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Management Strategies for Irrigated Crop Production

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Red River Authority BAC Meetings

Improving Life through Science and Technology.

Objectives

- Management strategies to conserve water resources
- Management strategies to protect water resources

Cropping Systems

- Water is the most limiting factor in crop production within semi-arid environments.
- Systems which capture precipitation and maximize water use efficiencies will theoretically also maximize nutrient use efficiencies and subsequent yields.
- Develop conservation tillage and water management strategies that enhance crop production in the Texas Rolling Plains

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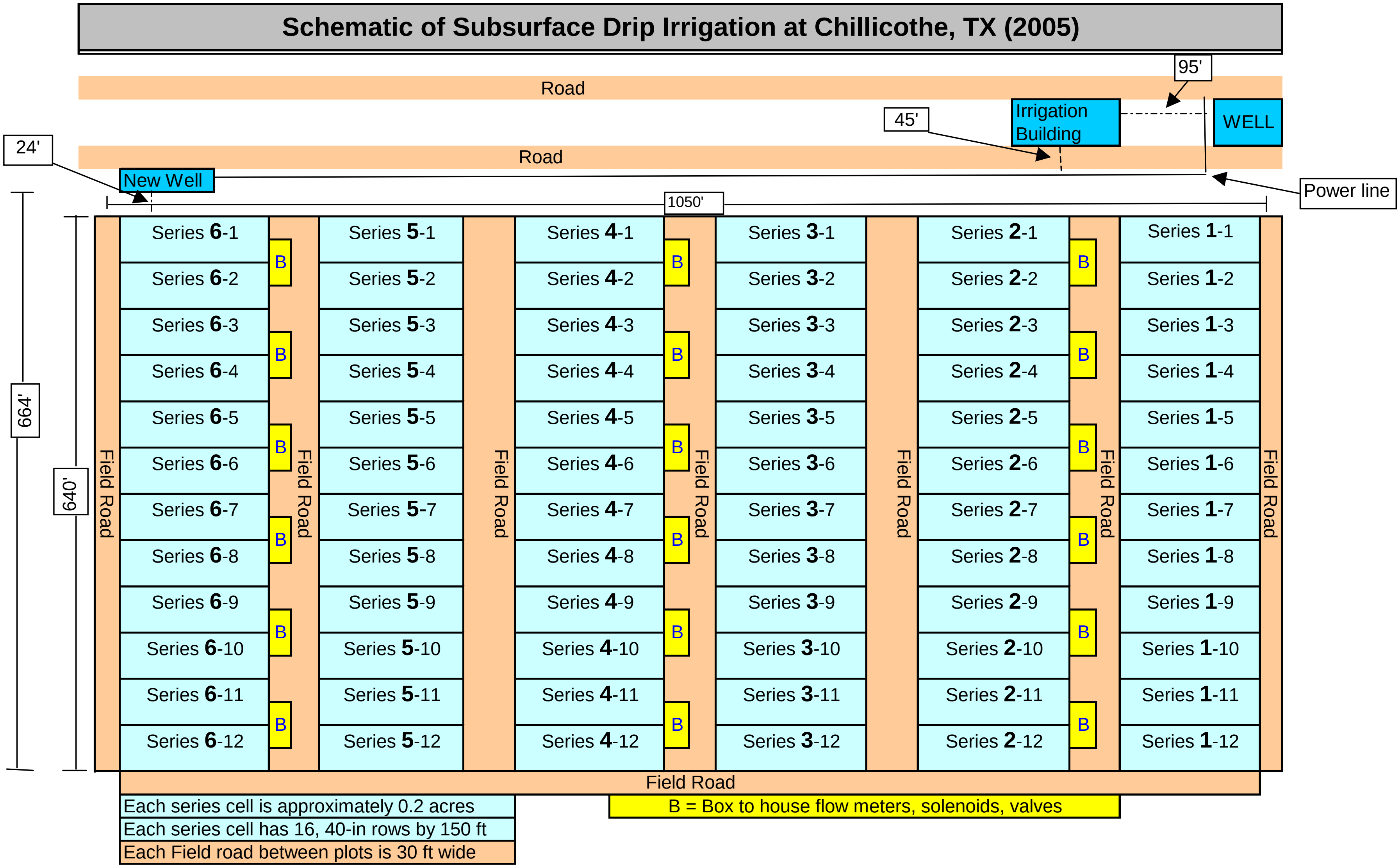
LEVELAND

Chillicothe Research Station



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Materials and Methods

- Planting Date:
  - 5/15 ’08
  - 5/21 ’09
  - 5/20 ‘10
- Seeding rate: 4.2 seed/ft
- Variety: Stoneville 4554 B2RF
- 3 Reps, RCB

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Tillage & Irrigation Systems

- Conventional till (bedded)
  Reduced till (flat)
  No-till in terminated cover crop (flat)
  No-till (flat)

- ET replacement @
  0, 33, 66, 100, and 133
  (High Plains ET Network)

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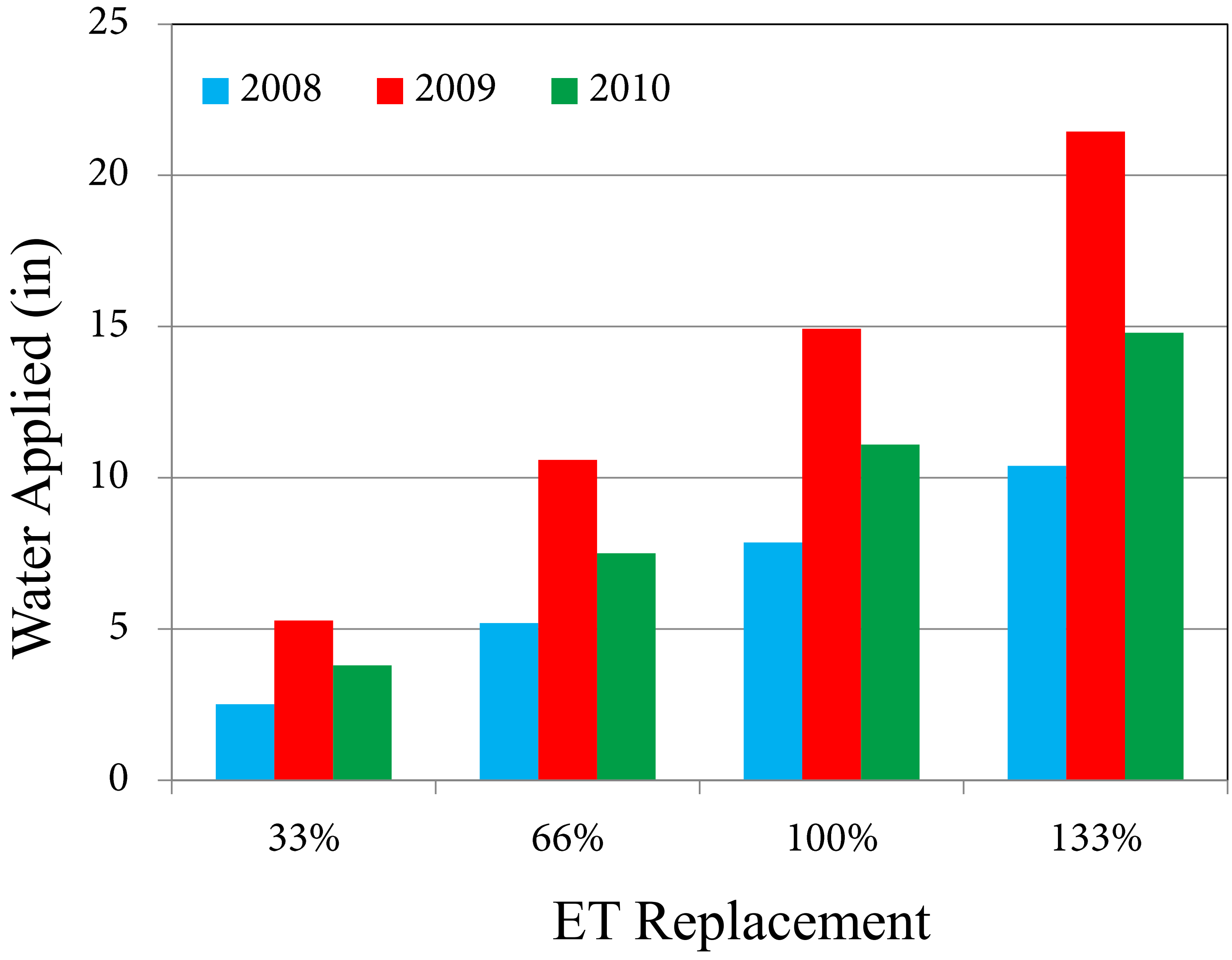

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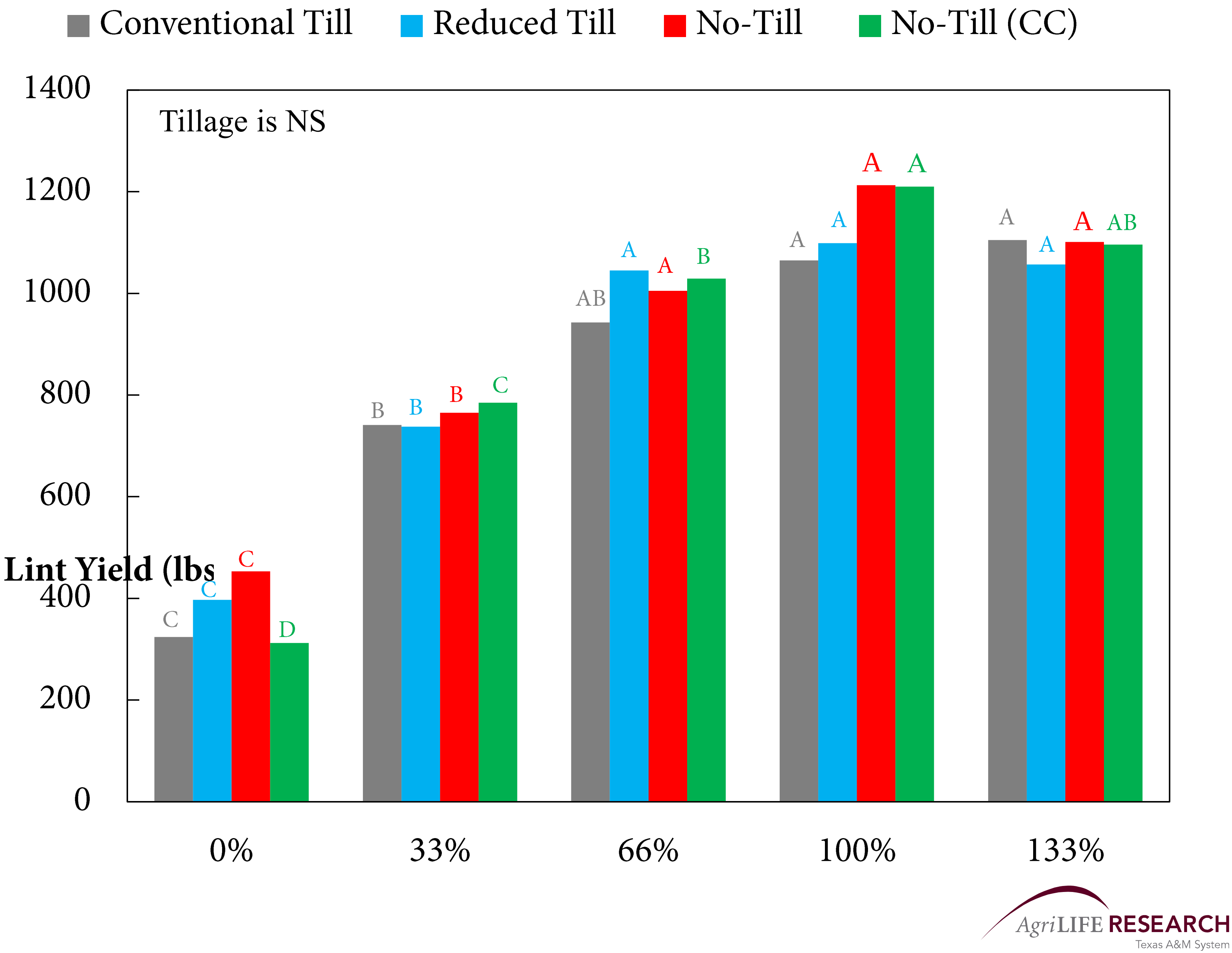

Conventional Till
Reduced Till
No-Till
No-Till (CC)
Tillage is NS
Lint Yield (lbs
1400
1200
1000
800
600
400
200
0
C C C D
B B B C
AB A A B
A A A A
A A A AB
0%
33%
66%
100%
133%
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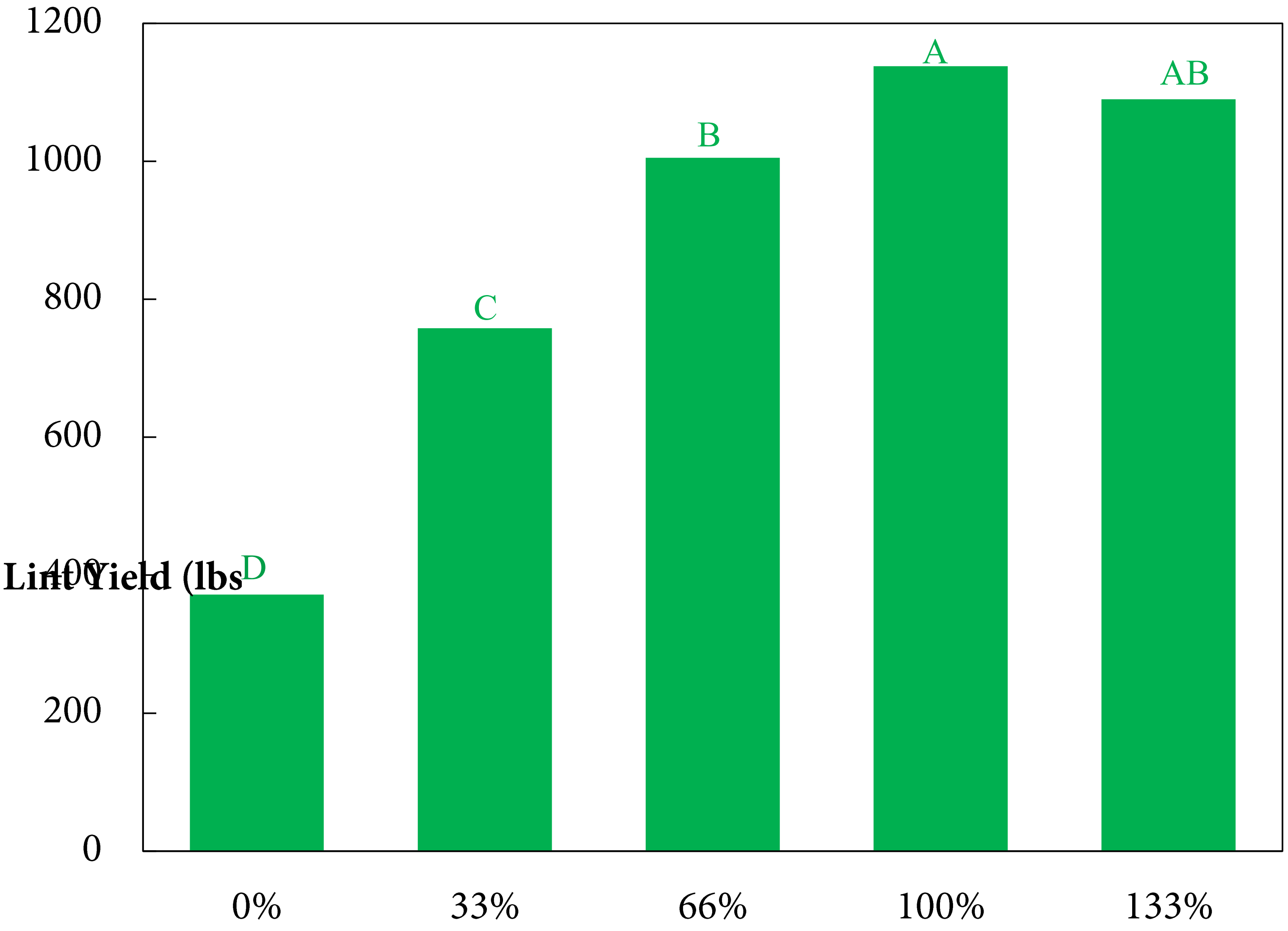

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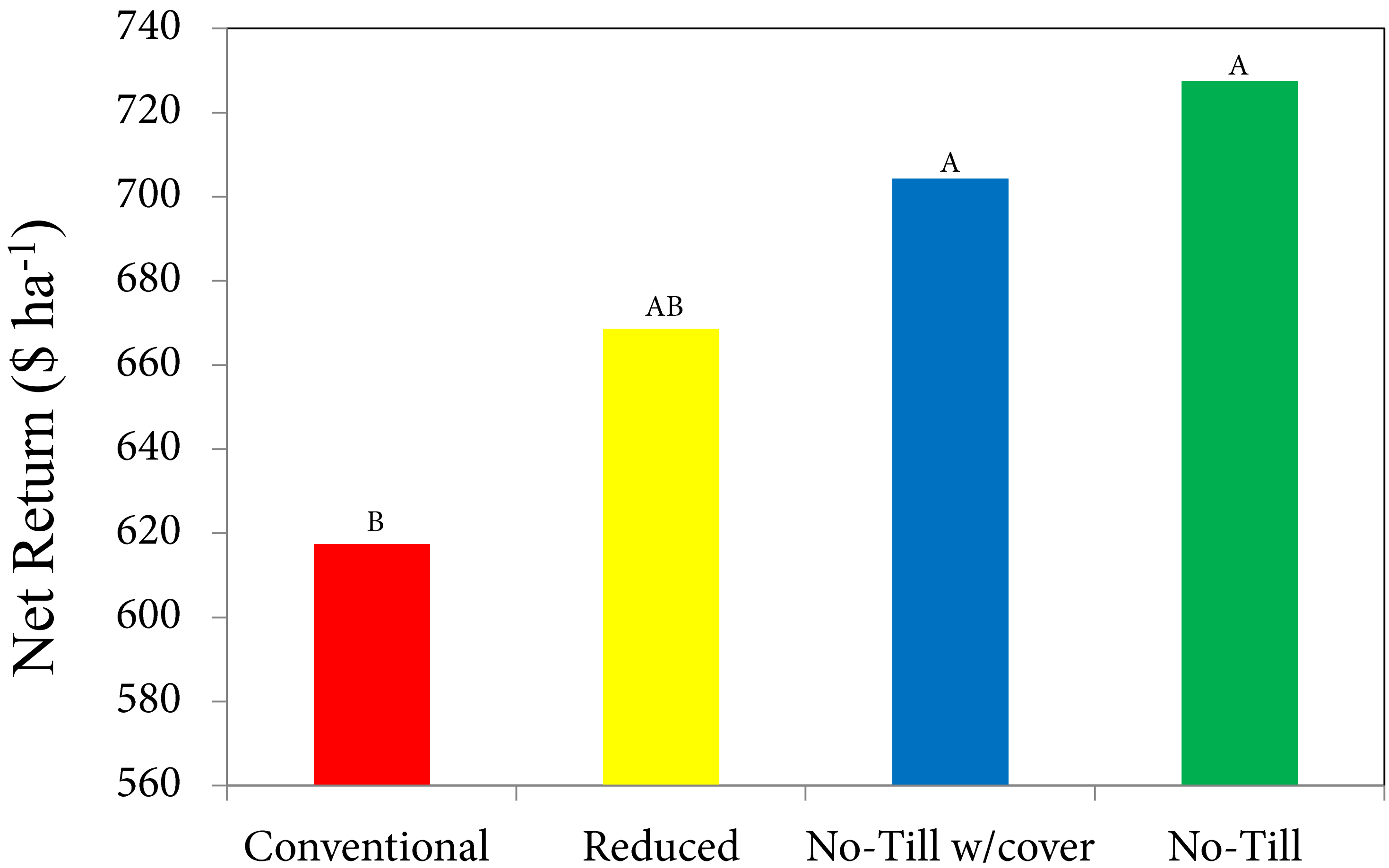

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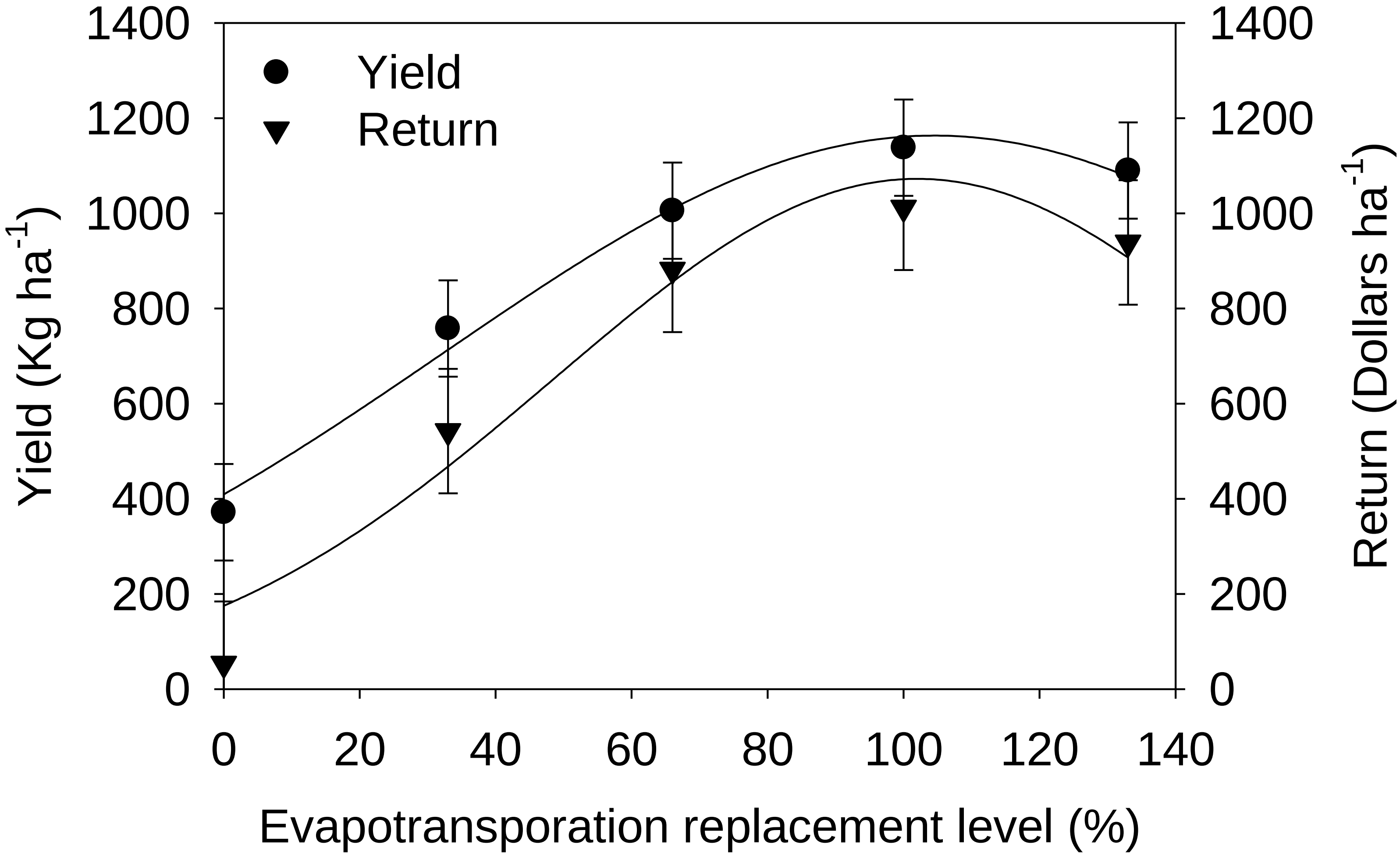


Yield
Return
Yield (Kg ha-1)
Return (Dollars ha-1)
0
200
400
600
800
1000
1200
1400
0
20
40
60
80
100
120
140
Evapotransporation replacement level (%)

Conclusions

- ✓ Lint yields were not affected by tillage, but significantly affected by ET replacement level.
- ✓ Greatest lint yields and net returns were achieved at 100% ET replacement.
- ✓ 95% confidence interval of fitted model indicated that maximum lint yields could be achieved at 83% ET replacement; savings of 1.34-2.5 ac-in of water.
- ✓ The adoption of conservation tillage systems should not negatively affect lint yield or net returns in deficit irrigated SDI cotton systems within the Texas Rolling Plains, particularly during the transition from intensively tilled systems to conservation tilled systems.

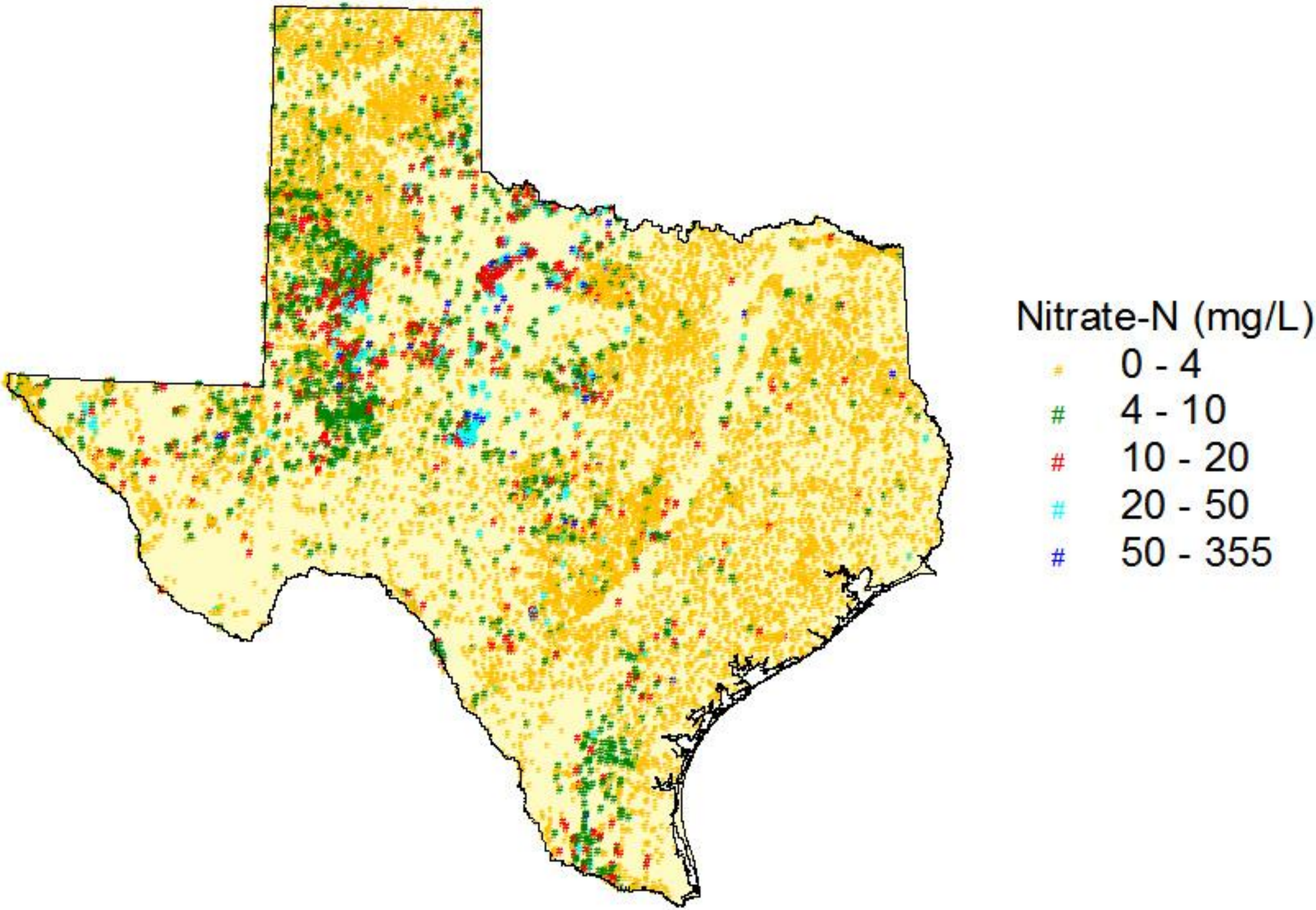
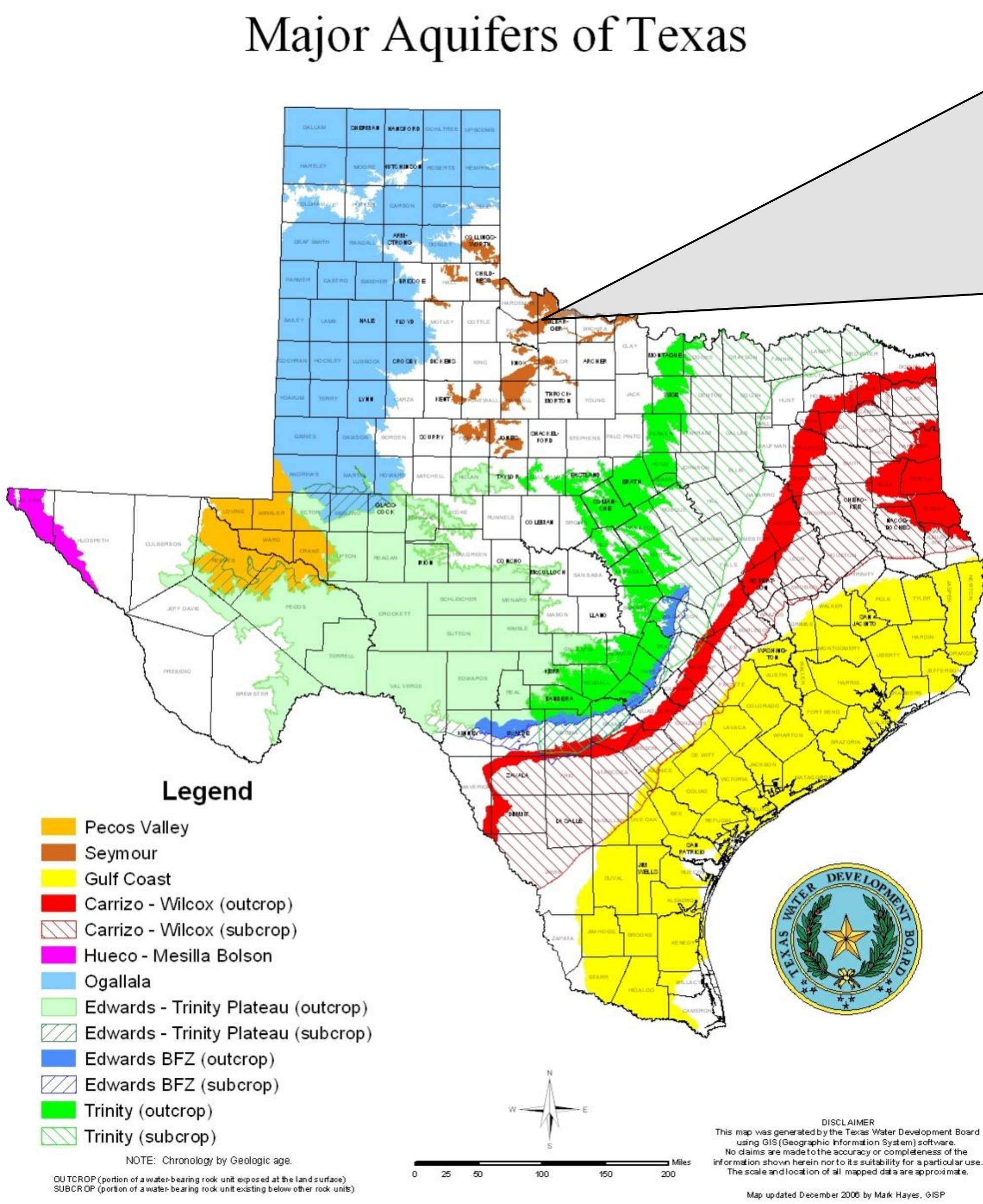
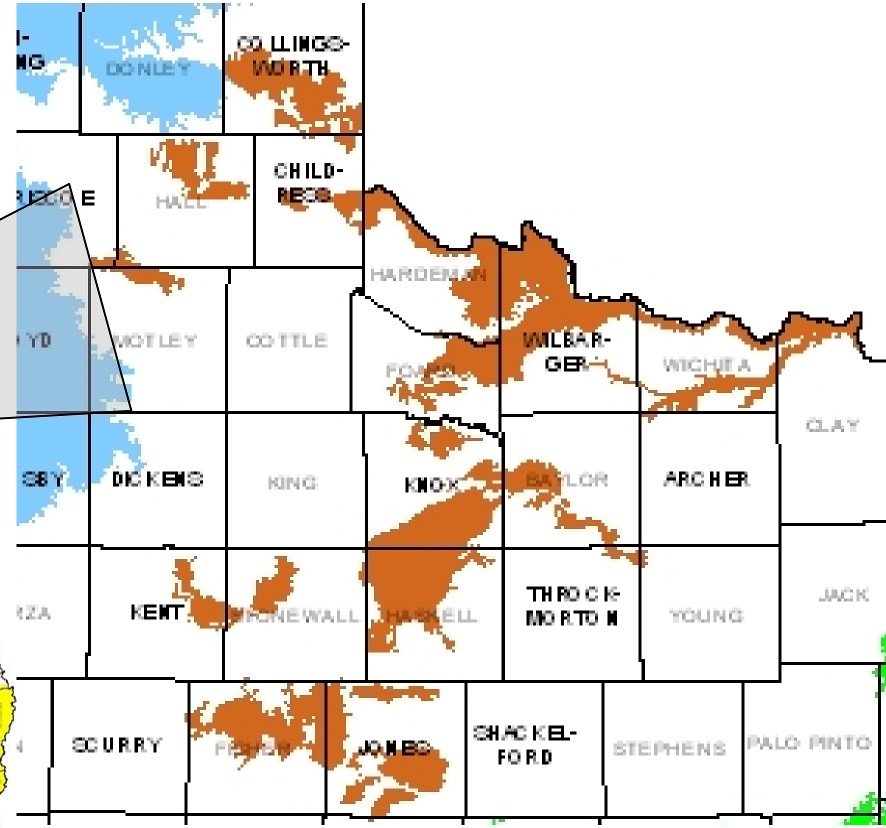


Figure 1. Distribution of NO_3-N in groundwater in Texas (TWDB Data).





- ✓ Seymour Aquifer
- ✓ Underlies 300,000 ac
- ✓ 3000 wells
- ✓ 75% >10 ppm NO_3-N

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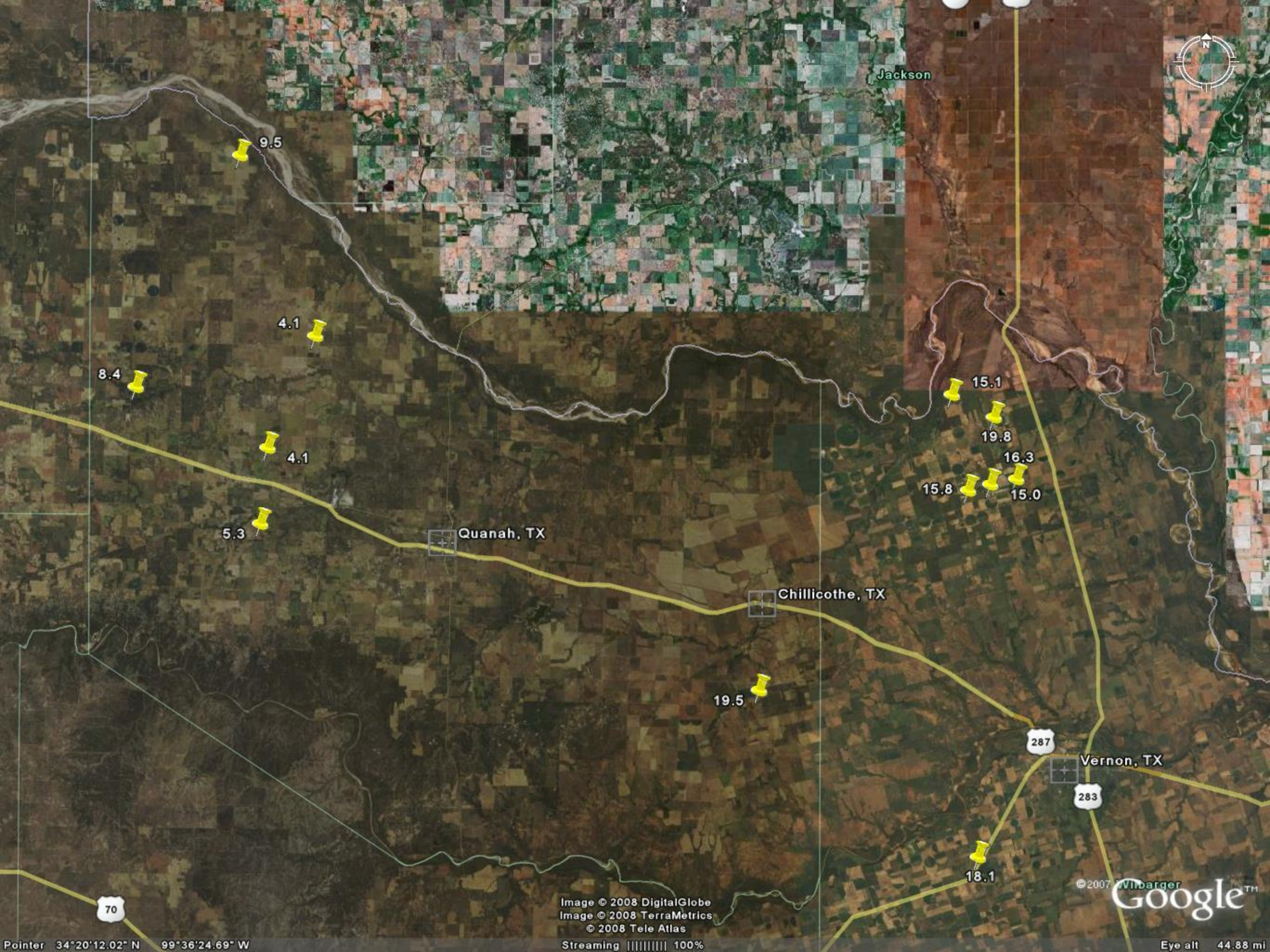
Jackson
9.5
4.1
8.4
4.1
5.3
Quanah, TX
Chillicothe, TX
15.1
19.8
16.3
15.8
15.0
19.5
287
Vernon, TX
283
18.1
70
©2007 Wilbarger
Google™
Image © 2008 DigitalGlobe
Image © 2008 TerraMetrics
© 2008 Tele Atlas
Pointer 34°20'12.02" N 99°36'24.69" W
Streaming |||||||||| 100%
Eye alt 44.88 mi

Problem or Resource?

✓ **Environmentally**

- \- exceeds EPA safe drinking water standards (10 ppm)
- \- spring fed streams may exceed freshwater screening standards (1.95 ppm)

✓ **Resource**

- \- if it is credited as a N source

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Nitrate in Irrigation Water

- ✓ can supply considerable amounts of N since it is applied during the growing season
- ✓ immediately available for crop uptake
- ✓ could potentially reduce the amount of fertilizer needed

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Nitrate Crediting

- ✓ Two years of trials have shown that NO_3 crediting is a sound economic and agronomic practice.*
- ✓ When used properly, growers could maintain yields, reduce fertilizer costs, and help clean up groundwater
- ✓ The only significant yield loss from reducing N fertilizer applied occurred only when the expected water nitrate credit was not actually received from the applied irrigation water.

*CSU Fact Sheet #17

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Conversions

- ✓ ppm = mg/L
- ✓ Each ppm of nitrate nitrogen will add
  - 2.72 lb/ac of N with each foot of water applied or…
  - 0.23 lb/ac of N with each inch of water applied

Nitrate Applied Through Irrigation

lbs N/acre = NO_3-N (ppm) x 0.23 x inches of water applied/acre

Well Water NO_3-N (ppm)	------Inches of Water Applied------				
	6	12	18	24	30
	----------------lbs N/acre----------------				
5	7	14	21	28	35
10	14	28	41	55	69
15	21	41	62	83	103
20	28	55	83	110	138
25	34	69	104	138	173

Methods

✓Study initiated in 2010 at the Chillicothe Research Station – Chillicothe, TX

✓Plots are 8 row (40” row spacing) x 50 ft long (drip and pivot); 8 row x 100 ft (furrow)

✓3 reps (furrow) or 4 reps per treatment

✓FM 1740 planted on May 22, ‘10; May 31 ‘11

✓Plants clipped and dissected for N uptake determination; harvested for lint yield.

✓Post-harvest soil samples taken for nutrient evaluation.

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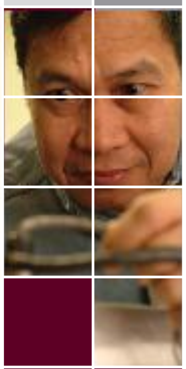

Nitrate Crediting

- Fertility Treatments
  - Unfertilized (Irrigation N Only)
  - N based on soil test
  - N&P
  - N minus irrigation N
  - N minus irrigation N & P
- Irrigation Treatments (100% ET)
  - Furrow, Pivot, Subsurface Drip

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Resulting N Application Rates

2010

	Yield Goal (bale/ac)	Residual Soil NO_3 (lb/ac)	Applied N (lb/ac)*	Applied N with irrigation N credit (lb/ac)
Furrow	2	25	75	20
Pivot	3	20	130	75
SDI	3	20	130	75

*70 lb P_2O_5 added to all P treatments

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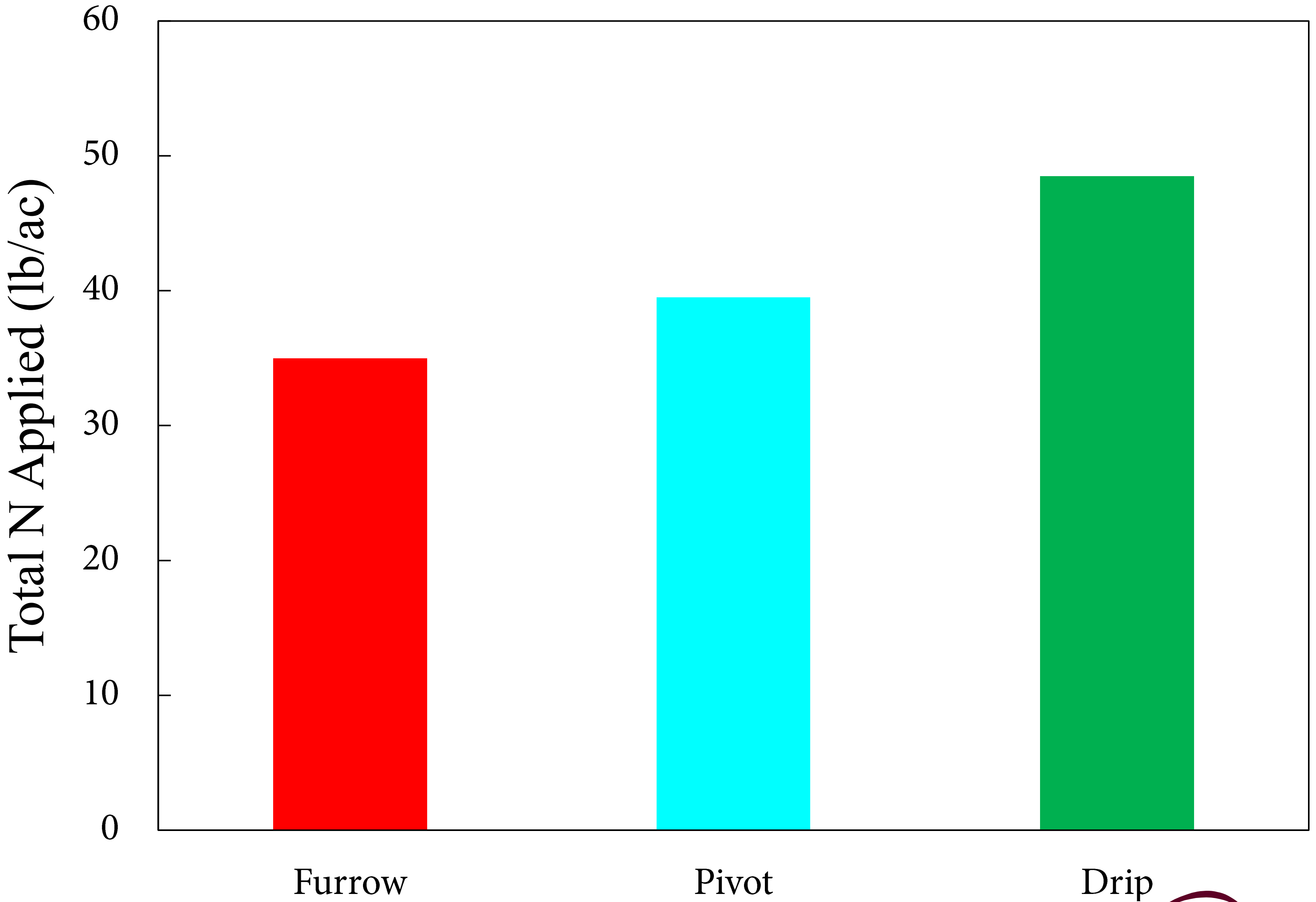
“Unfertilized” Control



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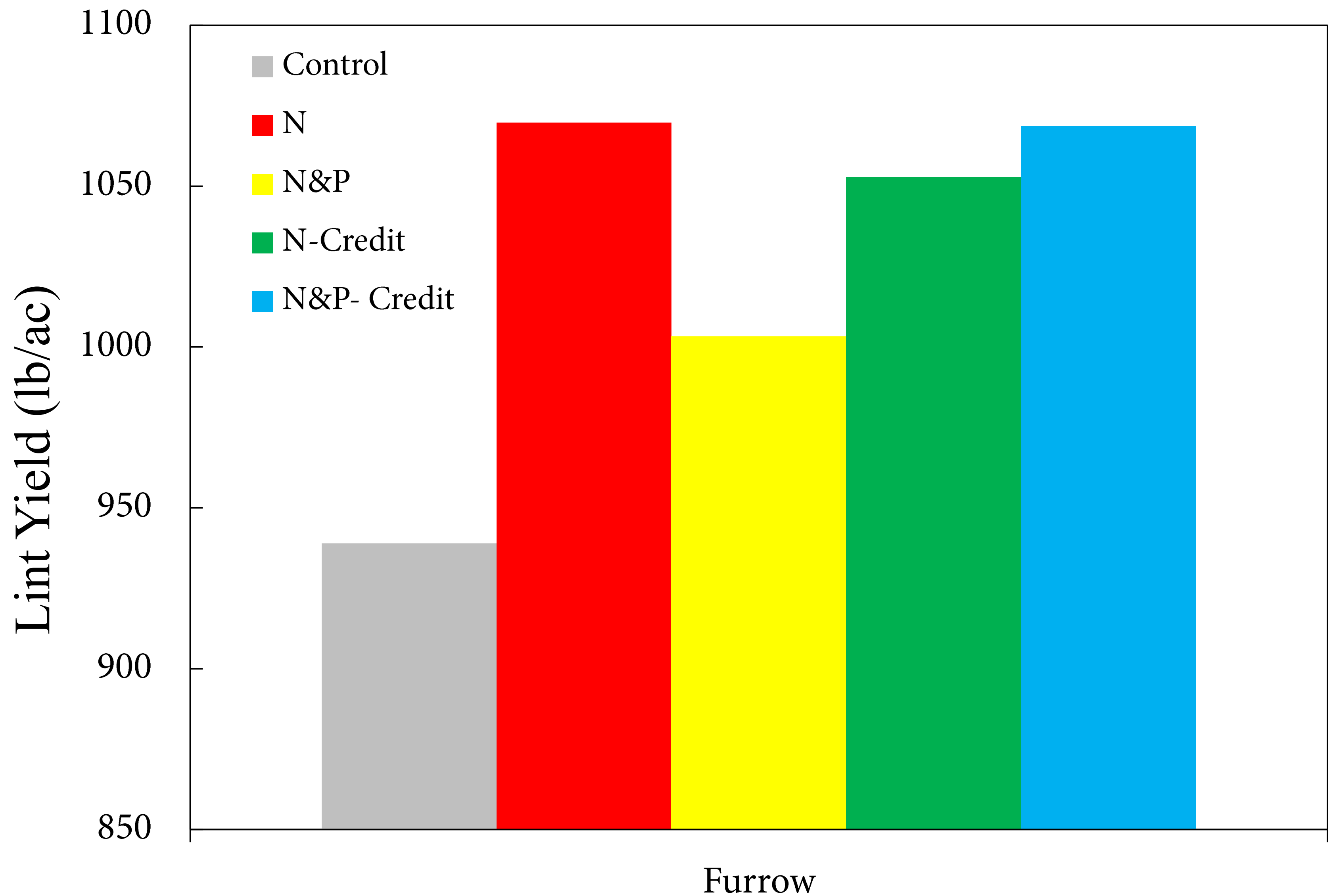

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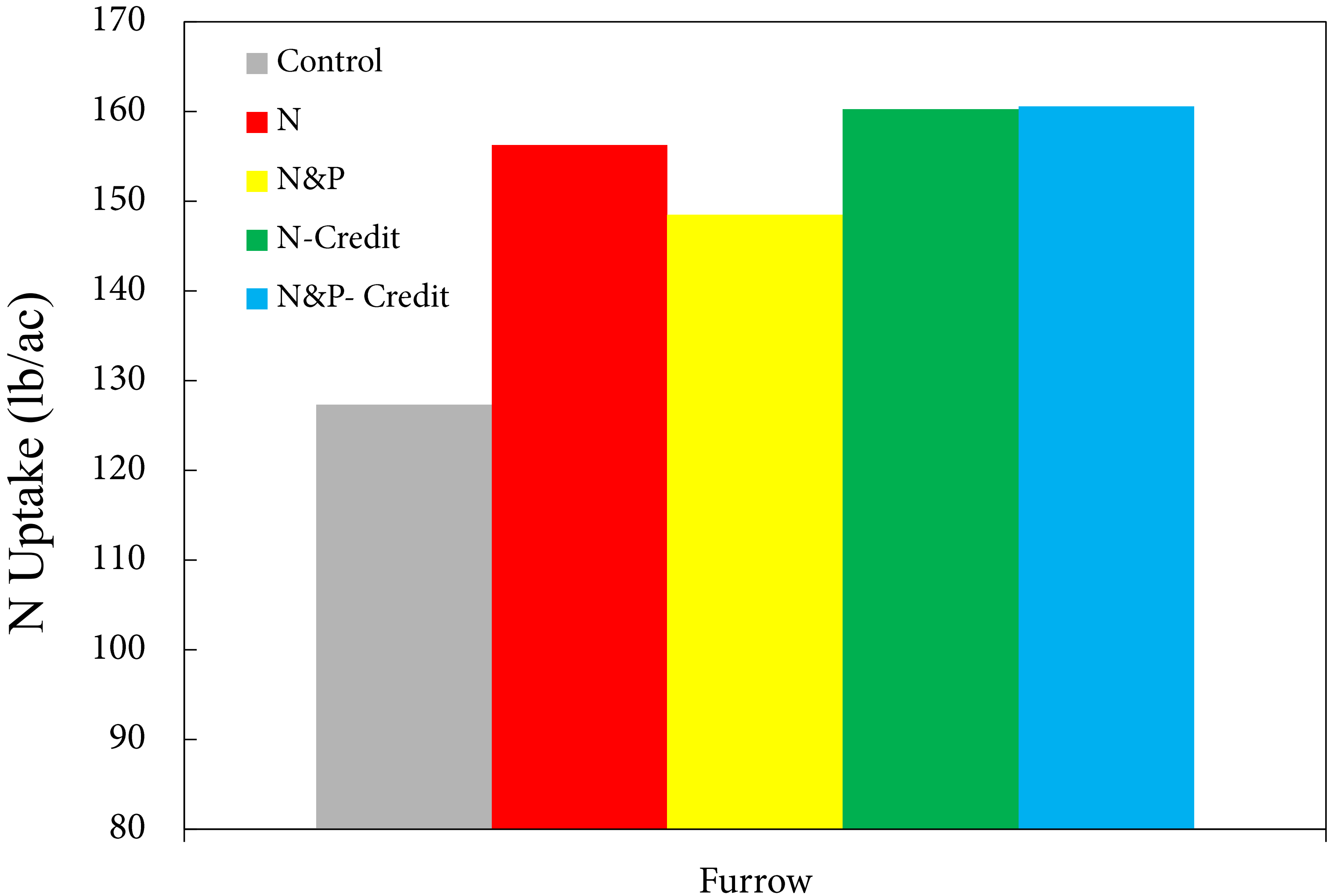

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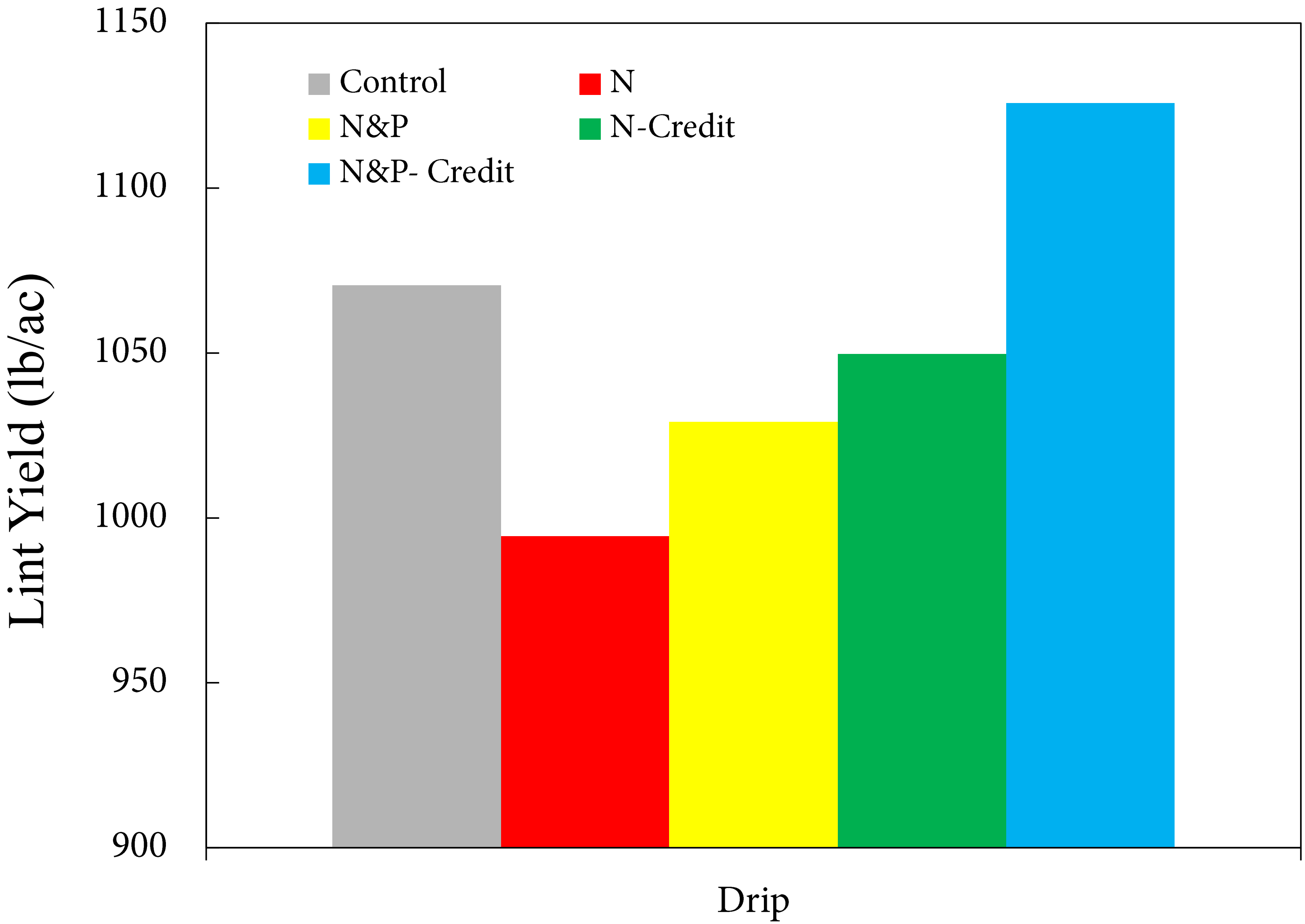

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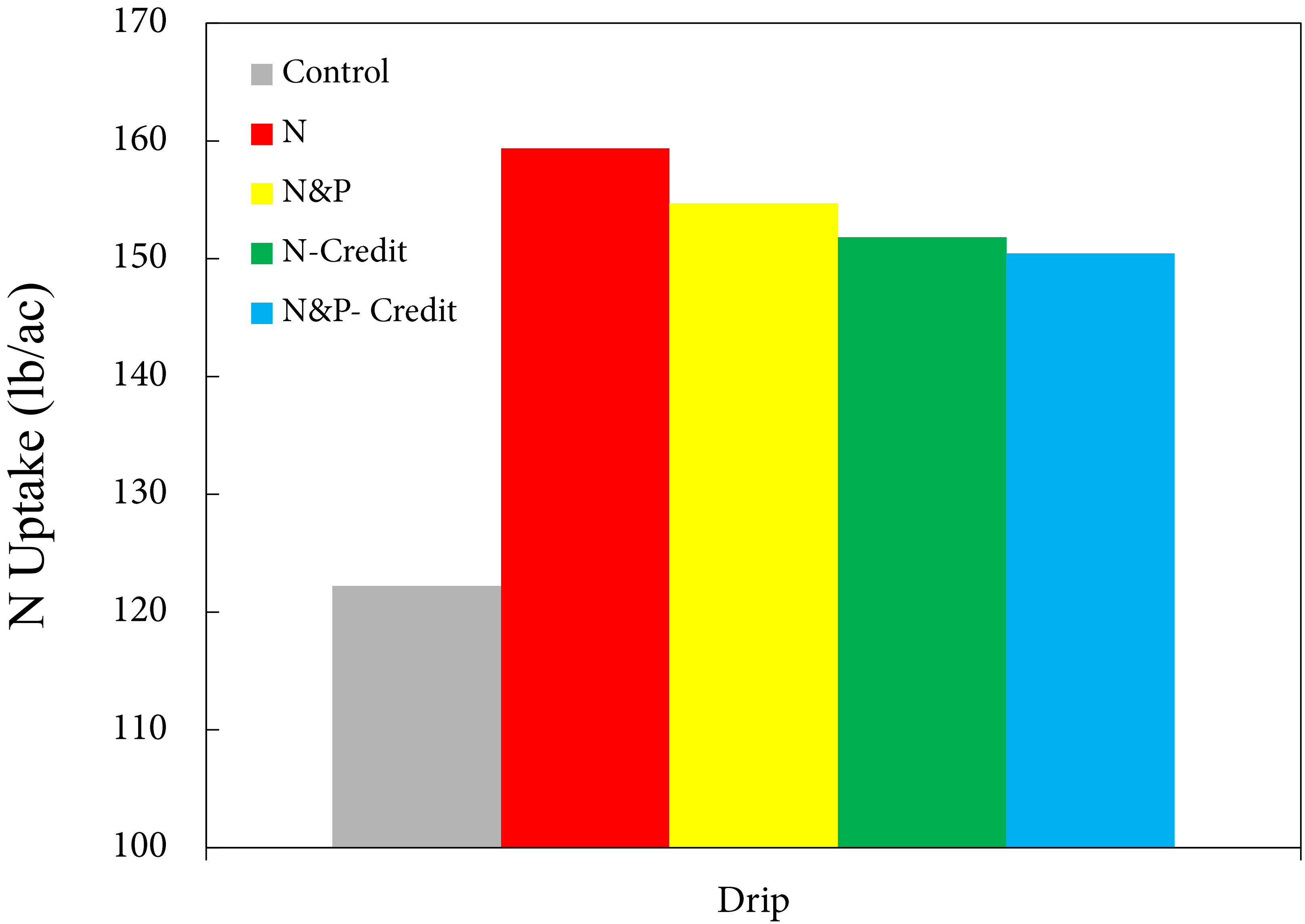

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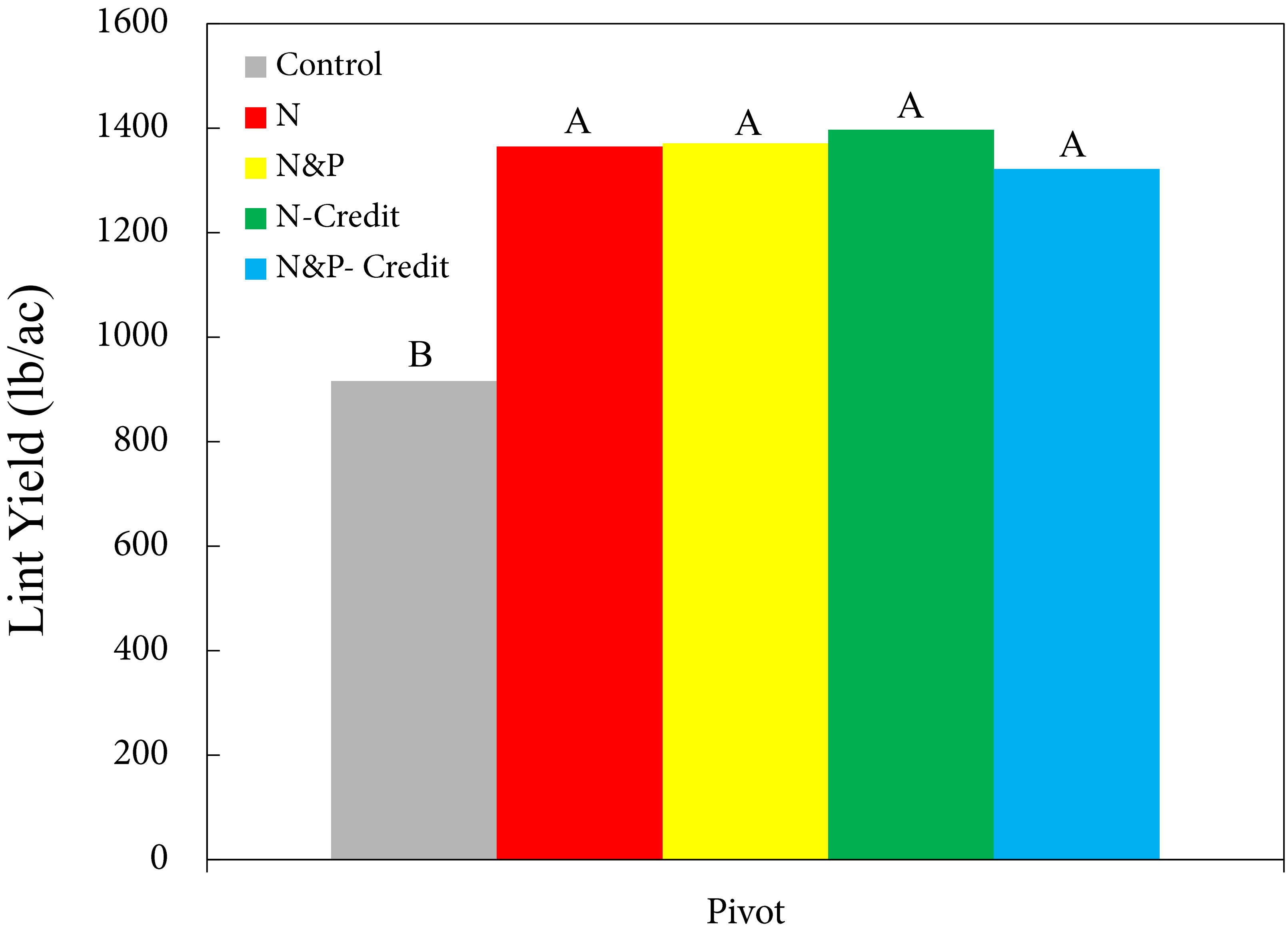

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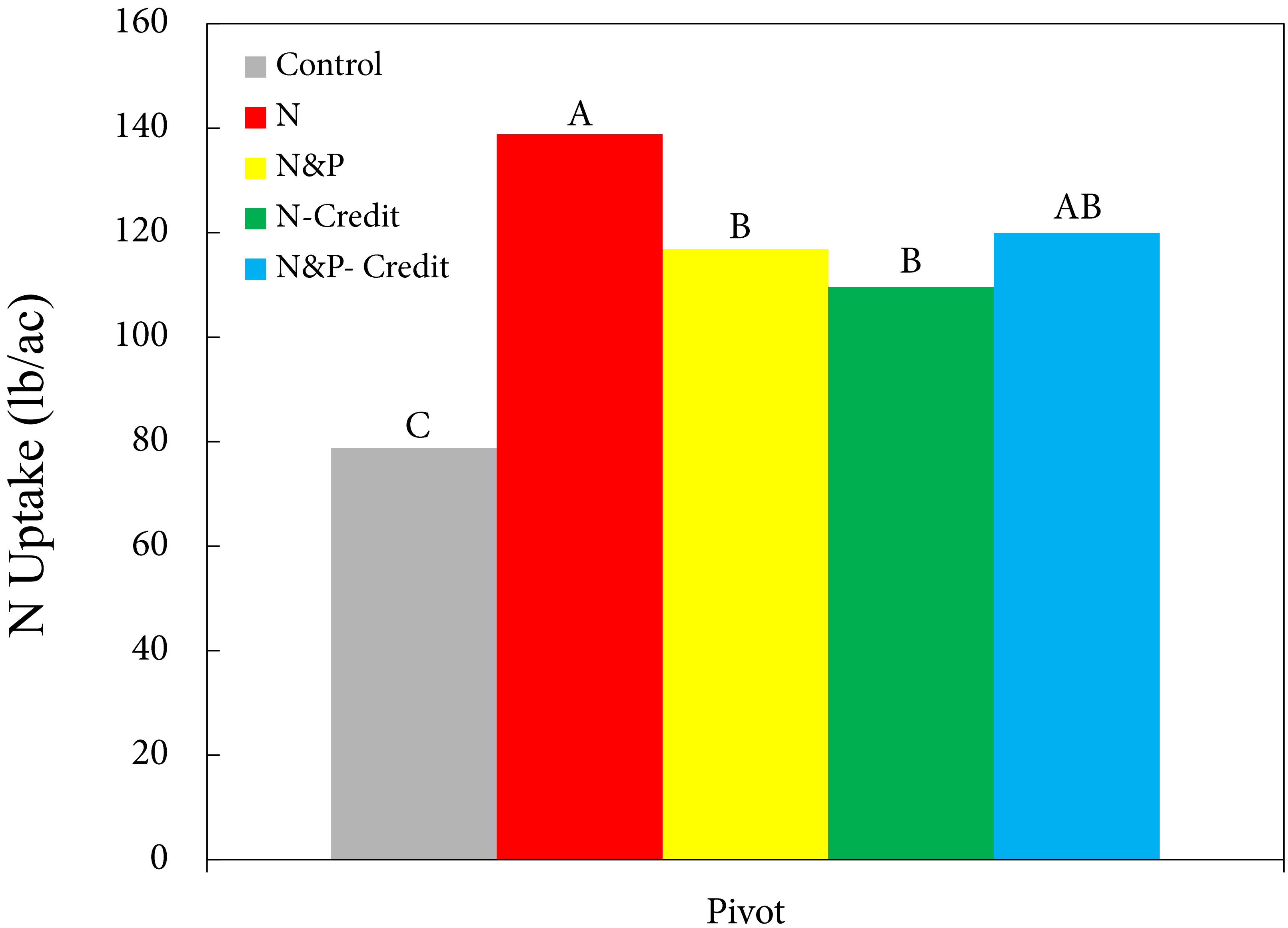

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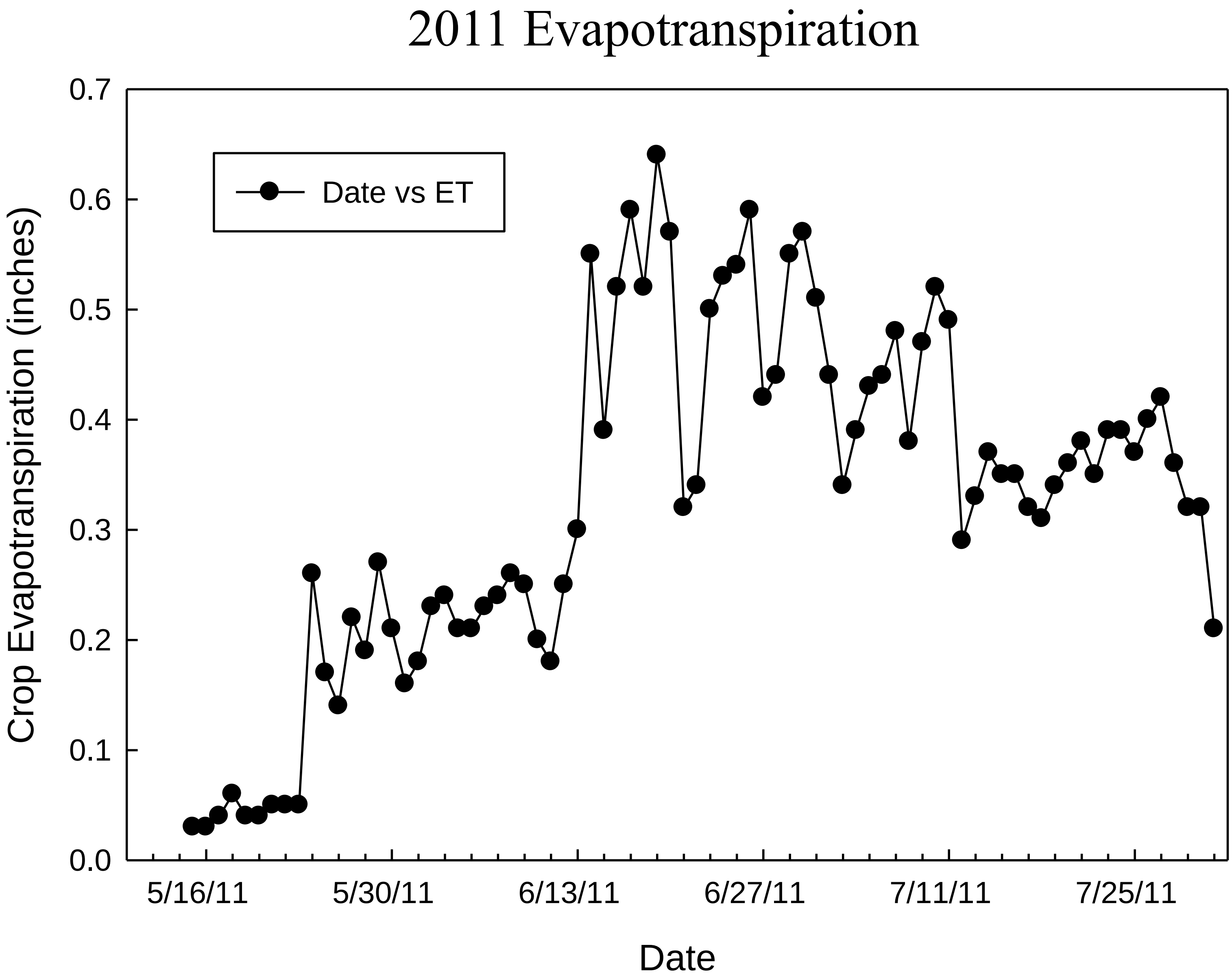
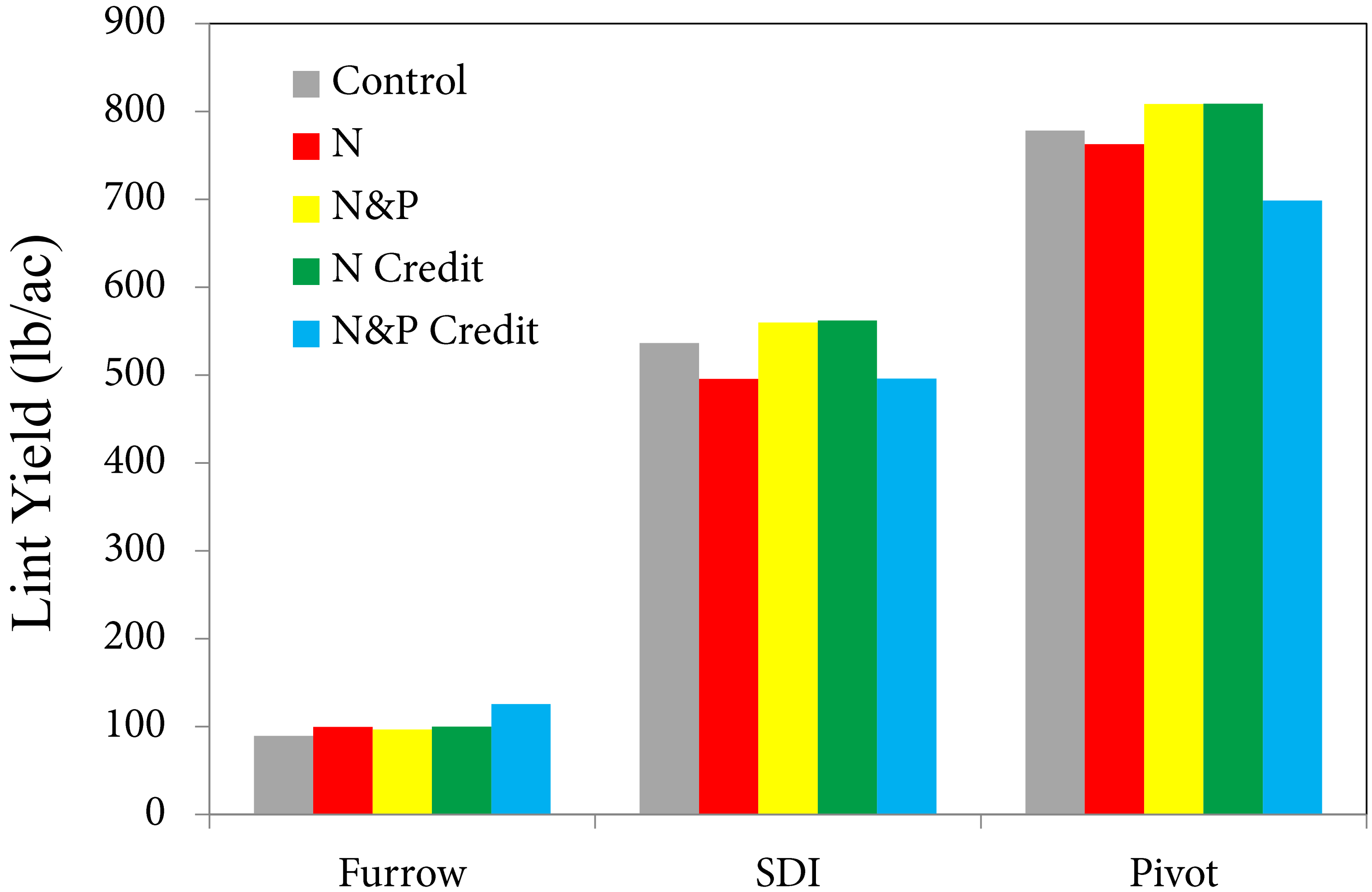

2011 Evapotranspiration
Crop Evapotranspiration (inches)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Date vs ET
5/16/11
5/30/11
6/13/11
6/27/11
7/11/11
7/25/11
Date

2011 Summary

	Yield Goal (bale/ac)	Applied N (lb/ac)*	Applied N with irrigation N credit (lb/ac)	Actual N Applied Through Irrigation (lb/ac)
Furrow	2	60-70	8-20	**31**
Pivot	3	130	80	**131**
SDI	3	110	65-75	**120**



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N Fertilizer Prices*

- ✓ Anhydrous Ammonia (82-0-0)
  - $680
  - $0.415/lb N
- ✓ Urea (46-0-0)
  - $620
  - $0.67/lb N
- ✓ UAN (32-0-0)
  - $379
  - $0.59/lb N

* Based on Wellington CO-OP prices 3/1/2012

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Value of Irrigation Nitrogen

Well Water Analysis	20 ppm Nitrate-N
Water Applied	12 inches
Nitrate Applied	55 lb/ac

N sufficient for:

1 bale+ cotton
3000 lb/ac grain sorghum

55 lb N is worth $33.00*

Potentially save $33.00/acre

*Assumes N @ $0.60/lb

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Conclusions

- N applications were reduced by 42% to 73% when nitrate in irrigation water was accounted toward crop N needs.
- Lint yields and N uptake were not significantly different among fertilized plots.
- Initial results show that crediting well water nitrate is a sound practice, from both an agronomic and economic viewpoint.
- Nitrate in irrigation water can meet or exceed crop N requirements.
- Potential for soil nitrate build up and leaching.

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Questions?

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