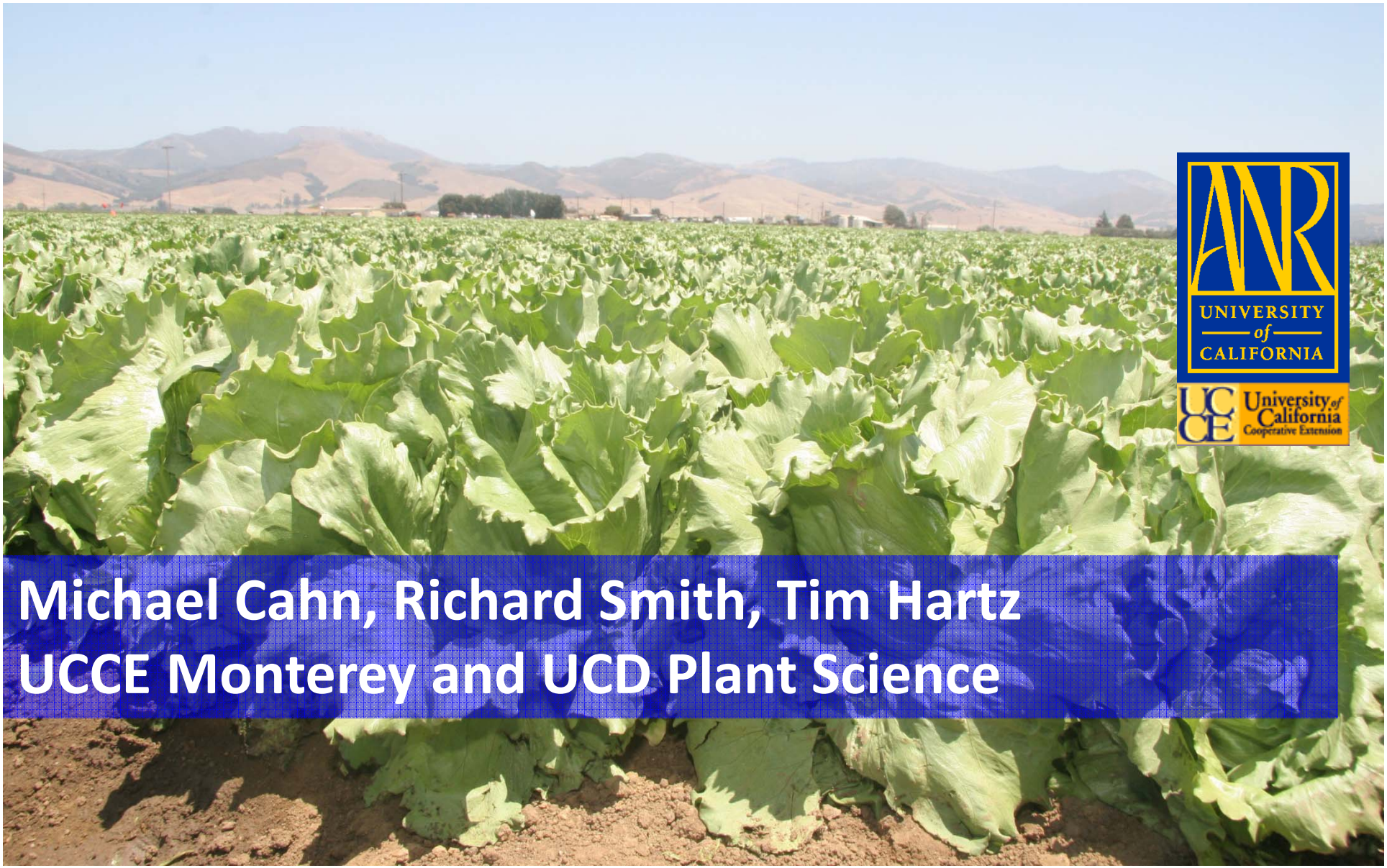
Fertilizer Value of Nitrate in Irrigation Water for Vegetable Production



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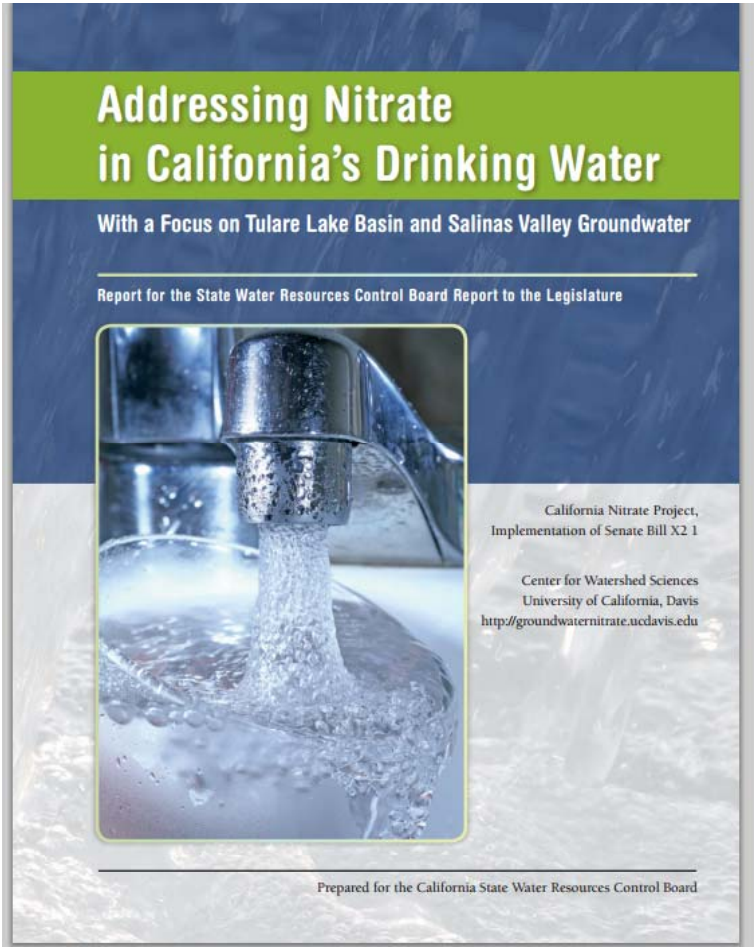
- California Department of Food and Agriculture, Fertilizer Research and Education Program
- California Leafy Green Research Board
- USDA-ARS (Sharon Benzen, David Lara, Jim McCreight)

SWRCB SBX2 1

“Pump and fertilize” was proposed as a partial solution for remediating nitrate contamination of ground water

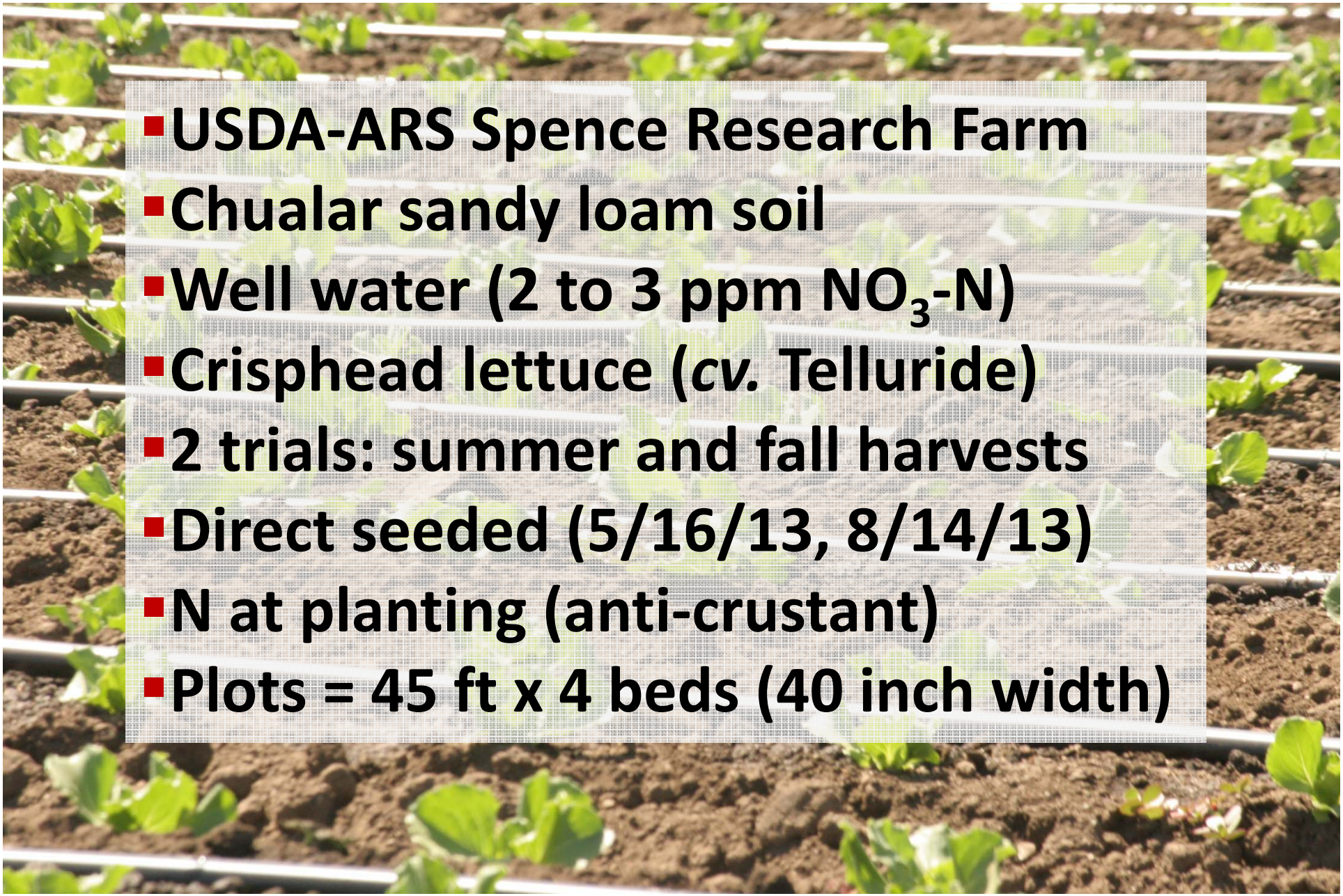


Harter and Lund 2012

How much fertilizer credit should be taken for nitrogen in well water?

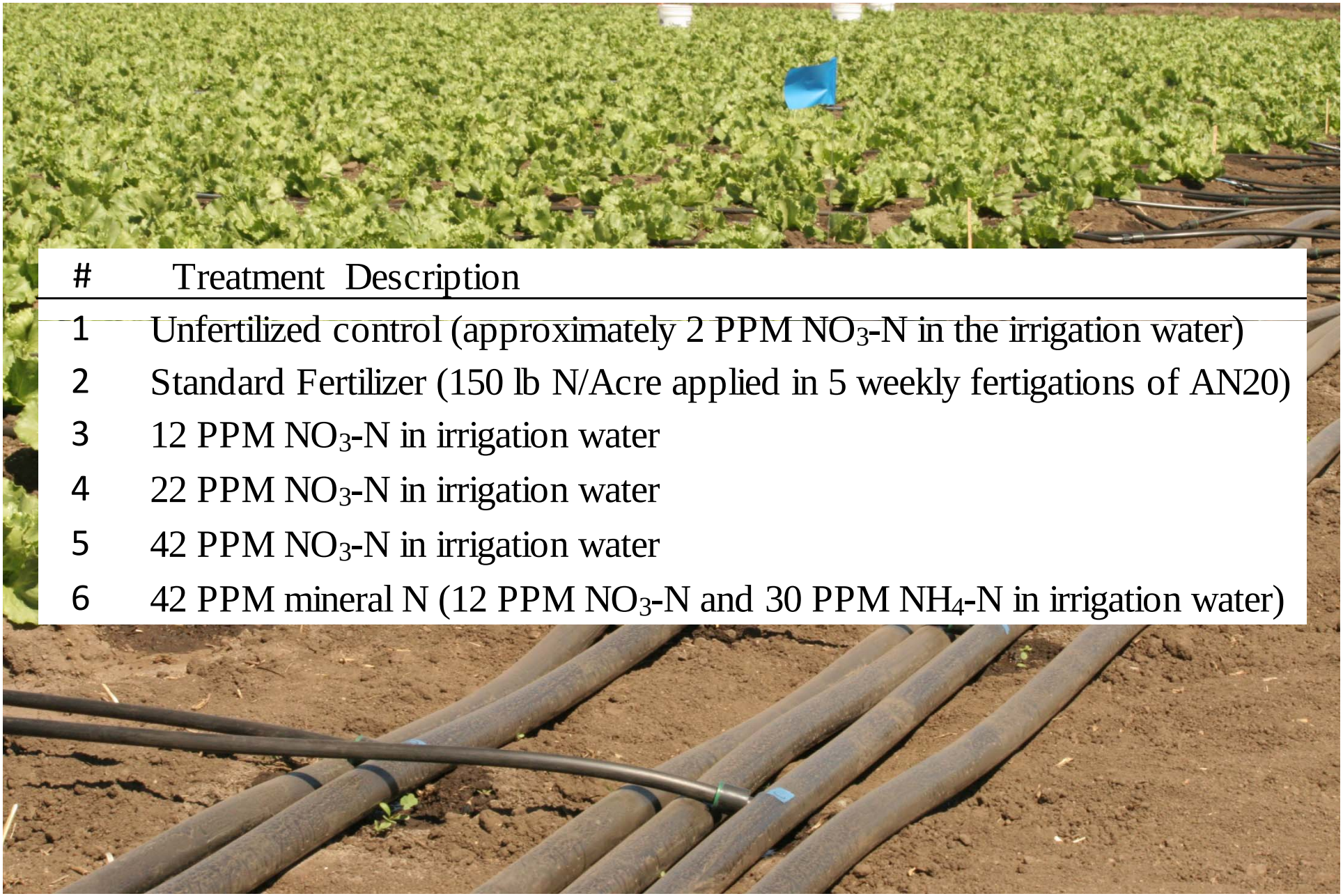
- How does the volume of applied water affect N recovery?
- Is there a minimum concentration of nitrate in water that has fertilizer value?
- Does the form of N (nitrate vs ammonium) affect recovery?
- Does high nitrate water affect soil nitrate levels?

Replicated Trials



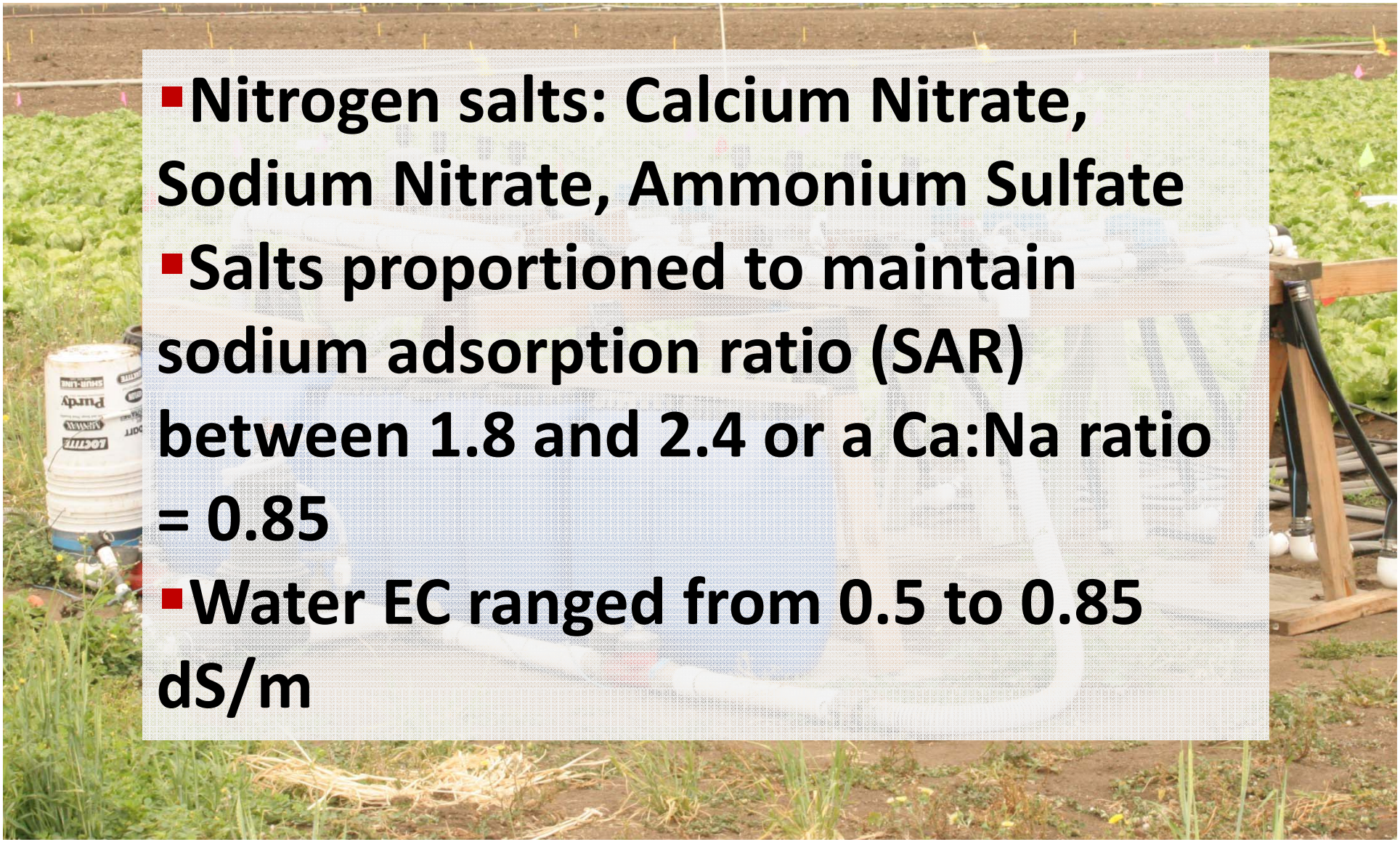
- USDA-ARS Spence Research Farm
- Chualar sandy loam soil
- Well water (2 to 3 ppm NO_3-N)
- Crisphead lettuce (*cv.* Telluride)
- 2 trials: summer and fall harvests
- Direct seeded (5/16/13, 8/14/13)
- N at planting (anti-crustant)
- Plots = 45 ft x 4 beds (40 inch width)

Water N treatments were applied by drip



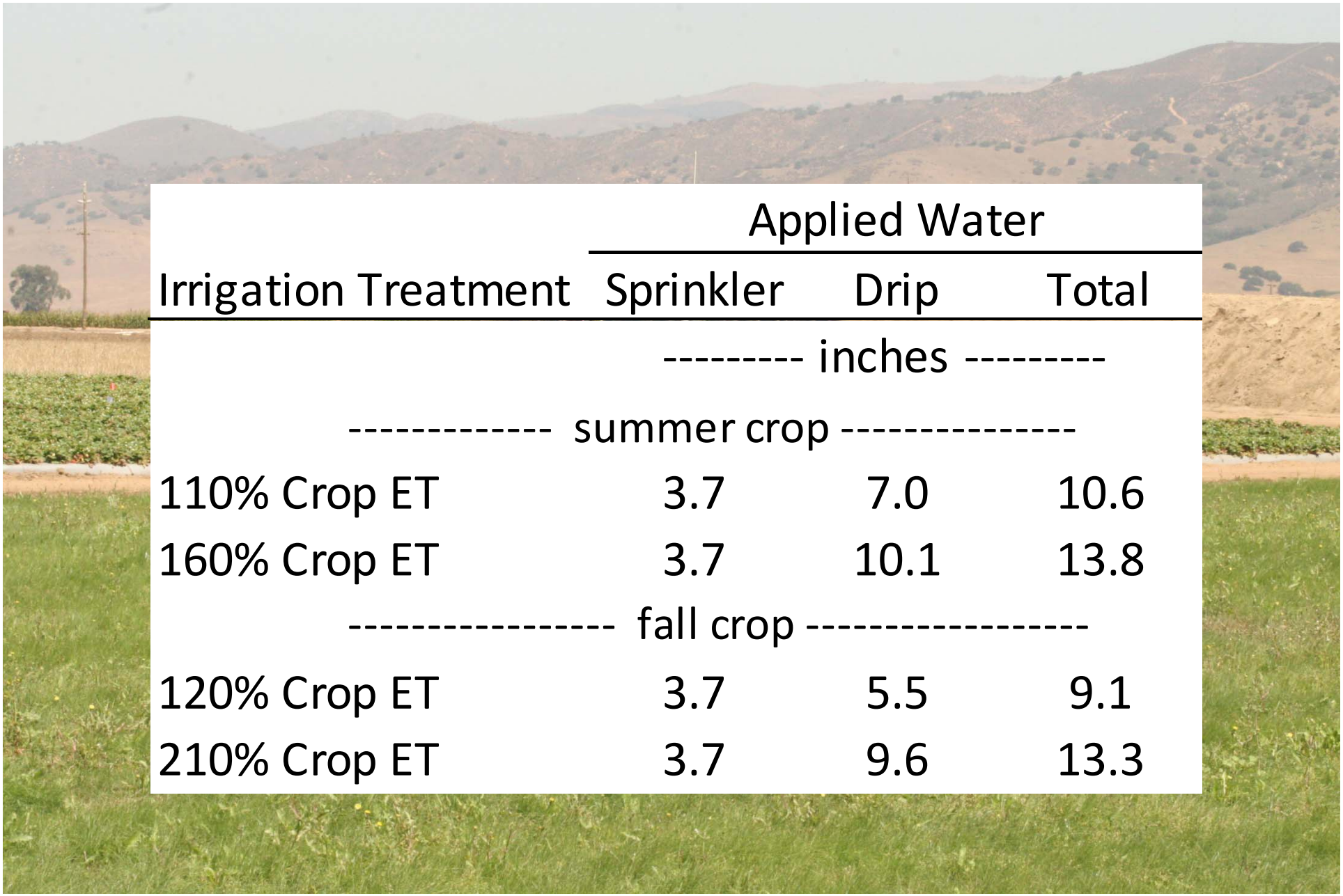
#	Treatment Description
1	Unfertilized control (approximately 2 PPM NO_3-N in the irrigation water)
2	Standard Fertilizer (150 lb N/Acre applied in 5 weekly fertigations of AN20)
3	12 PPM NO_3-N in irrigation water
4	22 PPM NO_3-N in irrigation water
5	42 PPM NO_3-N in irrigation water
6	42 PPM mineral N (12 PPM NO_3-N and 30 PPM NH_4-N in irrigation water)

Irrigation Manifold for Simulating Water with Varying Concentrations of Nitrate



- Nitrogen salts: Calcium Nitrate, Sodium Nitrate, Ammonium Sulfate
- Salts proportioned to maintain sodium adsorption ratio (SAR) between 1.8 and 2.4 or a Ca:Na ratio = 0.85
- Water EC ranged from 0.5 to 0.85 dS/m

Two irrigation rates were evaluated



Irrigation Treatment	Applied Water		
	Sprinkler	Drip	Total
	--------- inches ---------		
---------- summer crop ----------			
110% Crop ET	3.7	7.0	10.6
160% Crop ET	3.7	10.1	13.8
---------- fall crop ----------			
120% Crop ET	3.7	5.5	9.1
210% Crop ET	3.7	9.6	13.3

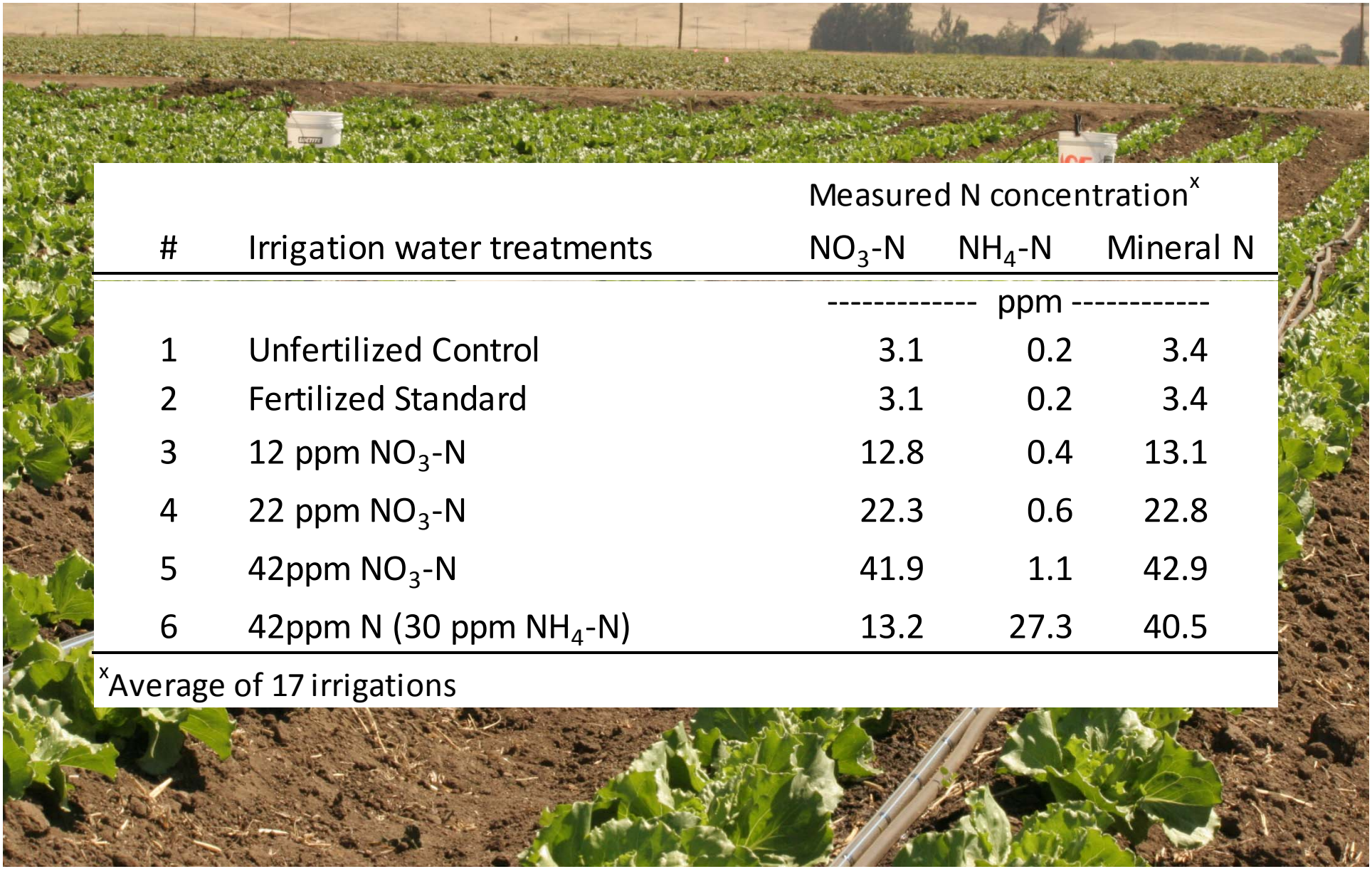
How is nitrate in irrigation water converted to applied N?

lbs of N/acre=

applied water (inches) x NO_3-N conc (ppm) x 0.23

		Fertilizer N value	
	Applied	NO_3-N	
ET Treatment	Water	12 ppm	22 ppm
	inches	------ lbs N/acre ----	
110%	7.0	19.3	35.4
160%	10.1	27.9	51.1

Verifying N concentration of irrigation water treatments



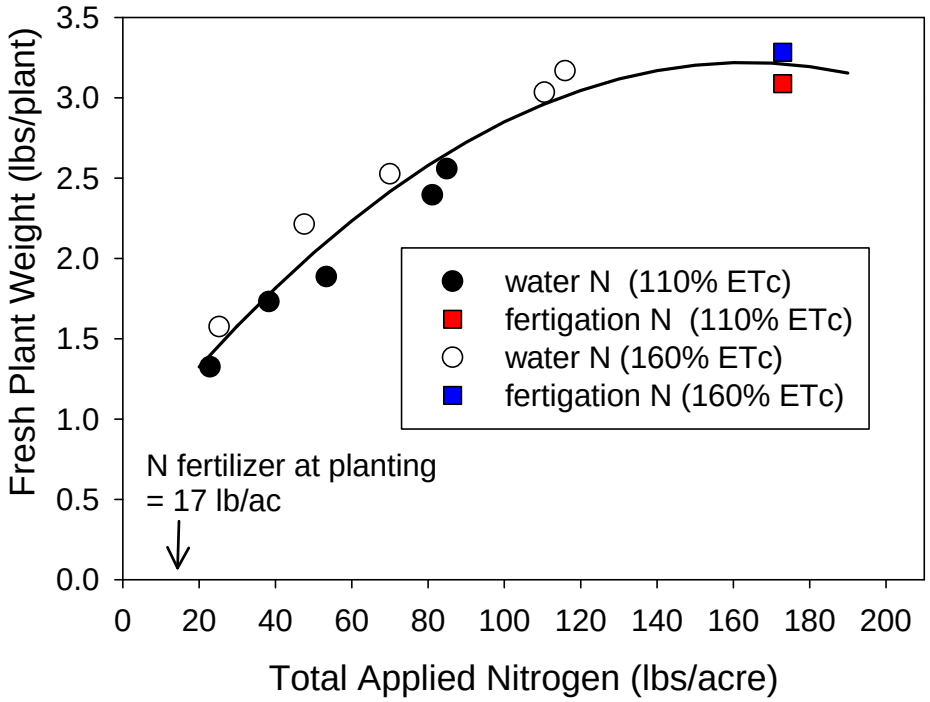
#	Irrigation water treatments	Measured N concentration[x]		
		NO_3-N	NH_4-N	Mineral N
		---------- ppm ----------		
1	Unfertilized Control	3.1	0.2	3.4
2	Fertilized Standard	3.1	0.2	3.4
3	12 ppm NO_3-N	12.8	0.4	13.1
4	22 ppm NO_3-N	22.3	0.6	22.8
5	42ppm NO_3-N	41.9	1.1	42.9
6	42ppm N (30 ppm NH_4-N)	13.2	27.3	40.5

[x]Average of 17 irrigations

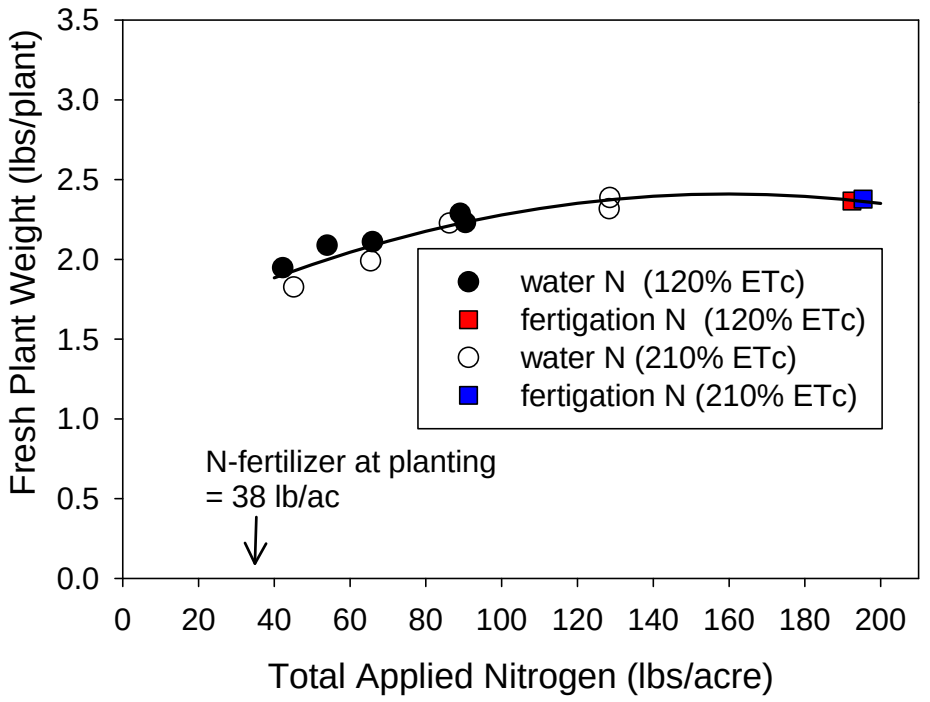
Nitrate in water affected both plant size and color

Irrigation Water Treatments Affected Untrimmed Plant Weight

Summer

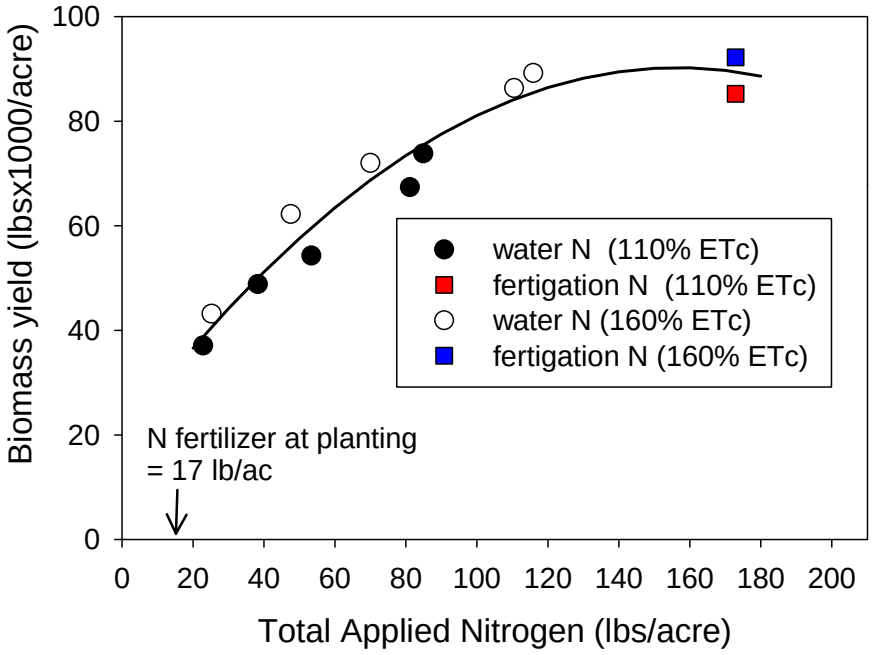


Fall

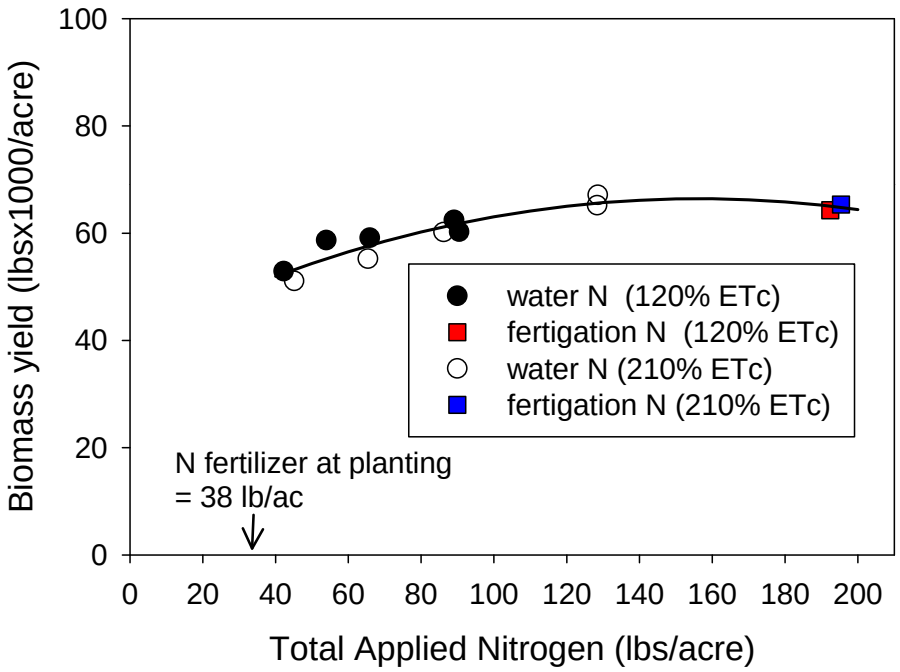


Irrigation Water Treatments Affected Biomass Yield

Summer

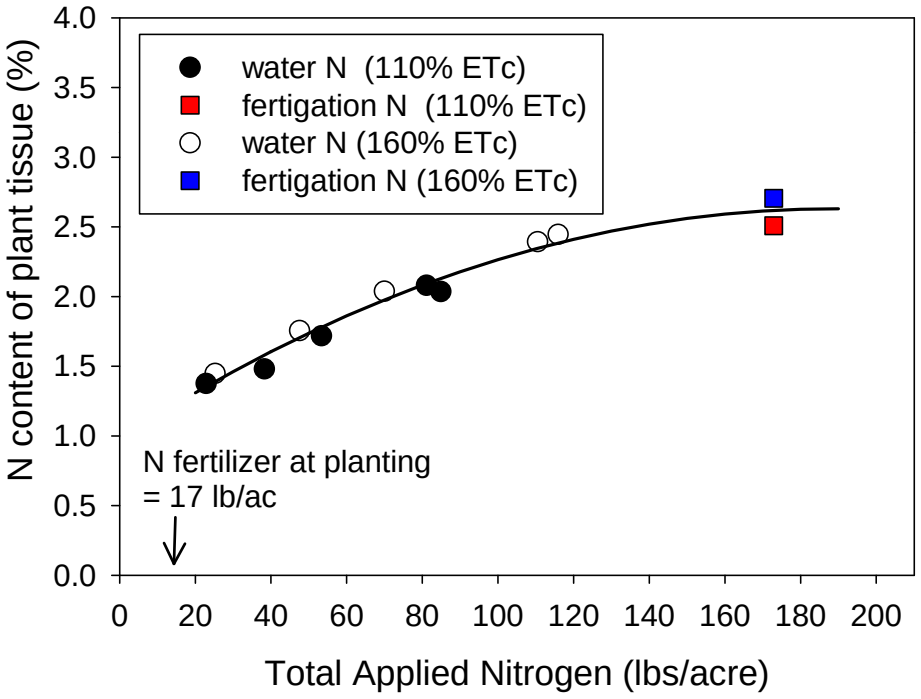


Fall

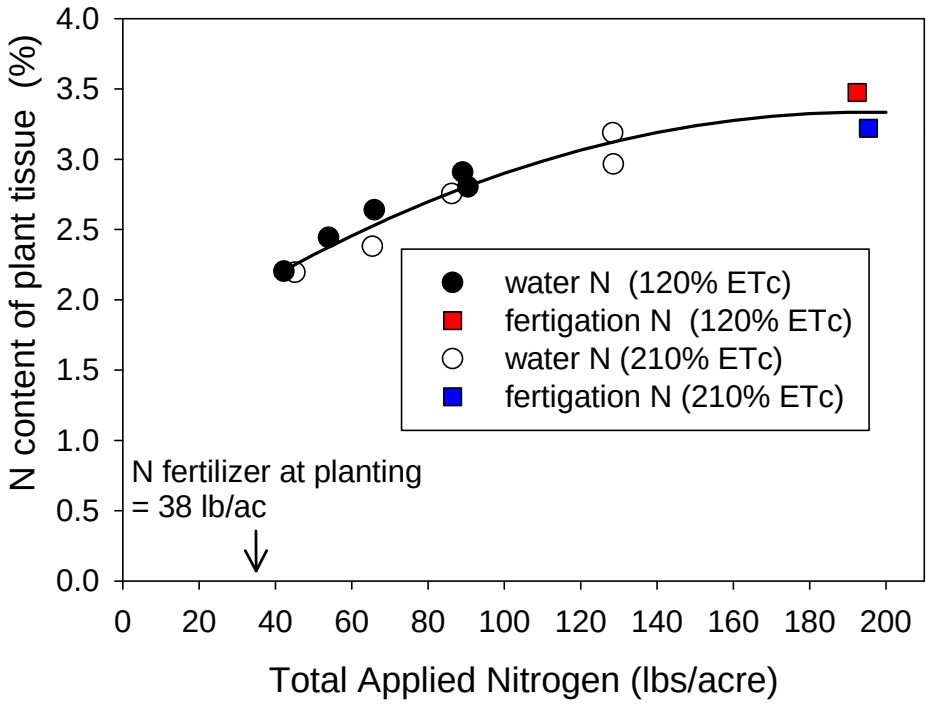


Irrigation Water Treatments Affected Tissue N

Summer

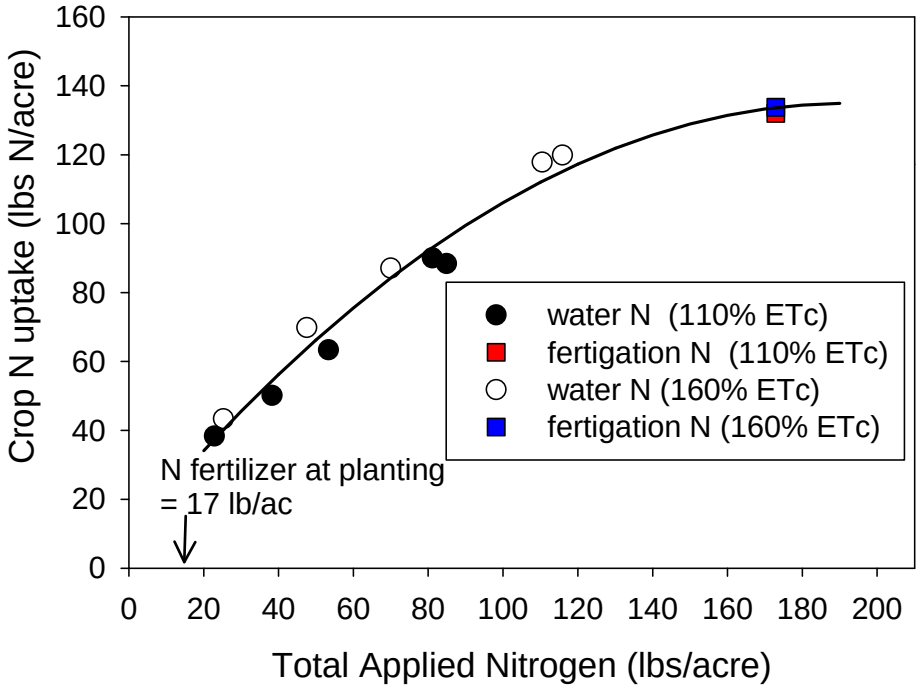


Fall

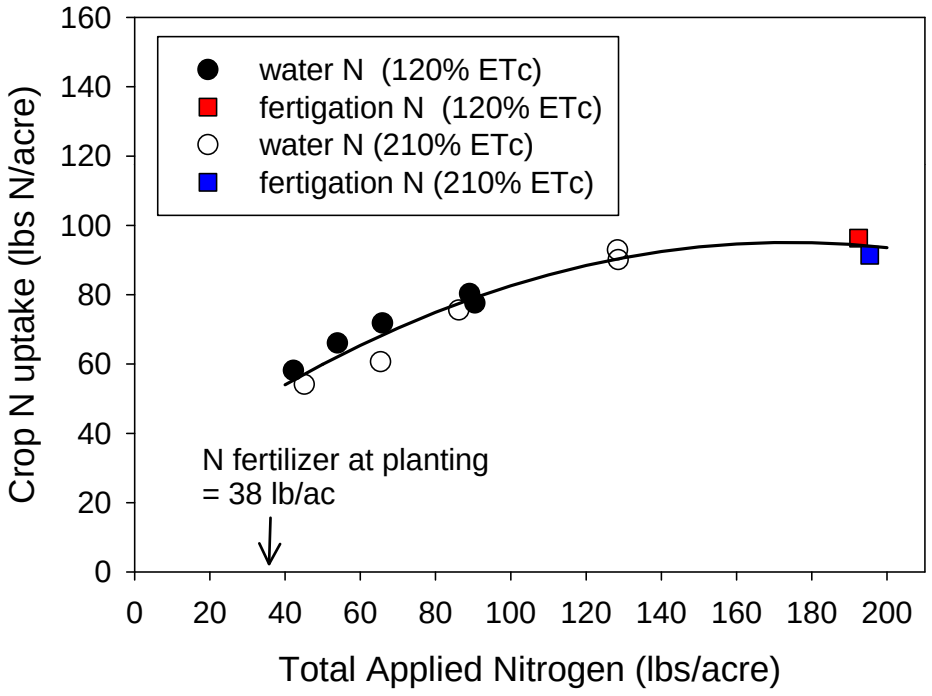


Irrigation Water Treatments Affected Crop Uptake of Nitrogen

Summer

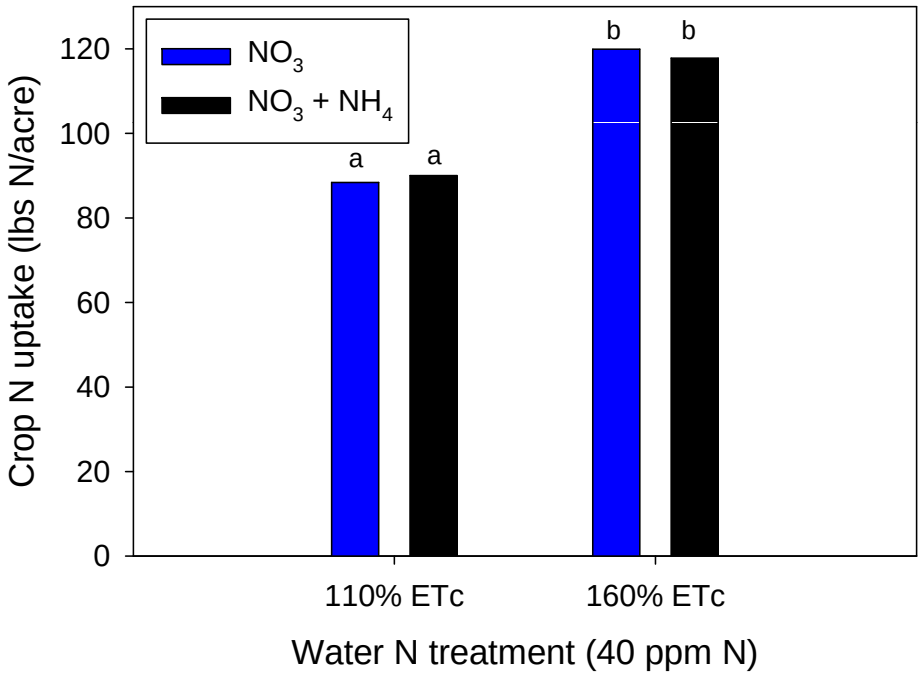


Fall

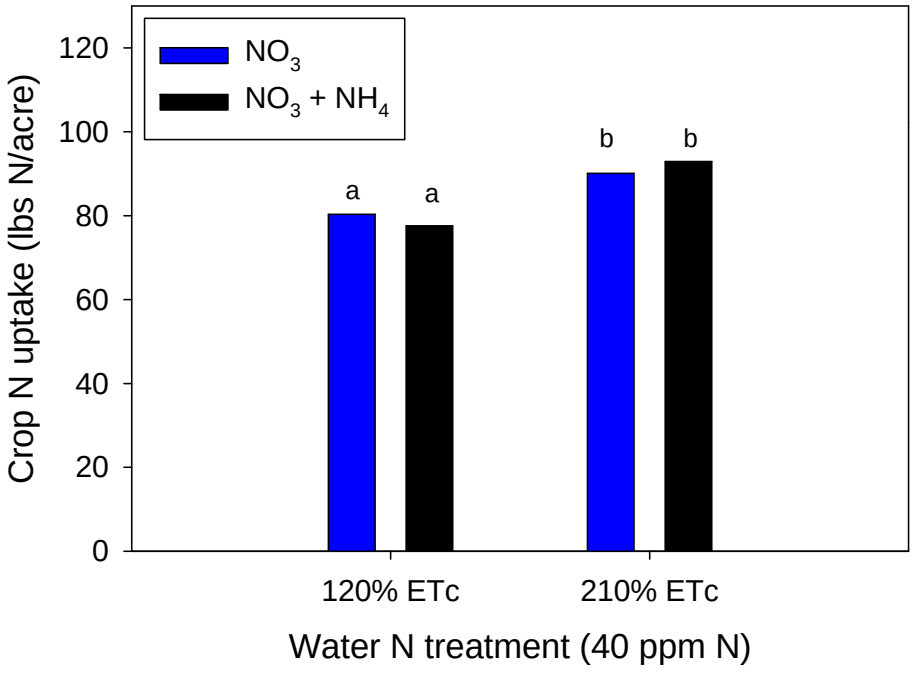


Crop uptake of N was similar for NH_4 and NO_3 sources in irrigation water

Summer

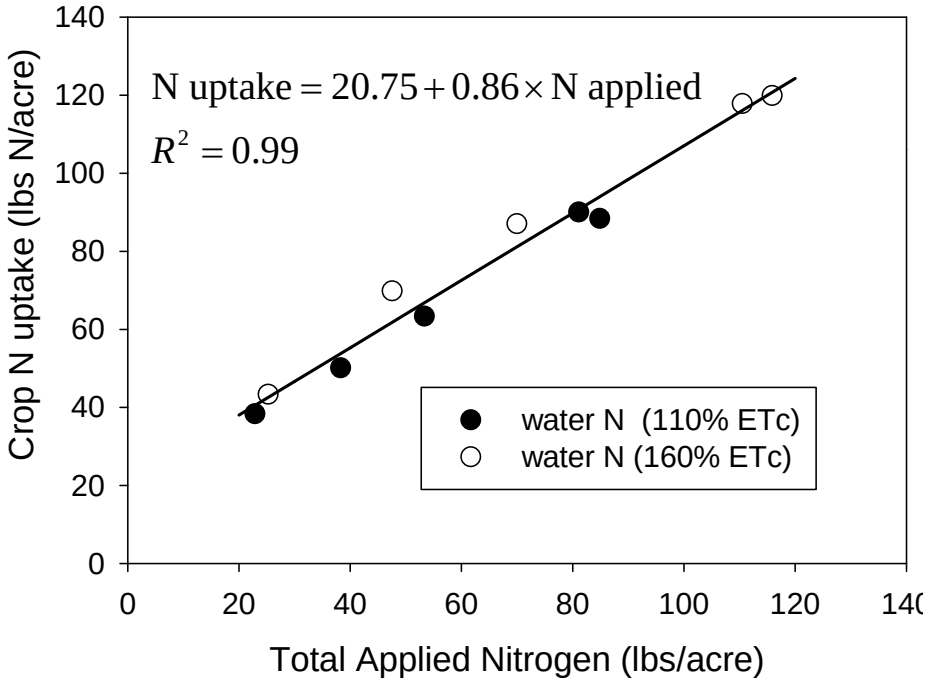


Fall

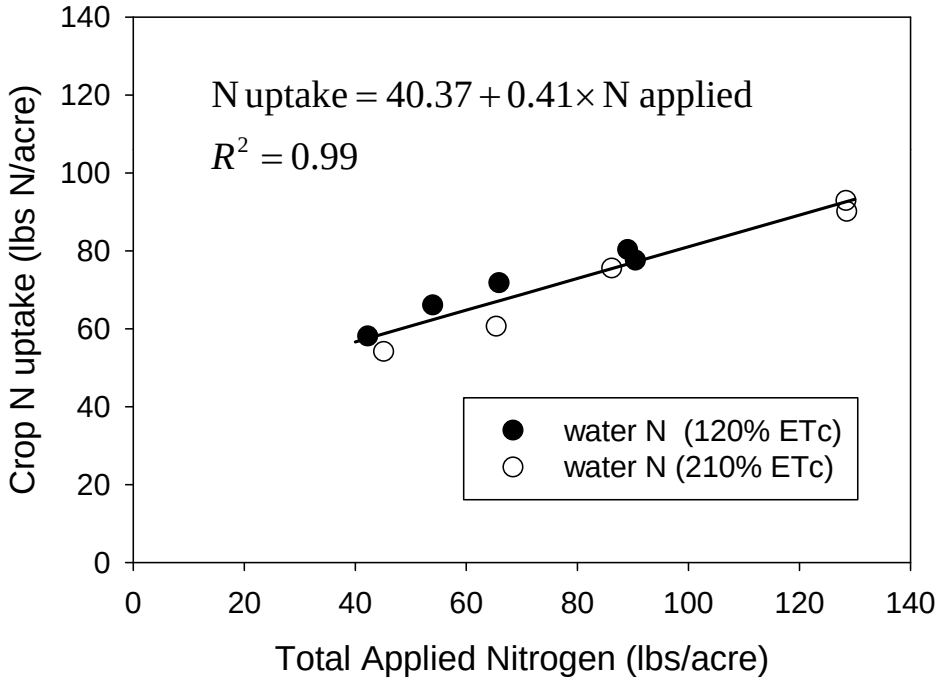


Crop Recovery of N from irrigation water:

Summer



Fall



H_2O = 86% , Fertilizer std = 55%

H_2O = 41% , Fertilizer std = 20%

Did N levels in water affect soil nitrate concentration?

Fall: Soil Mineral N 0-1 foot (14 days before) harvest)

#	Treatment Description	NO_3-N	Mineral N
1	Unfertilized control (2 PPM NO3-N)	4.5	5.5
2	Standard Fertilizer (150 lb N/Acre)	17.3	18.3
3	12 PPM NO_3-N in irrigation water	8.7	9.7
4	22 PPM NO_3-N in irrigation water	5.1	6.1
5	42 PPM NO_3-N in irrigation water	12.0	13.0
6	42 PPM N (NO_3+NH_4)	12.0	13.3
$LSD_{0.05}$		6.8	6.8

Summary

- Low concentrations of nitrate-N (12 ppm) in irrigation water were taken up by lettuce
- Fertilizer value of NH_4 and NO_3 sources of N were equivalent
- Volume of water applied to the crop did not affect the recovery rate of N from the irrigation water
- 2014 trials will evaluate if N in water is equivalent to fertilizer N