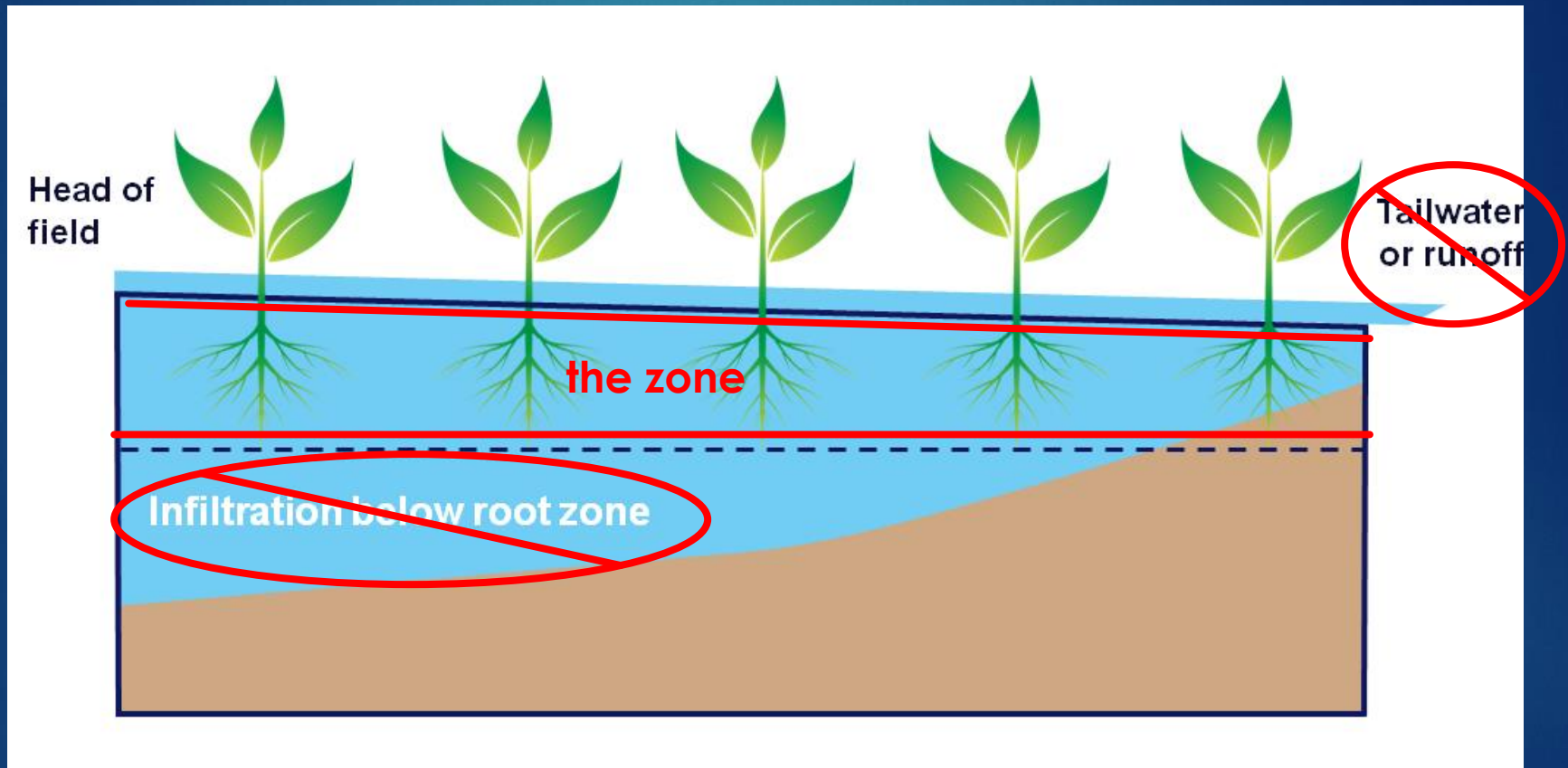


# Irrigation Efficiency: how much?



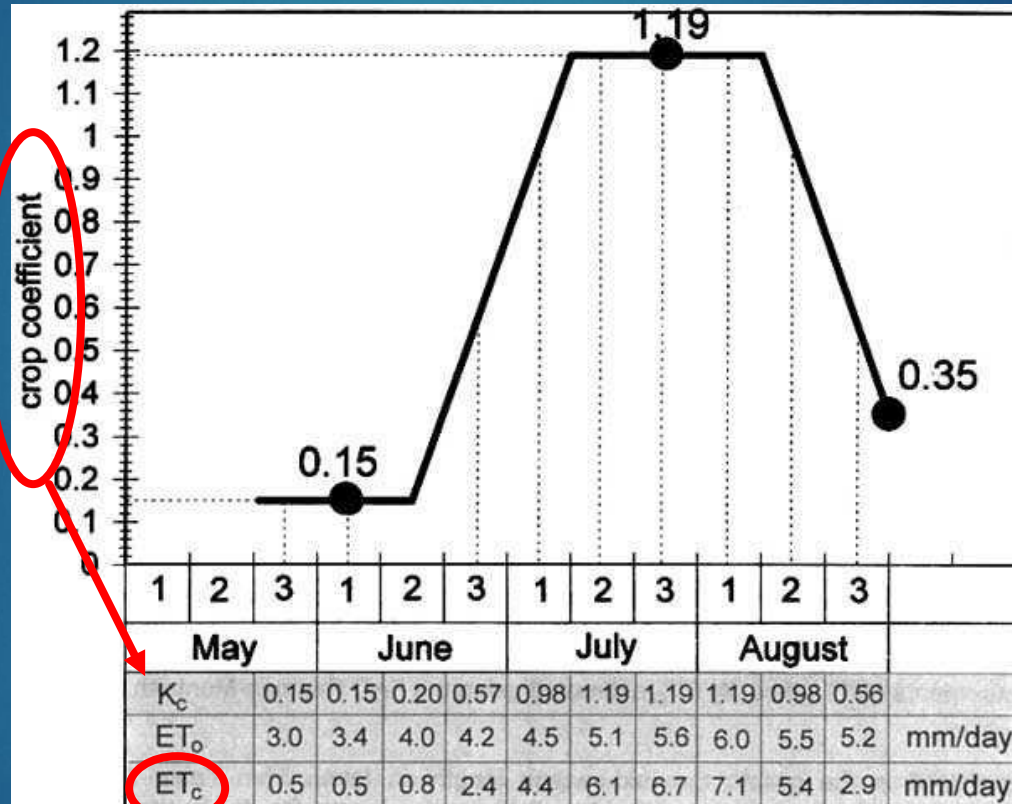
- ▶ While 100% efficiency is virtually unattainable due to variable crop condition and soil types across a field, historically above 70% was the goal.
- ▶ Now, an 80-90% efficiency during irrigation events is realistic and achievable.

# Irrigation efficiency: how much?



We want to stay in “the zone”, where plant roots can take up most of the available water

# Irrigation Efficiency: how much?

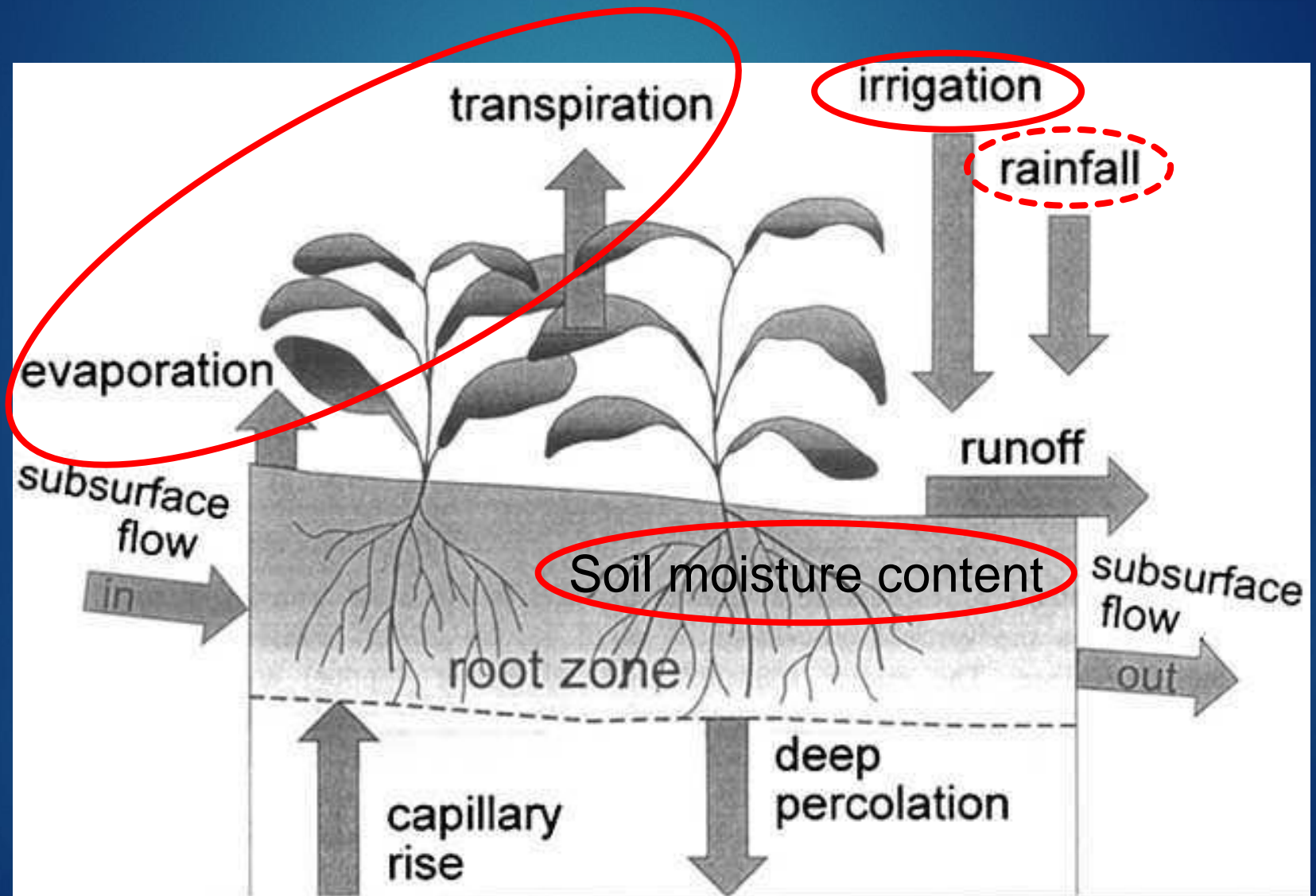


Crop-specific ET



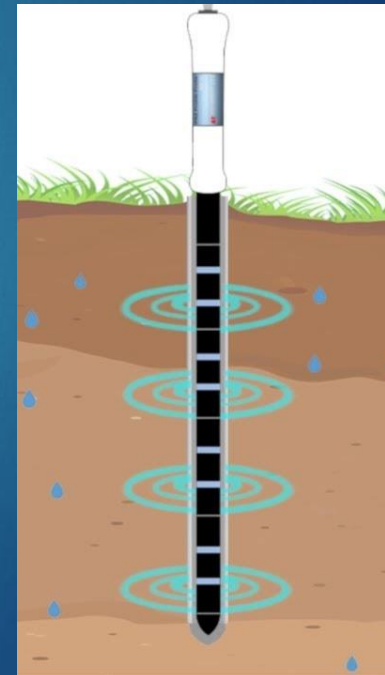


# Irrigation Efficiency: when?



# Irrigation Efficiency: when?

- ▶ Monitor soil moisture
  - ▶ How much water can be applied without percolating deeper than the root zone?
  - ▶ How much water has the soil profile lost since the last irrigation event?



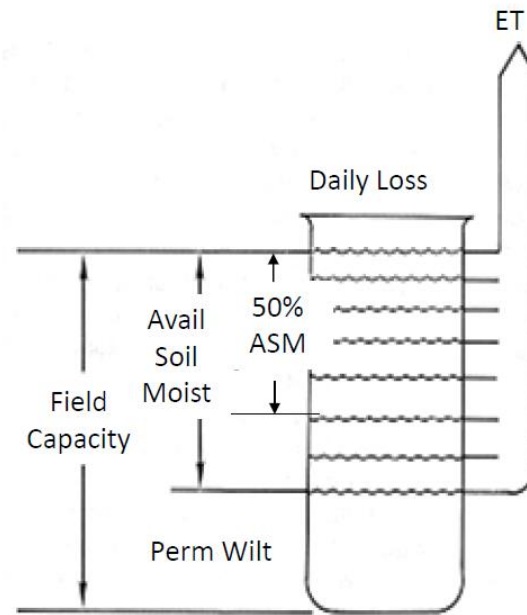


# Irrigation Efficiency: when?



# Soil texture affects water holding capacity.....

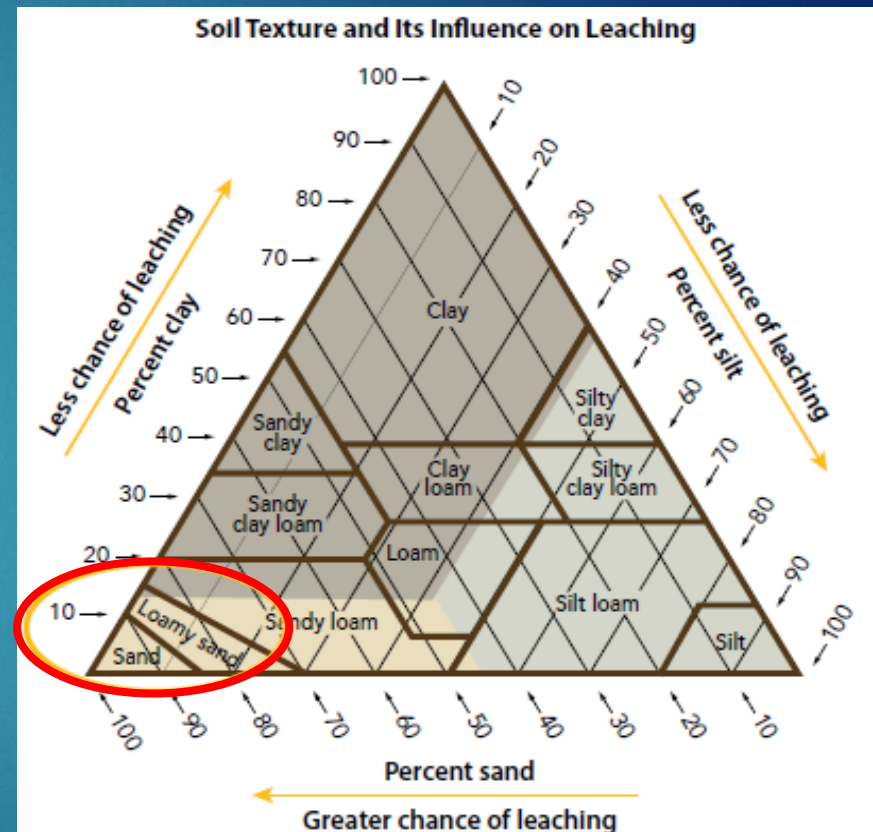
Soil Text	Field Capac	Perm't Wilt Pt (15 b)	Avail Soil Moist	50% Avail
	in/ft	in/ft	in/ft	in/ft
Sand	1.2	0.5	0.7	0.35
Silt loam	3.6	1.8	1.8	0.9
Clay	4.8	2.6	2.2	1.1



....as does soil organic matter, which, unlike texture, can be improved over time!

# Soil texture thus also affects N leaching in excess irrigation water

- ▶ Soil texture must be taken into consideration when irrigating
- ▶ If you flood or furrow irrigate, try to implement drip, microsprinklers or sprinklers into your operation



**Figure 1.** Association between soil texture and risk of leaching nitrogen. Coarse-textured soils in combination with gravity irrigation systems like flood and furrow are more prone to leaching. Source: Dan Munk.



# Impacts of Inefficient Irrigation Management



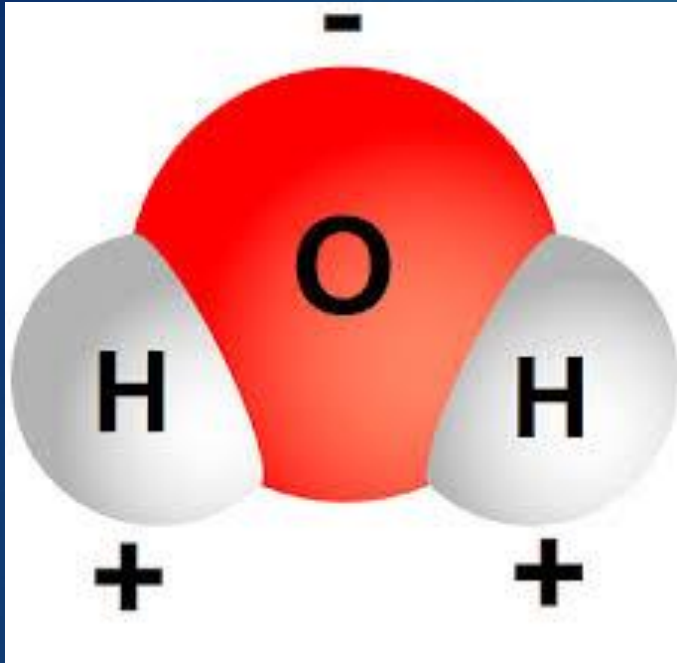
- ▶ Water waste
- ▶ Crop stress from excess or insufficient water
  - ▶ Lower crop yields = profit loss
- ▶ Off-site environmental impacts
  - ▶ Contamination of local waterways, groundwater

# A word on solubility

- ▶ Solubility is: the ability of a solid, liquid or gas (solute) to dissolve in a solvent (usually liquid) to create a solution
- ▶ It is affected by temperature, pressure and concentration. But it is also profoundly affected by chemical structure, and particularly the electrical charge of molecules in solution.

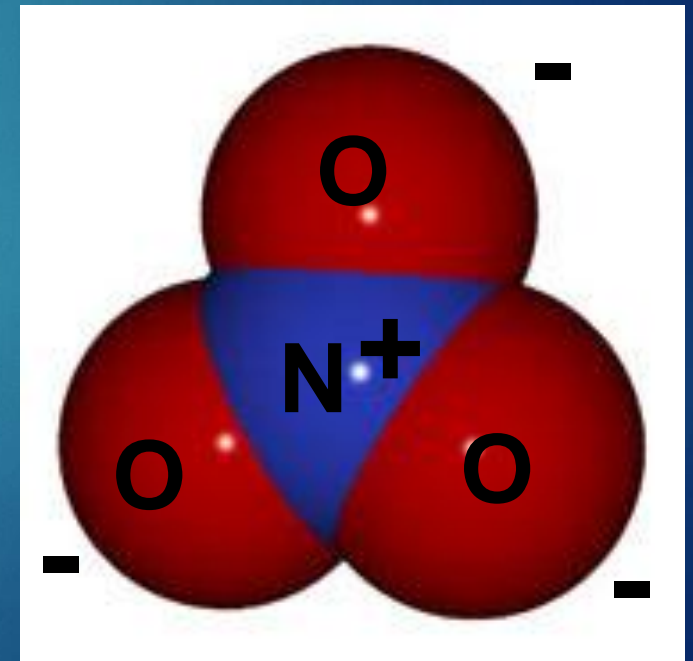


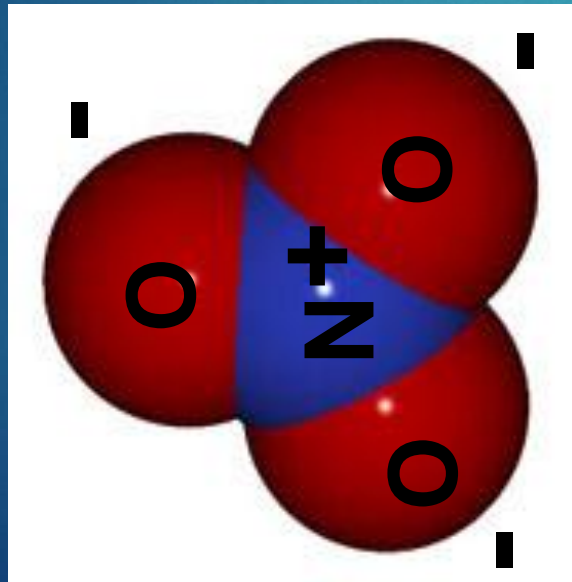
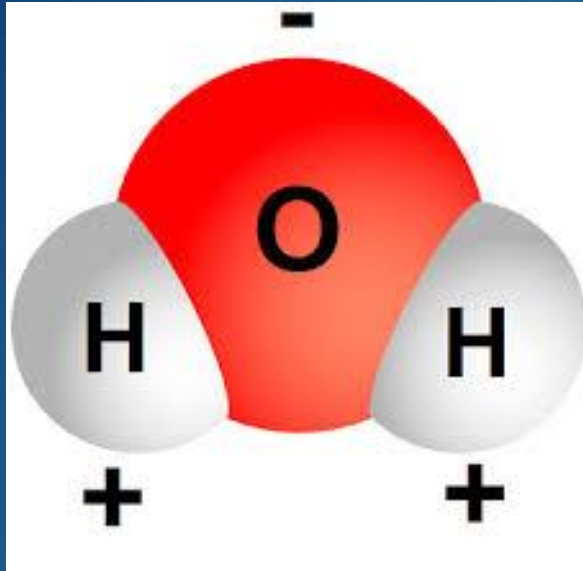




Water has areas of positive and negative charge.....

...and so does nitrate





The opposite charges attract one another, and the molecules then move together through the soil

# Solubility in water

Compound	Solubility (g/L)
<i>Table sugar</i>	2000
<b>Ammonium nitrate</b>	<b>1920</b>
<b>Calcium nitrate</b>	<b>1290</b>
<i>Epsom salts</i>	1150
<b>Urea</b>	<b>1060</b>
<b>Ammonium sulfate</b>	<b>750</b>
<b>Magnesium nitrate</b>	<b>710</b>
<i>Table salt</i>	350
<i>Baking soda</i>	100



Increasing  
solubility

# Distribution Uniformity (DU)

- ▶ Irrigation uniformity is a measure of how evenly water is applied to a field. It is commonly referred to as distribution uniformity (DU) and expressed as a percentage.



# Distribution Uniformity

## B. Calculate Distribution Uniformity (DU)

1. Sort the list of volumes from largest to smallest.
2. Calculate the average of the lowest quartile (AvgLQ). If you have 36 volumes, that would be the average of the lowest 9 measurements.
3. Calculate the average of all of the measurements (total average or AvgT).
4. Divide the average of the lowest quartile (AvgLQ) by the total average (AvgT) to get distribution uniformity (DU).

### Calculation #1:

$$DU = \frac{Avg_{LQ}}{Avg_T}$$

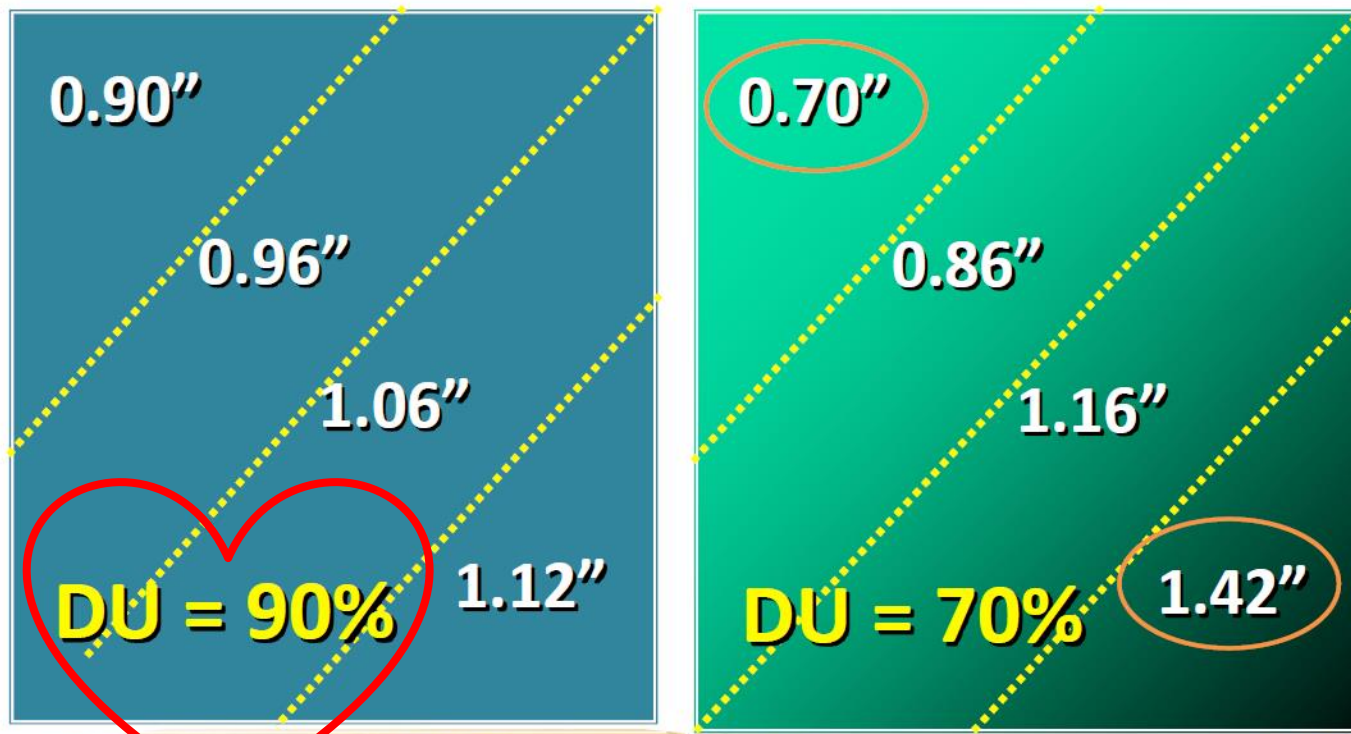
From: UC Davis California Center for Urban Horticulture





# Distribution Uniformity

Example: Target application 1.0 inch water *average*



# References

- ▶ Fulton, A. and Munk, D. – (2019) University of California Cooperative Extension, *“Irrigation and Nitrogen Management”*
- ▶ USDA/NRCS – (1998) *“Estimating Soil Moisture by Feel and Appearance”*
- ▶ Fulton, A. – (n.d.) University of California Cooperative Extension, *“Irrigation Distribution Uniformity”*

# To contact me:

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This presentation is a partnership effort between Dixon RCD, Solano RCD and USDA NRCS.

