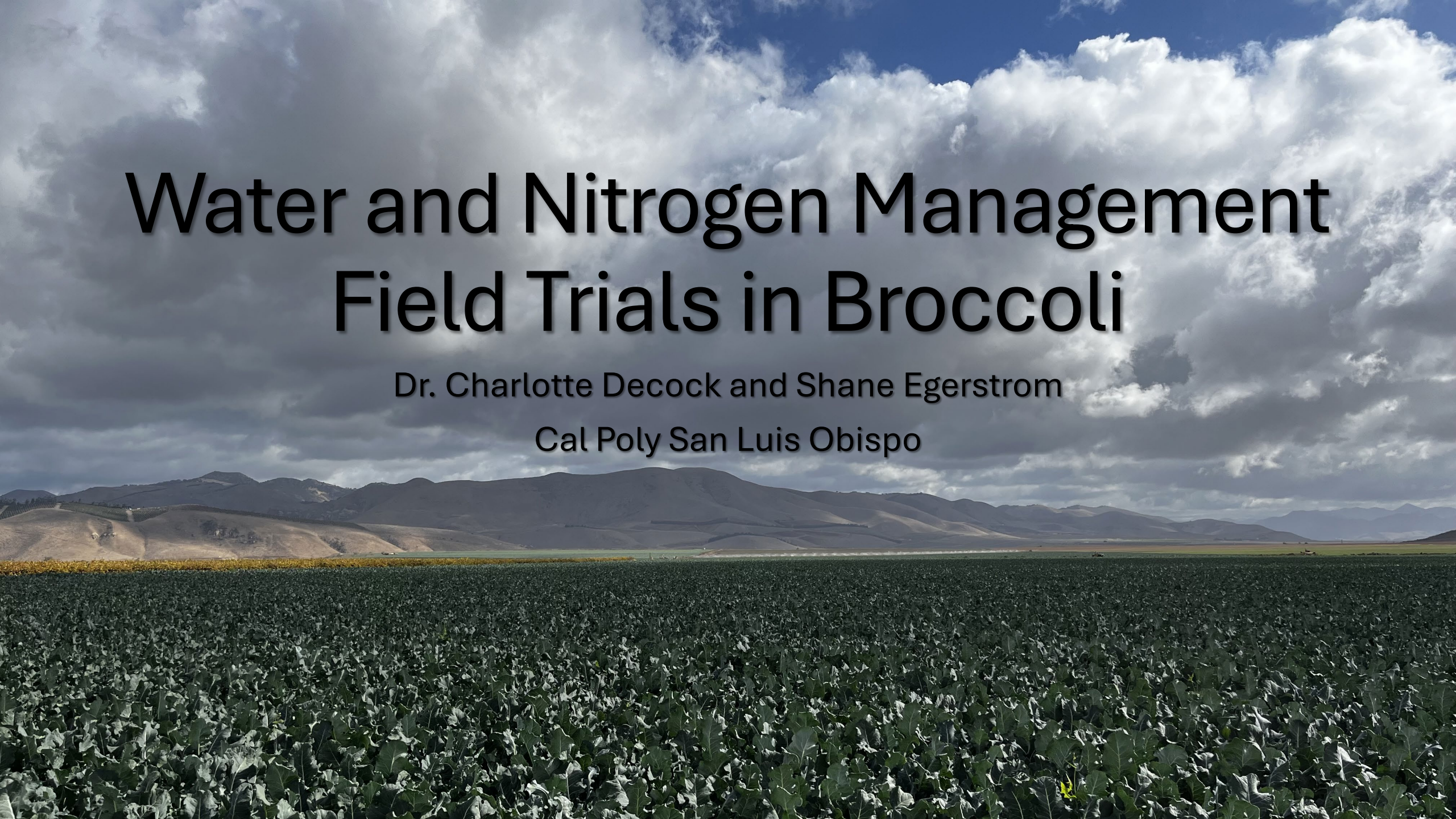

Water and Nitrogen Management Field Trials in Broccoli

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Background

- Pressures from Ag Order 4.0
- More stringent N budgeting

N in irrigation water

Residual Preplant Soil N

Efficient irrigation management

- How much can irrigation management affect NUE?

Objectives

1. Evaluate whether ET-based irrigation (ETI) improves nitrogen use efficiency (NUE) compared to the grower's standard irrigation practice (GS) in commercial broccoli production across diverse field conditions.

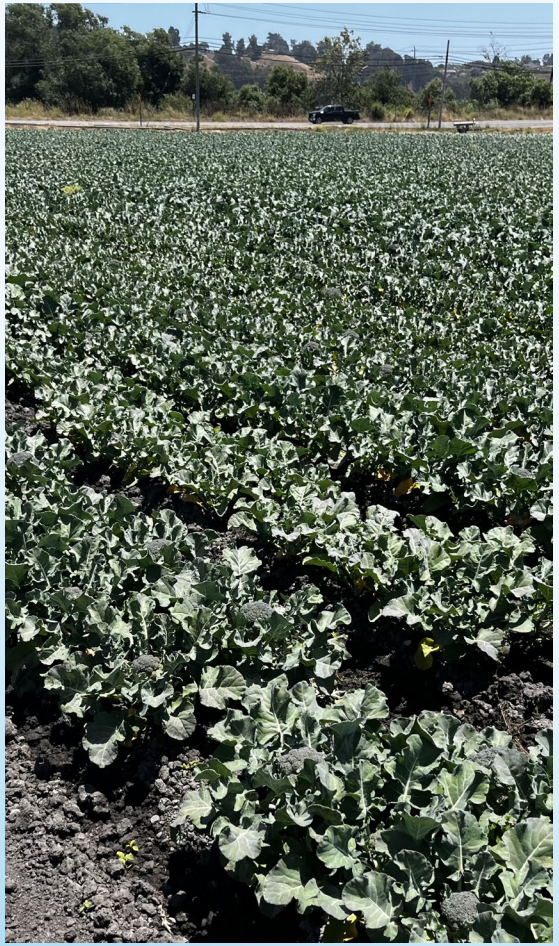
2. Compare the importance of factors such as irrigation water N, residual soil N, and irrigation management on yield and NUE.

Hypothesis

- ETI will show greater NUE and lower optimal fertilizer N rates compared to GS across diverse field conditions, due to greater retention of N from various sources in the root zone.

Experimental Design

- Located in Santa Maria Valley
- 3 seasons, all conventional broccoli
- Each season different field
- CropManage used to inform ET based irrigation rates



Experimental Design

- 6 beds per field, each divided into five 100’ subplots
- 2 irrigation treatments
  - ETI and GS
- 5 N rates
  - Preplant only – 150% grower application

ETI	GS				
	37.5%	150%	75%	preplant	112.5%
	37.5%	112.5%	150%	75%	preplant
	37.5%	preplant	75%	112.5%	150%
	37.5%	112.5%	preplant	75%	150%
	preplant	37.5%	150%	75%	112.5%
	preplant	112.5%	75%	150%	37.5%

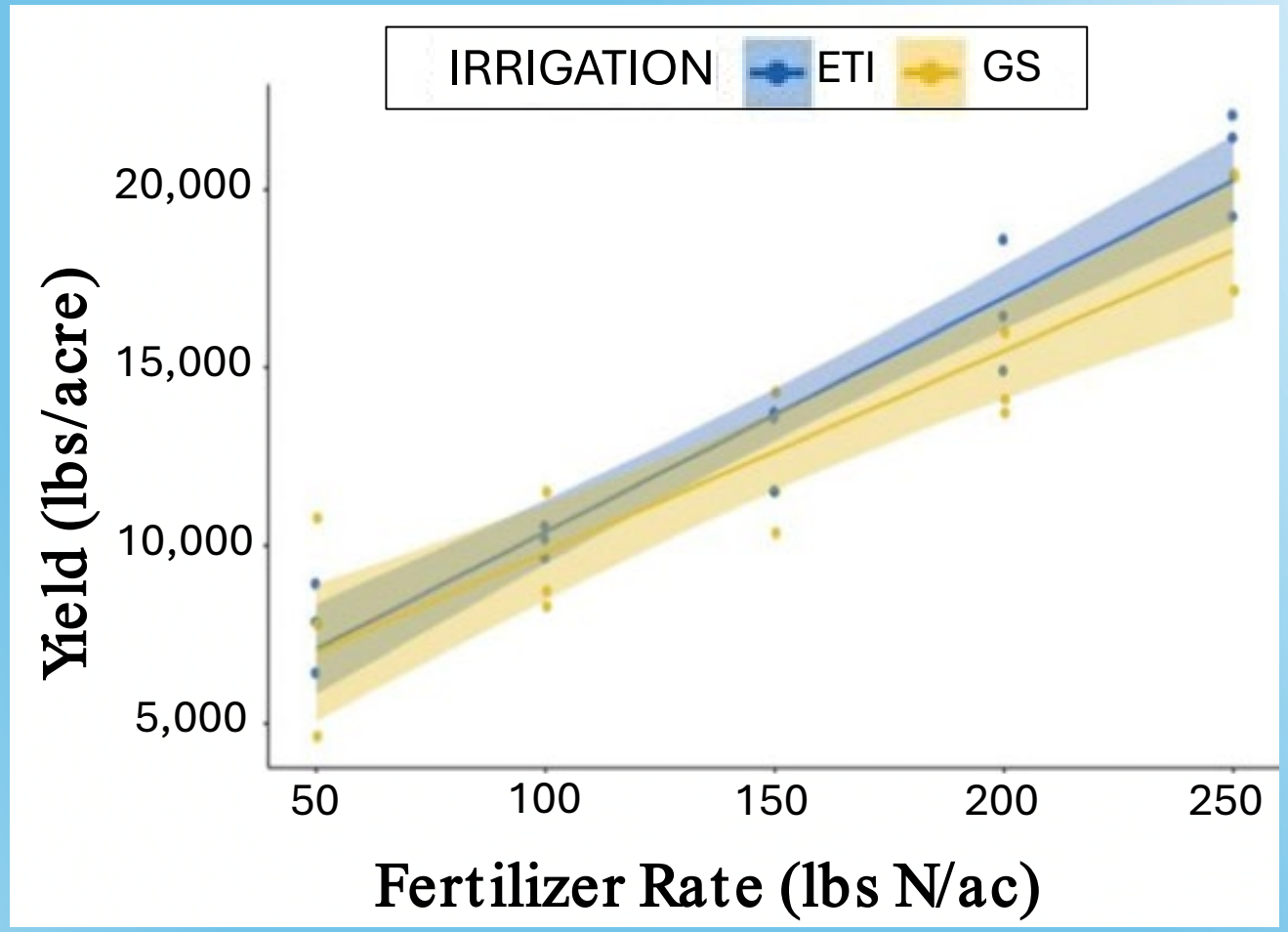
Measurements Taken

- Preplant, Midseason, and Postharvest soil samples.
- 2’ cores (trials 1 and 2) and 3’ cores (trial 3).
- Analyzed for N content at 0-6”, 6-12”, 12-24”, and 24-36” distinctions.

- Plant samples were collected for assessment of yield, total aboveground biomass, and aboveground N uptake.

Trial 1 – 26% ETI Water Reduction

Yield



Linear regression: Significance of irrigation found based on log likelihood test.

- Chi-square = 12.35
- p-value < 0.001

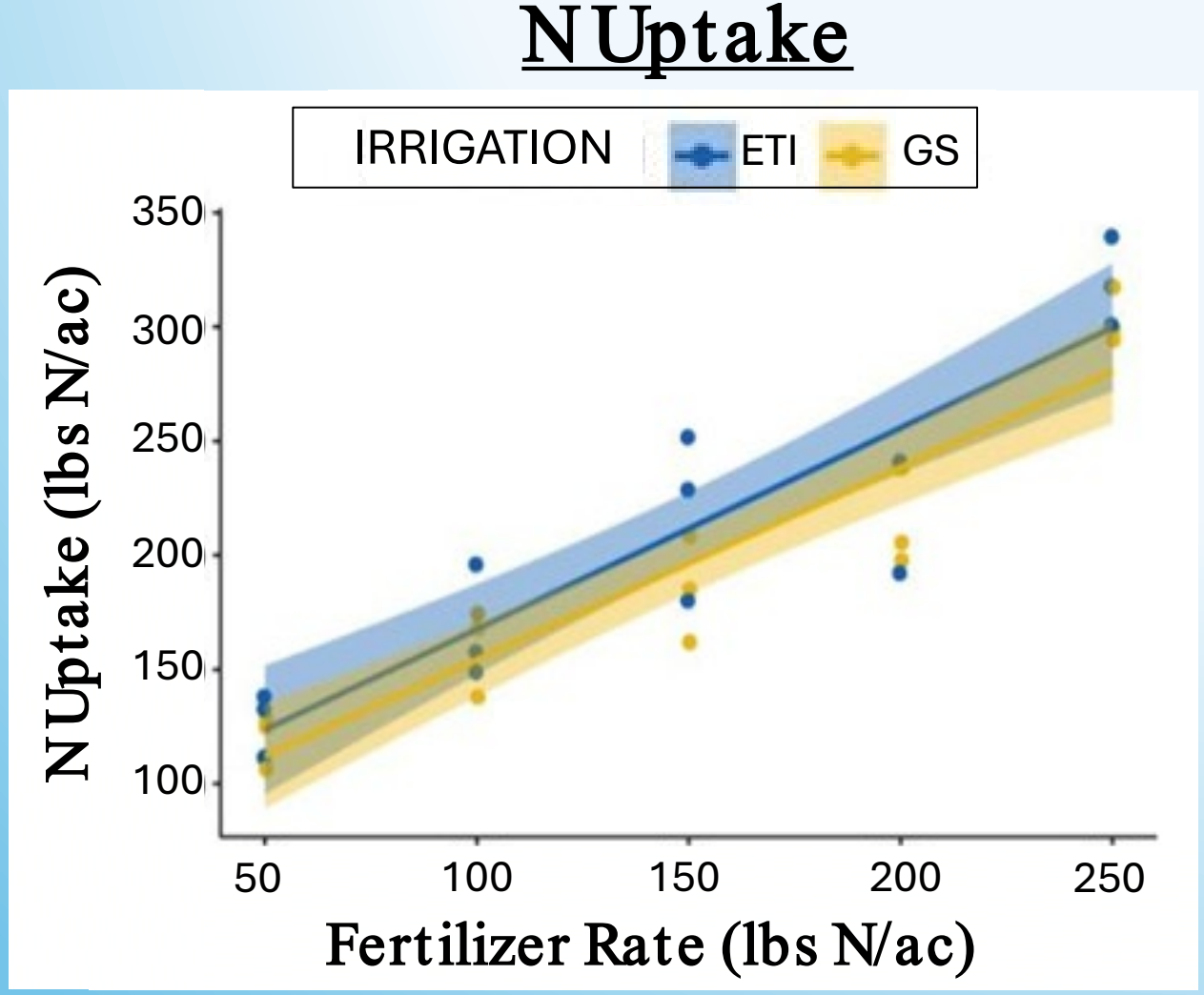
	Yield	
	F value	p value
Irrigation	2.62	0.122
N rate	46.98	<0.001
Irrigation x N rate	0.32	0.861

Trial 1 – 26% ETI Water Reduction

Linear regression: Significance of irrigation found based on log likelihood test.

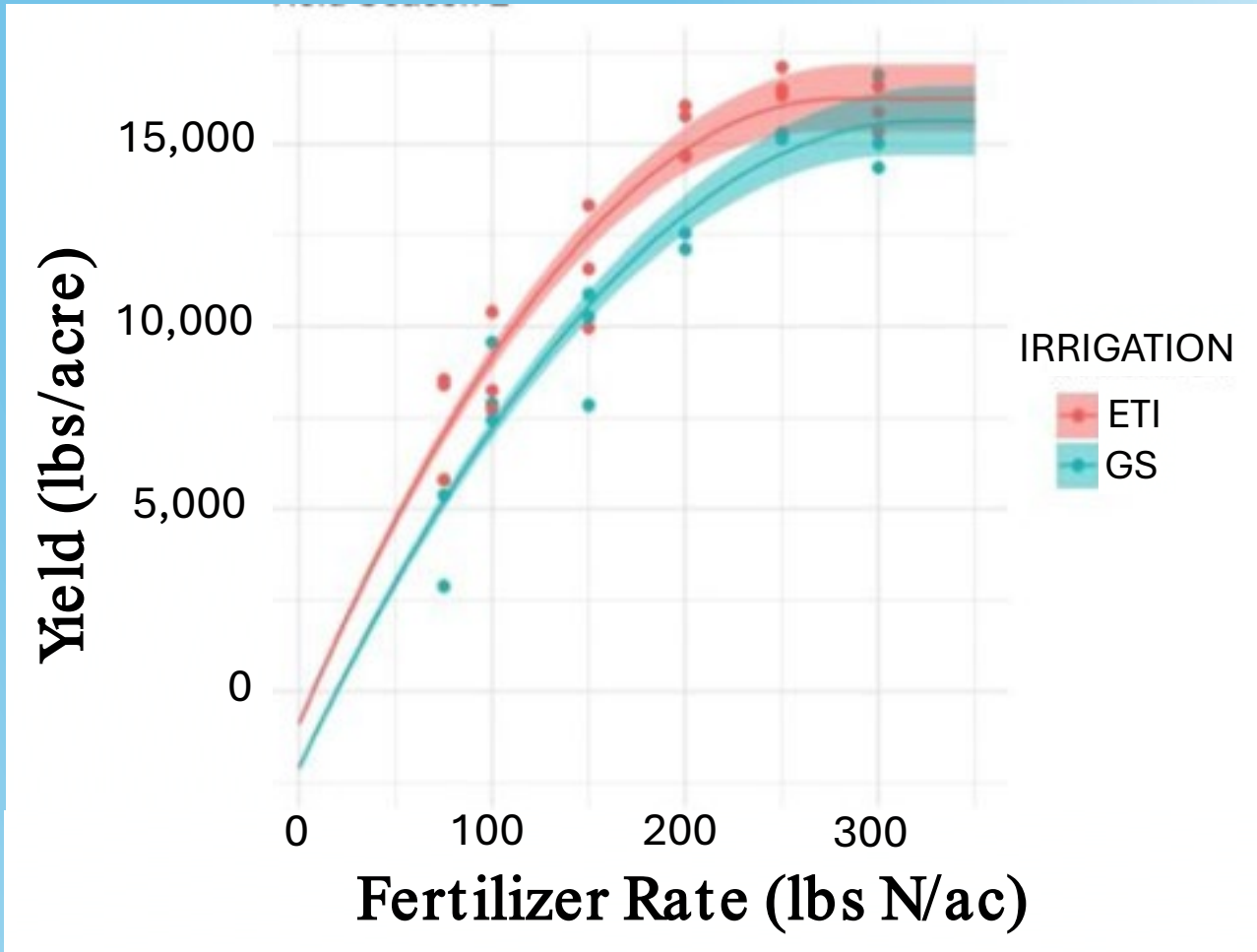
- Chi-square = 6.03
- p-value < 0.001

	N uptake	
	F value	P value
Irrigation	1.64	0.270
N rate	84.23	<0.001
Irrigation x N rate	0.57	0.670



Trial 2 - 15% ETI Water Reduction

Yield (lbs/ac)



Quadratic plateau model yield:

- Optimal N rate for ETI was significantly smaller than GS
- Maximum yield for ETI was significantly greater than GS

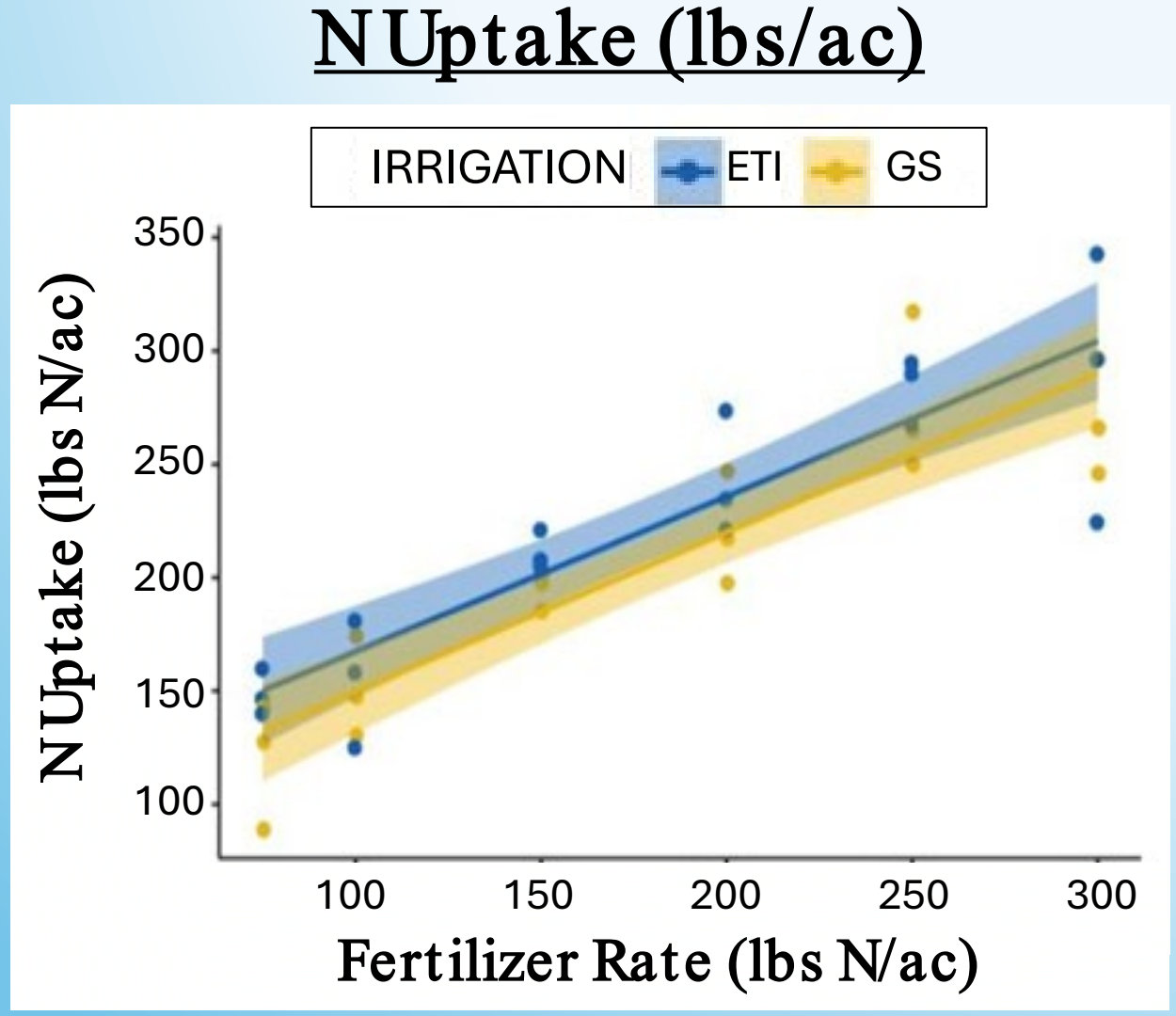
	Yield	
	F value	p value
Irrigation	7.78	0.049
N rate	80.37	<0.001
Irrigation x N rate	1.18	0.355

Trial 2 - 15% ETI Water Reduction

Linear regression: Significance of irrigation found based on log likelihood test.

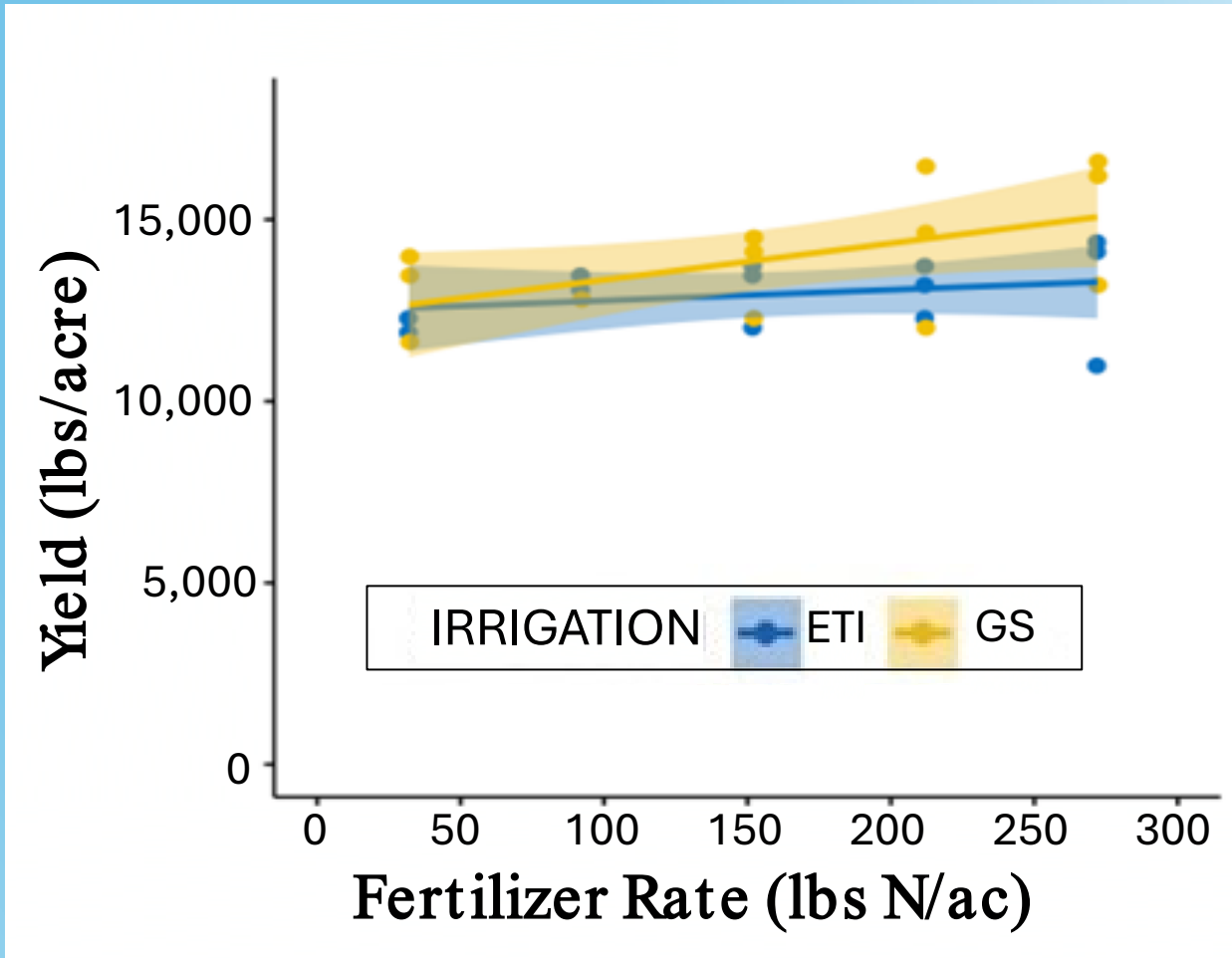
- Chi-square = 3.01
- p-value < 0.001

	N uptake	
	F value	P value
Irrigation	1.11	0.351
N rate	45.28	<0.001
Irrigation x N rate	0.27	0.927



Trial 3 – 13% ETI Water Reduction

Yield (lbs/ac)



Linear regression: No significance of irrigation found.

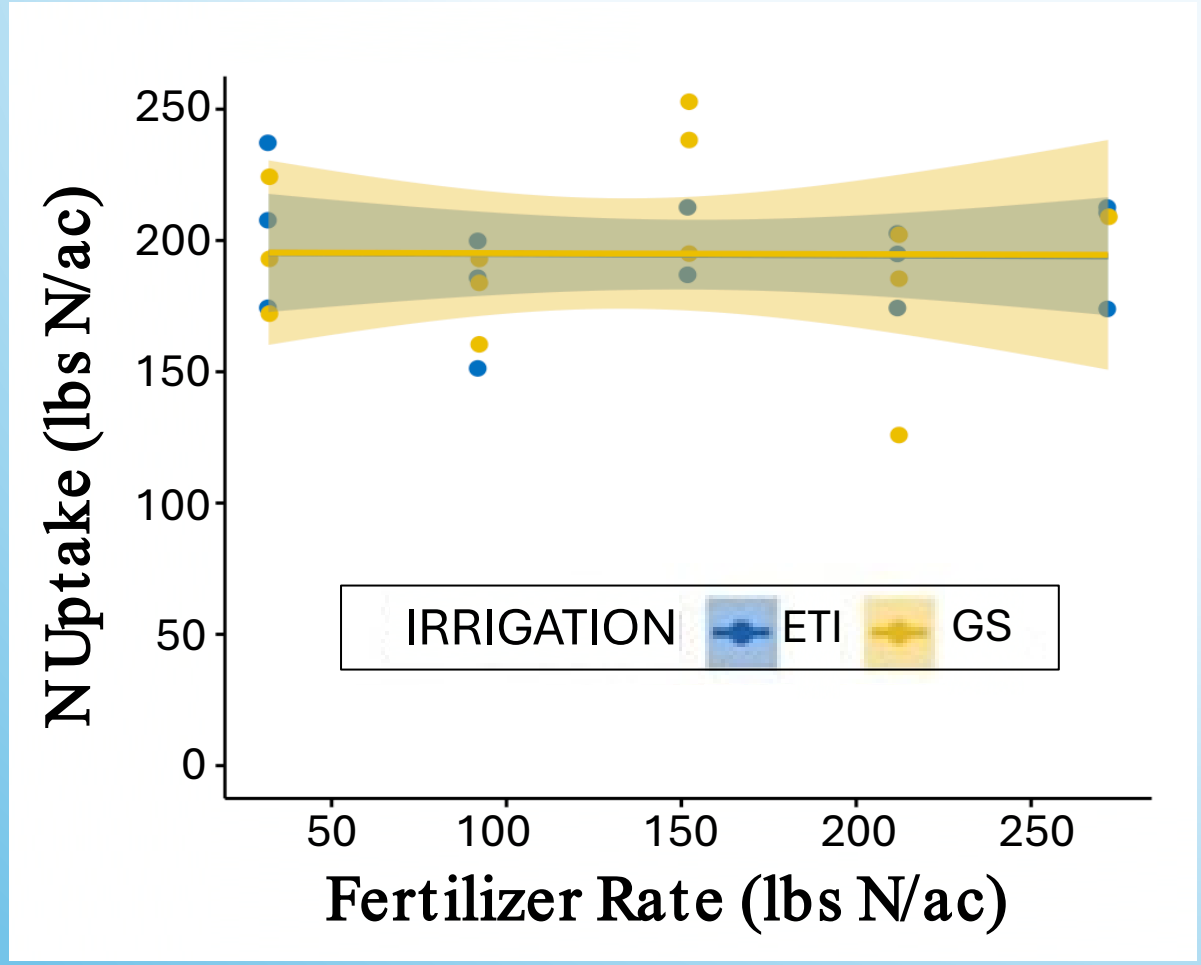
	Yield	
	F value	p value
Irrigation	2.01	0.222
N rate	1.29	0.322
Irrigation x N rate	0.66	0.628

Trial 3 – 13% ETI Water Reduction

Linear regression: No significance of irrigation found.

	N uptake	
	F value	P value
Irrigation	0.03	0.860
N rate	1.78	0.180
Irrigation x N rate	0.64	0.641

N Uptake (lbs/ac)



Comparing Trial Conditions

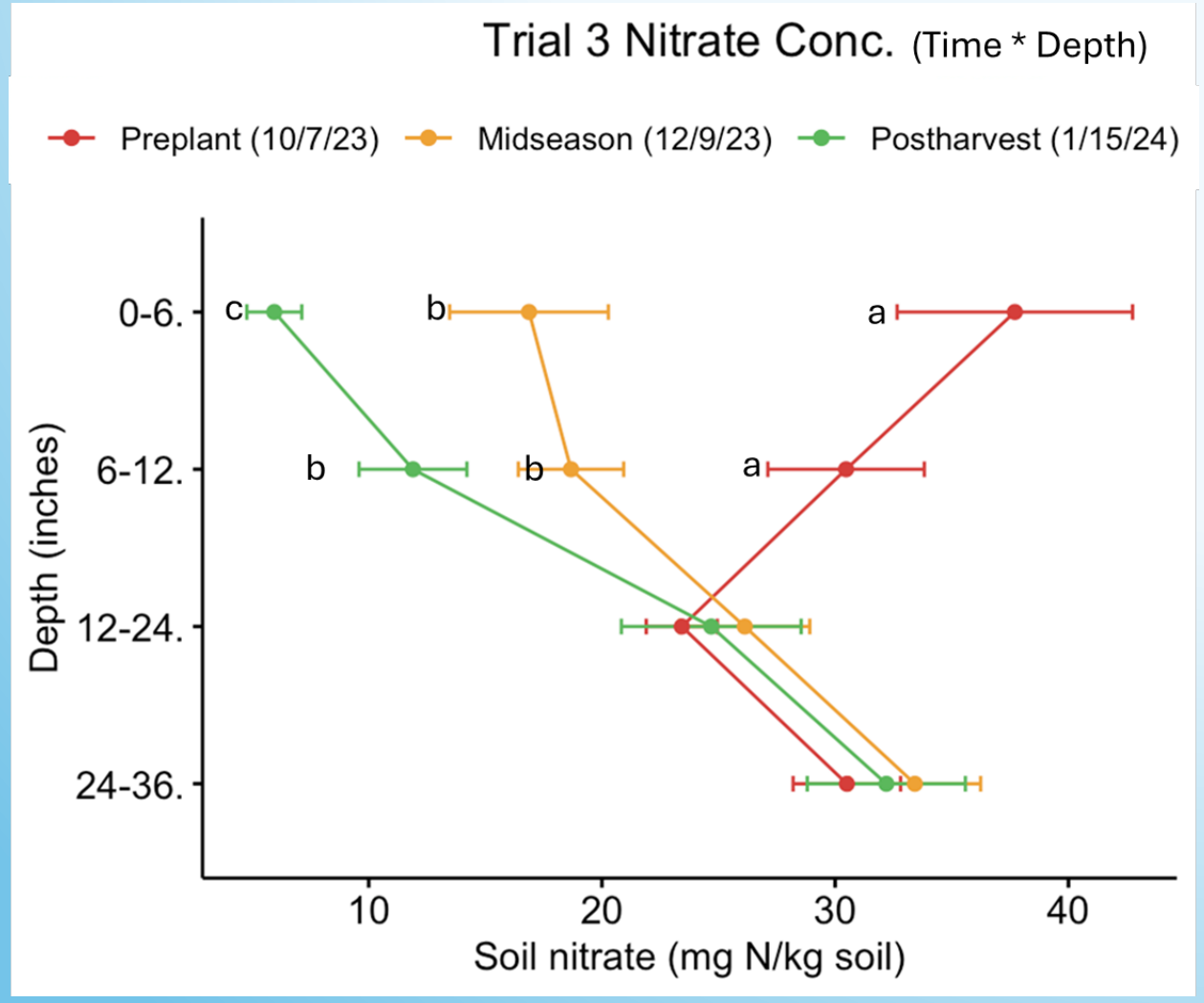
	Trial 1	Trial 2	Trial 3
Preplant Nitrate-N concentration (0-12” depth)	24 mg N/kg soil	38 mg N/kg soil	34 mg N/kg soil
Preplant Nitrate-N Concentration (12-24” depth)	13 mg N/kg soil	18 mg N/kg soil	23.4 mg N/kg soil
Lbs N/ac applied by irrigation (GS)	10.4	7	27.3
Lbs N/ac applied by irrigation (ETI)	7.69	5.95	23.8
Inches of rainfall	0”	2.5”	1.5”

Hypothesis

- ETI will show greater NUE and lower optimal fertilizer N rates compared to GS across diverse field conditions, due to greater retention of N from various sources in the root zone.

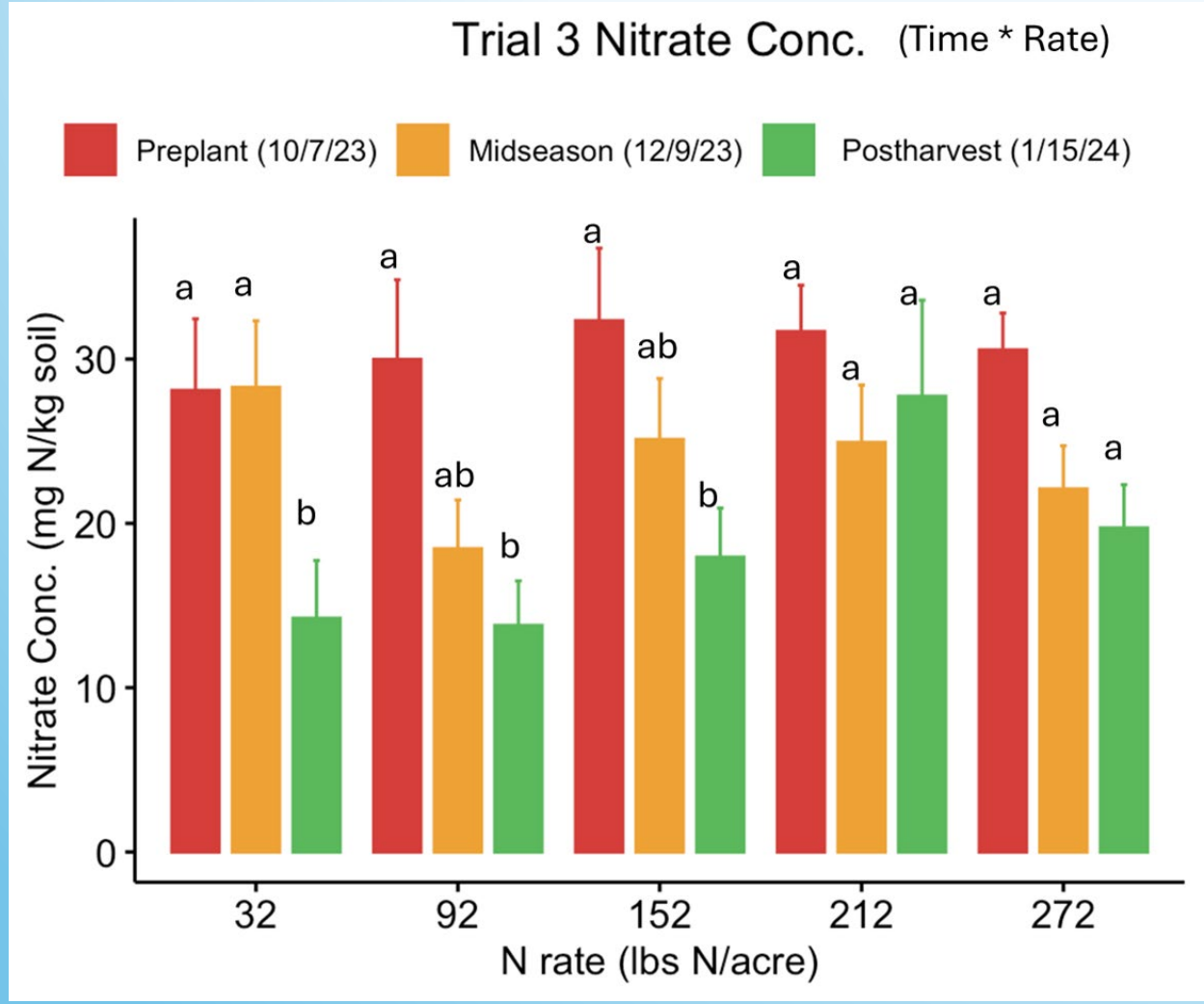
Trial 3: Time and Depth

ANOVA	Soil Nitrate	
	F value	P value
Time x Depth	14.22	<0.001



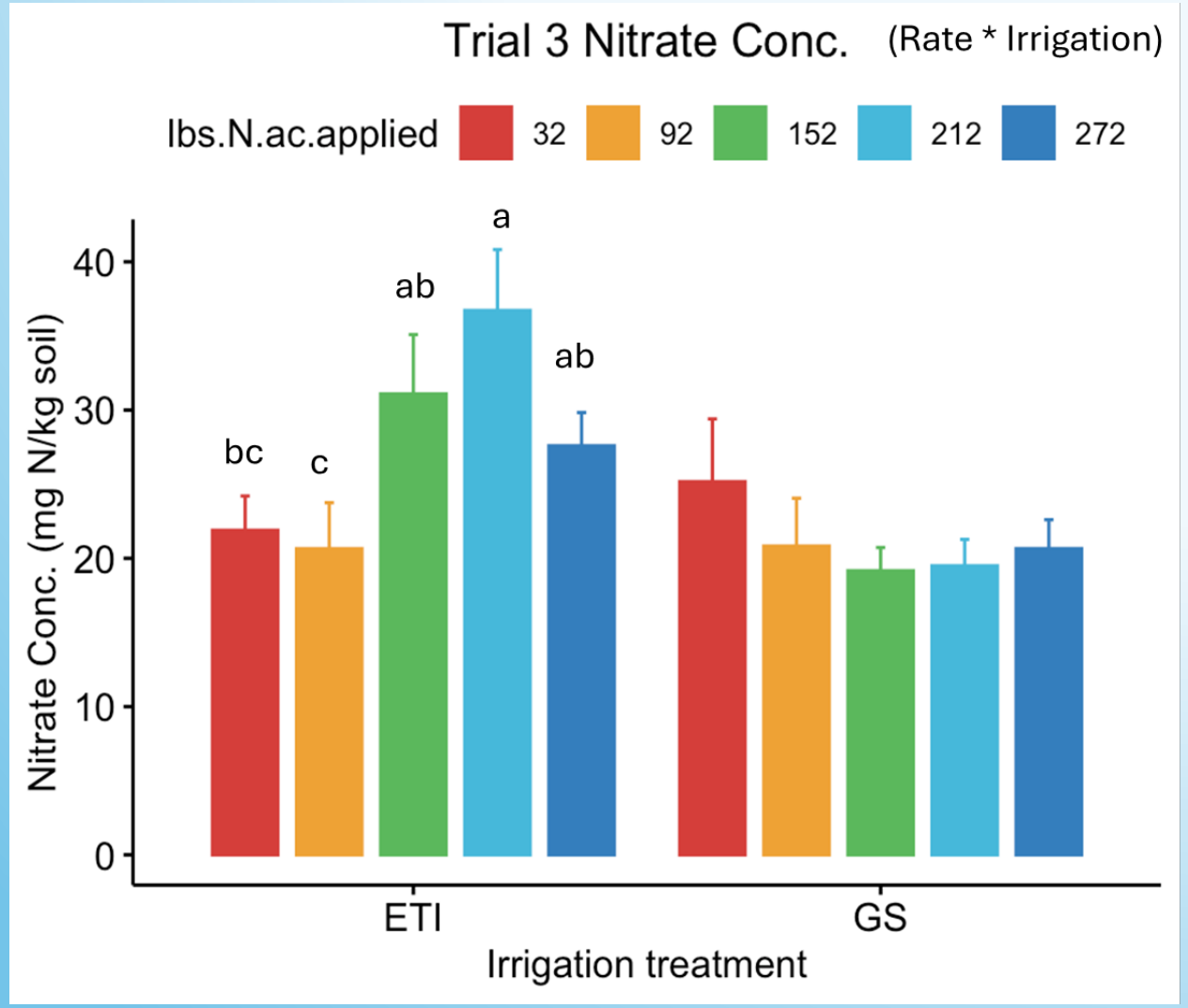
Trial 3: Time and Rate

ANOVA	Soil Nitrate	
	F value	P value
Time x N rate	2.25	0.025



Trial 3: Rate and Irrigation

ANOVA	Soil Nitrate	
	F value	P value
Irrigation x N rate	5.26	<0.001



Conclusions

- In all 3 trials, irrigation water inputs were lower in ETI compared to GS without negatively affecting yield.
- Trial 2 demonstrated that yield could be maximized at lower N rates under ETI compared to GS.
- Differences in yield responses across all three trials highlight the importance of accounting for all N sources, including irrigation water N and residual preplant N to a depth of 2(+) feet.
- Soil nitrate data demonstrated that ETI irrigation was more effective at keeping N within the root zone.

Questions?

- Data analysis in progress for more trials
- Future trials planned