Nitrification Inhibitors and Controlled Release Fertilizers

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Why Nitrogen Fertilizer Technology?

- To improve Nitrogen Use Efficiency - NUE
- Given that nitrate is so readily leachable, the use of technologies that can reduce the pool of nitrate, but still make N available in adequate quantities and at the right timing for crop growth could improve NUE

Nitrification Inhibitors

Nitrapyrin (not registered on vegetables)

Urease inhibitor + DCD nitrification inhibitor

DMPP (not available in the US)

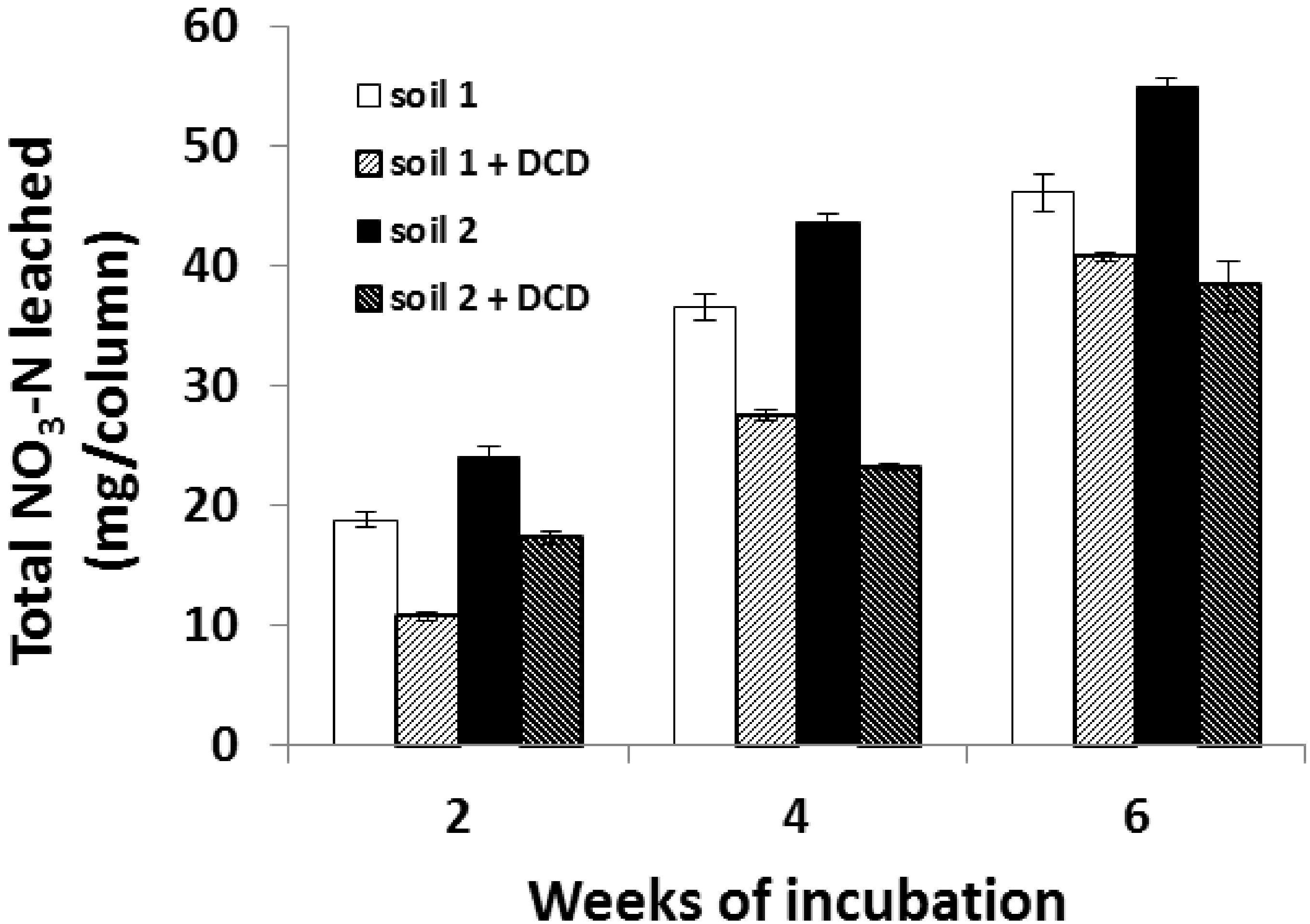
Nitrapyrin – low volatility formulation (not registered on vegetables)

Nitrification Inhibitors

$$NH4^{+} \not\longrightarrow NO3^{-}$$

- These chemicals disrupt the activity of *Nitrosomonas* and *Nitrobacter* bacteria which are responsible for nitrification of ammonium to nitrate
- If we can keep more of the applied N as ammonium, there would be less leaching losses

Impact of Dicyandiamide (DCD) on Nitrate Leaching



Tim Hartz 2011

Controlled Release Fertilizers

ESN
SmartNitrogen
Controlled Release Fertilizer
A smarter source of nitrogen. A smarter way to grow corn.

Duration 45
Controlled-Release Fertilizer

Coated urea prills (polyurethane and other coatings)

nitamin

GREENFEED™

N-Sure®

Chains or rings of urea molecules (can be foliar applied)

Controlled Release Fertilizer

one example

- **The diffusion of nitrate out of the prill is controlled by the thickness of the coating and environmental conditions (temperature)**
- **The coating meters the released nitrate rather than allowing the release of a large quantity that would build up a nitrate pool**

Urea **Polyurethane coated Urea**

Other slow release fertilizers

Calcium cyanamid

Dry organic materials:
meat, fish, bone, feather meals

And many others

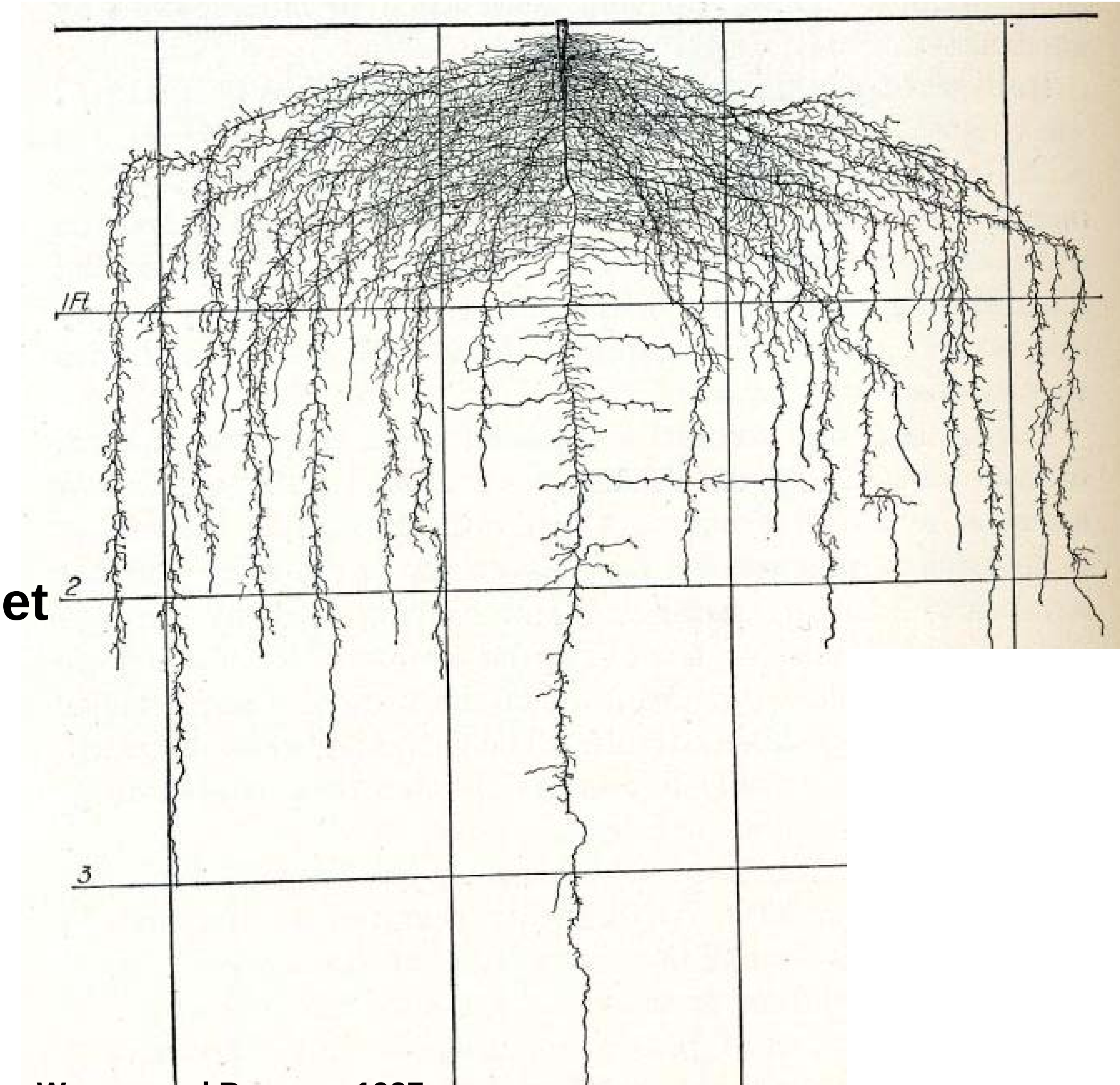
Factors Affecting NUE

- Irrigation management
  - The key driver in nitrate losses
- Shallow rooted crops
  - Narrow zone where the nitrate must remain in order to be used by the crop
- Short-term, high nitrogen demand
  - Difficult to supply large quantities of N for a short period of time without suffering some inefficiency in nitrate use

Irrigation Impact on Nitrogen Use Efficiency

- **One inch of leached water carries 23 lbs of N/A**
  - **@ 100 ppm nitrate-N in the soil solution**

Root Distribution of Lettuce - 60 days old

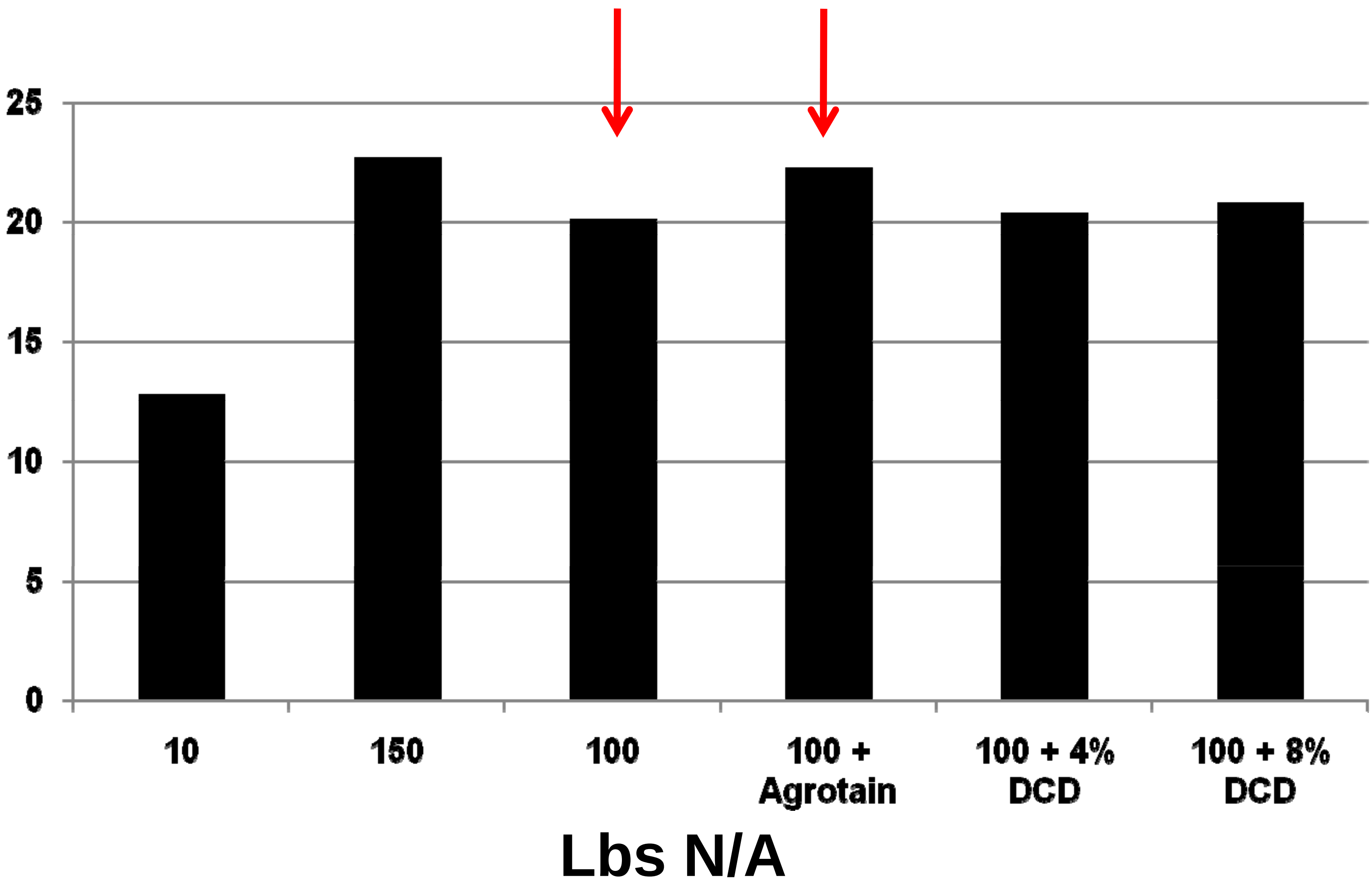


Two feet

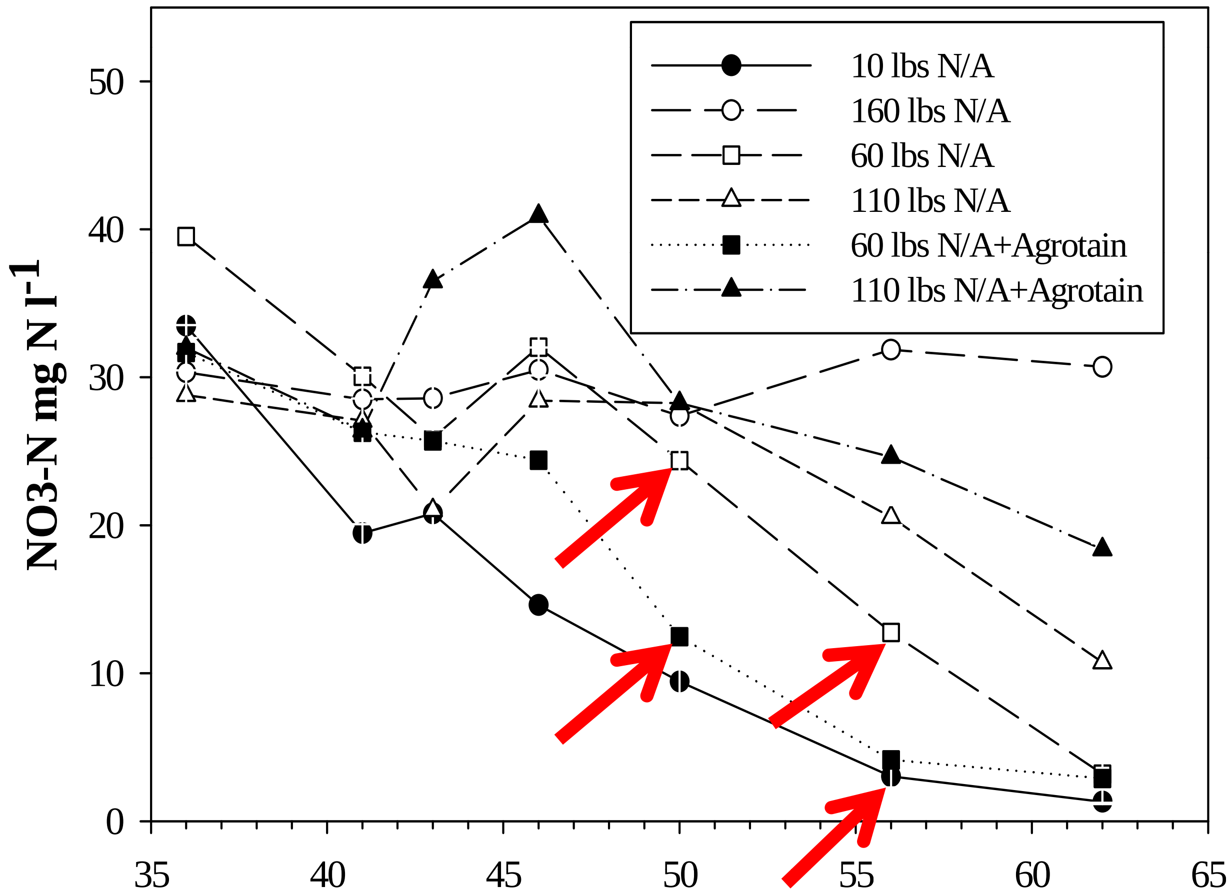
Weaver and Brunner, 1927

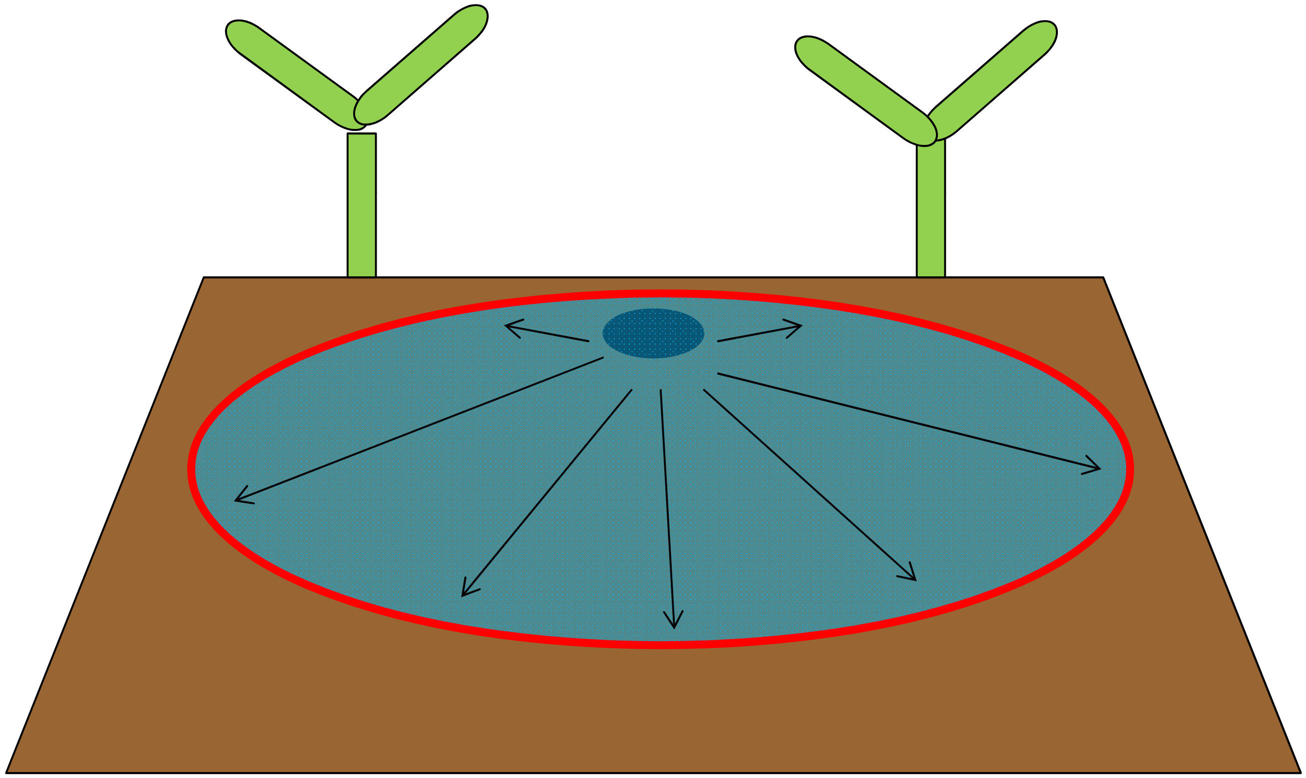
Recent Trials Evaluating Nitrogen Fertilizer Technology in Lettuce Production

2011 Lettuce Yield (T/A)
Nitrification Inhibitor Trial



2010 Nitrification Inhibitor Impact on Nitrate in Leachate





DCD applied in drip is diluted
in a greater volume of soil
and may affect its efficacy

2012 Lettuce Fertilizer Trial

Timeline

Deep Soil

Deep Soil

Deep Soil

Mowed CC	Apply CRF	Plant & anticrustant	Germ Water		Thin	1st fertigation		2nd fertigation			Harvest	
April	June 21	June 26	June 29		July 19	July 27		Aug 8			Aug 29	

Over Irrigation

Over Irrigation

2012 Lettuce Fertilizer Trial

Treatment	Total N/A
Untreated	25
Standard	155
Moderate	105
Agrotain Plus	105
G77	105
DMPP	105
D45	105
D45 + sidedress	155
D45	155
N-Sure	105

- Standard received 65 lbs N/A and all moderate treatments received 40 lbs N/A in two fertigations with UN32 on 29 & 41 days after planting
- D45+sidedress was treated with 50 lbs N/A on 1st fertigation
- N-Sure was applied as a 50:50 mix with UN32 in both fertigations

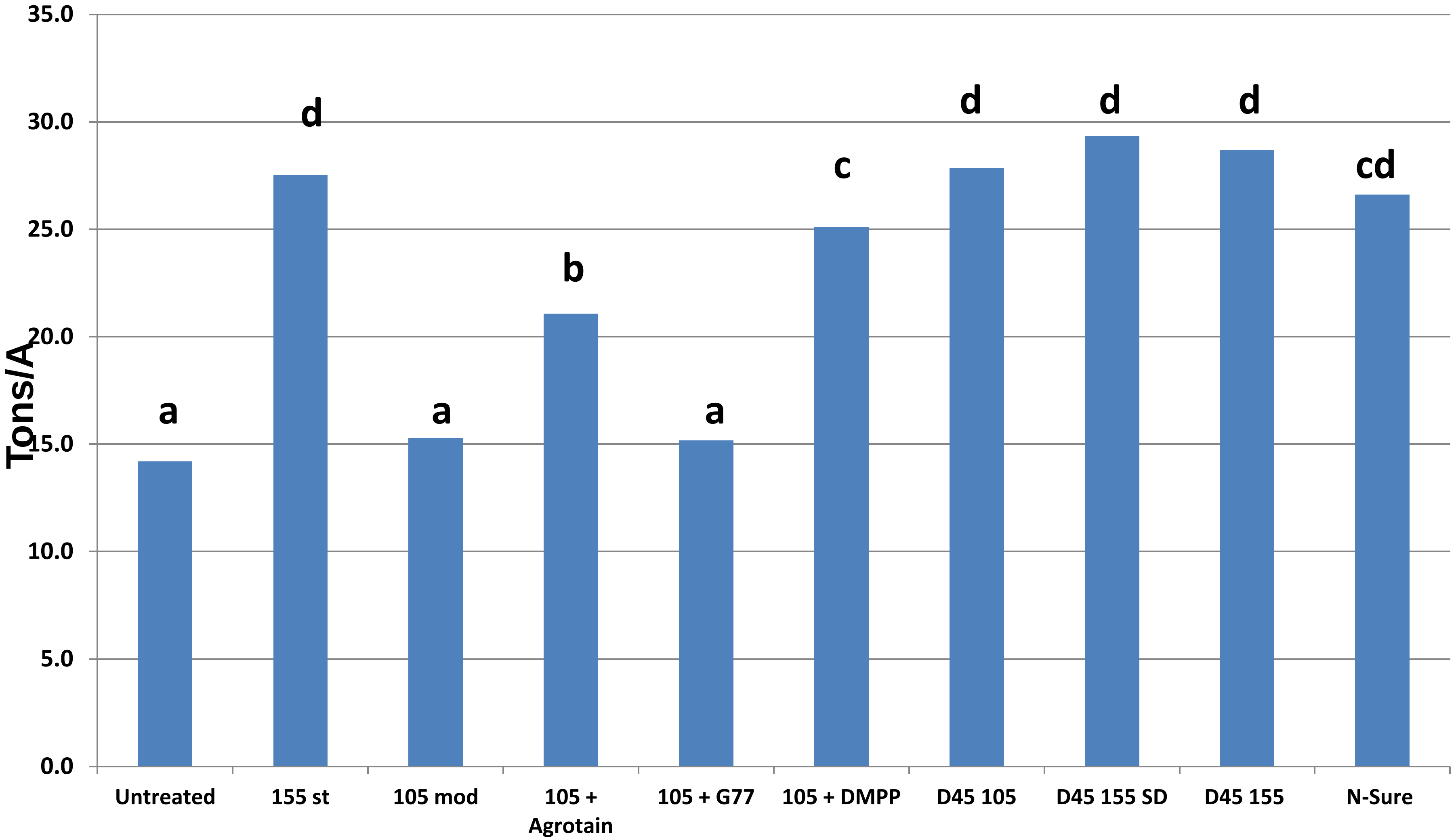
Injection of fertilizer treatments:

- **Each treatment had its own main**
- **Treatments were injected into the ports and each main delivered the N to the associated beds**

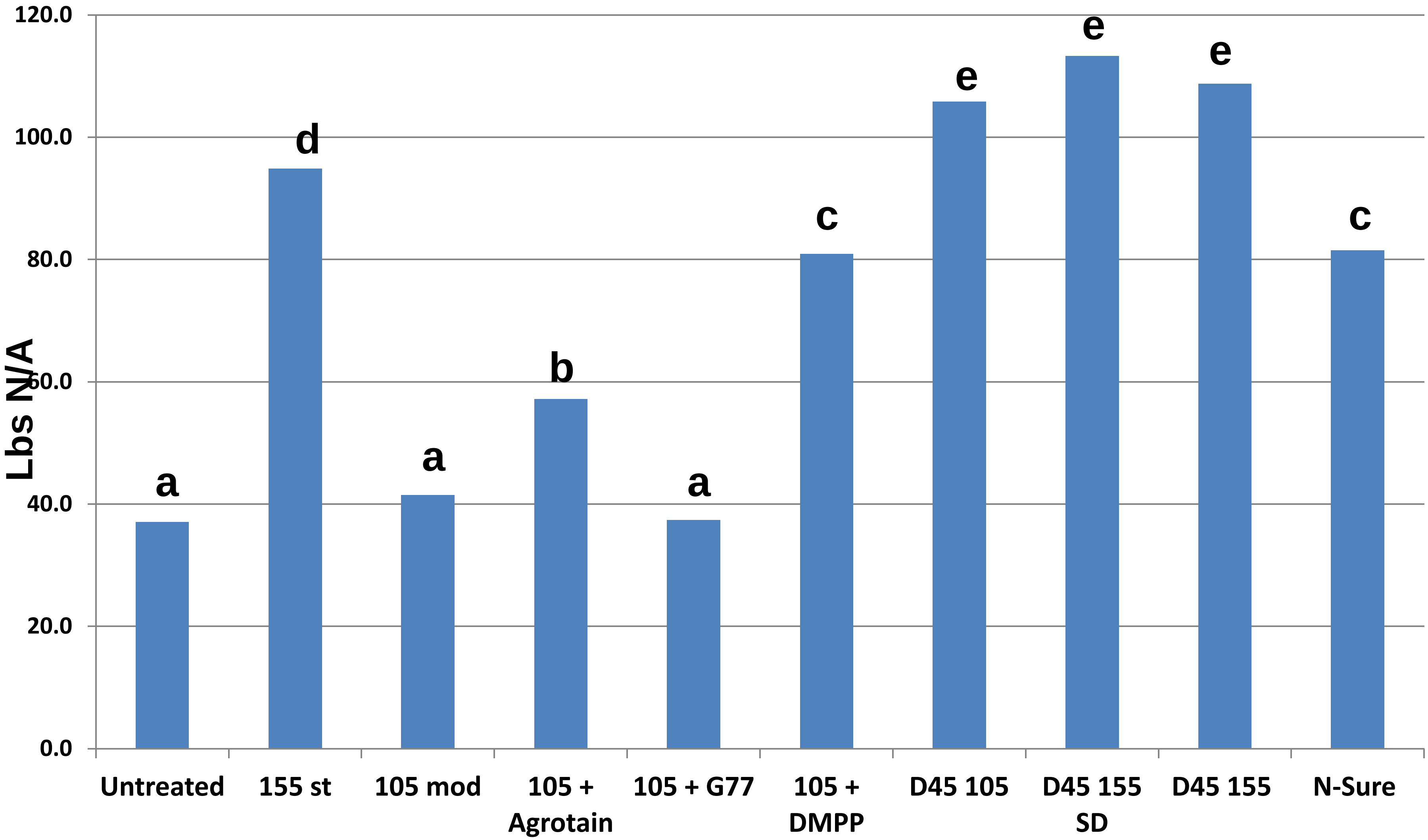
Excellent Response to Fertilizer

Untreated

Yield Evaluation

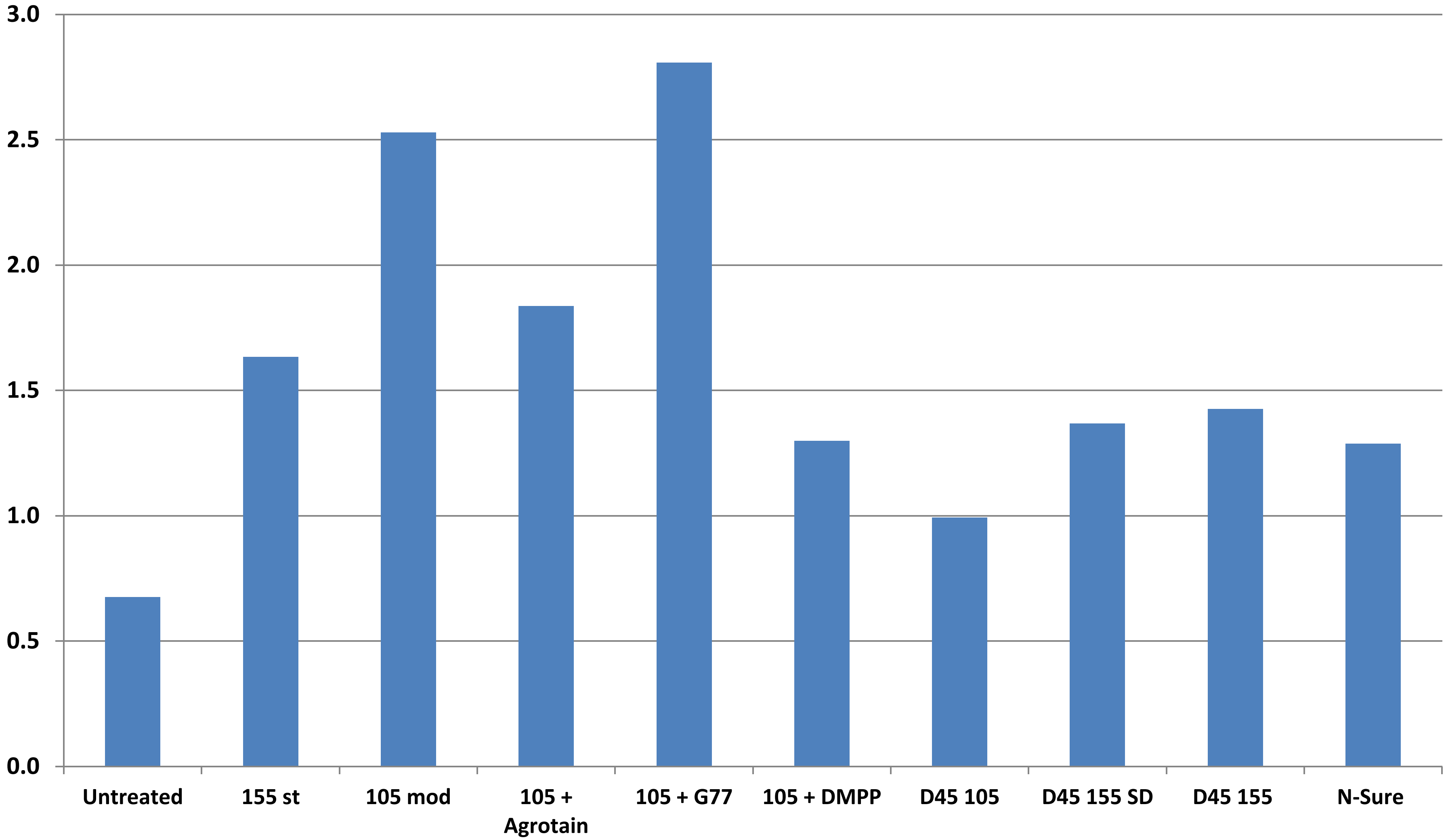


Nitrogen Uptake by Lettuce at Harvest

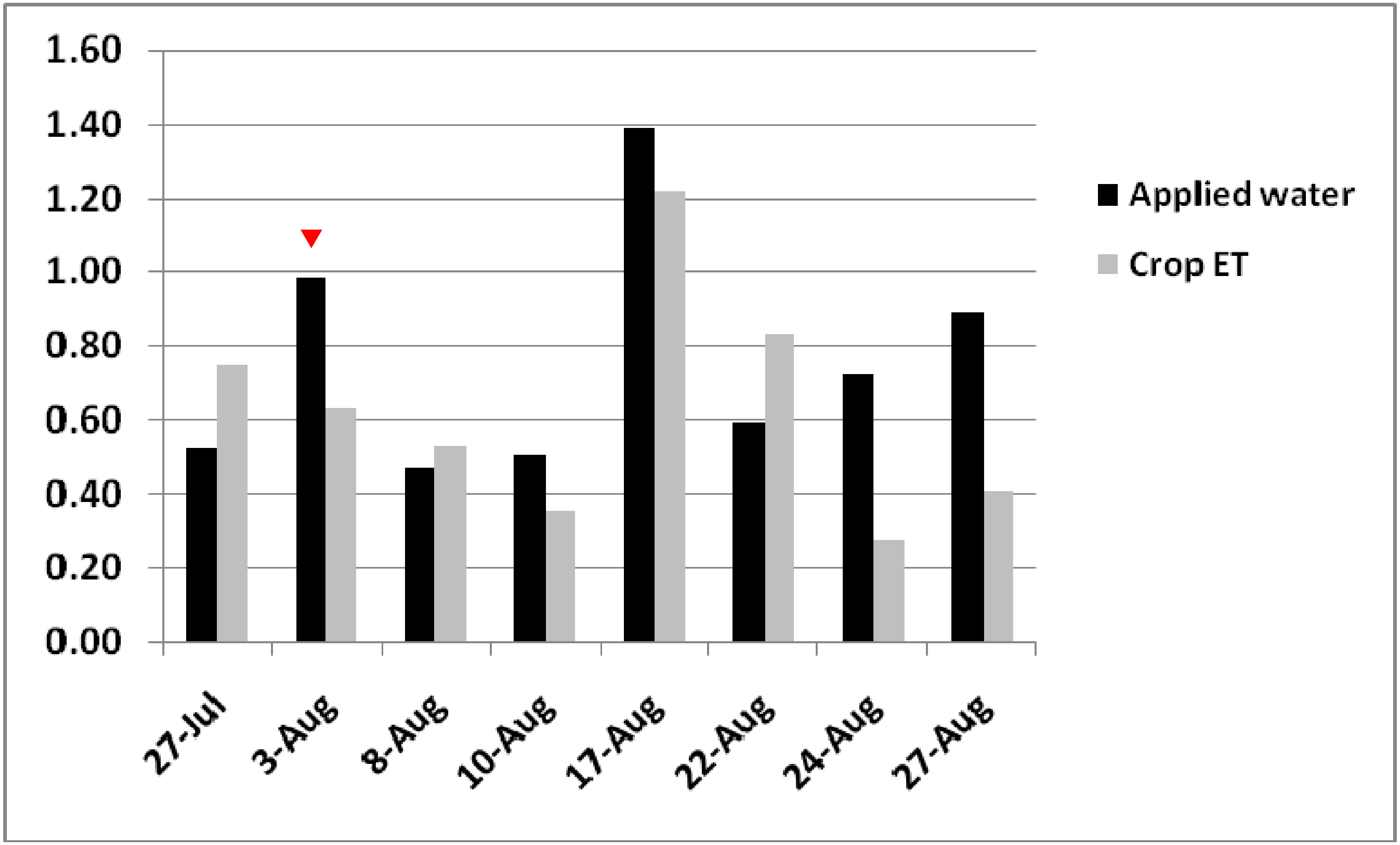


Applied N/Uptake N Ratio

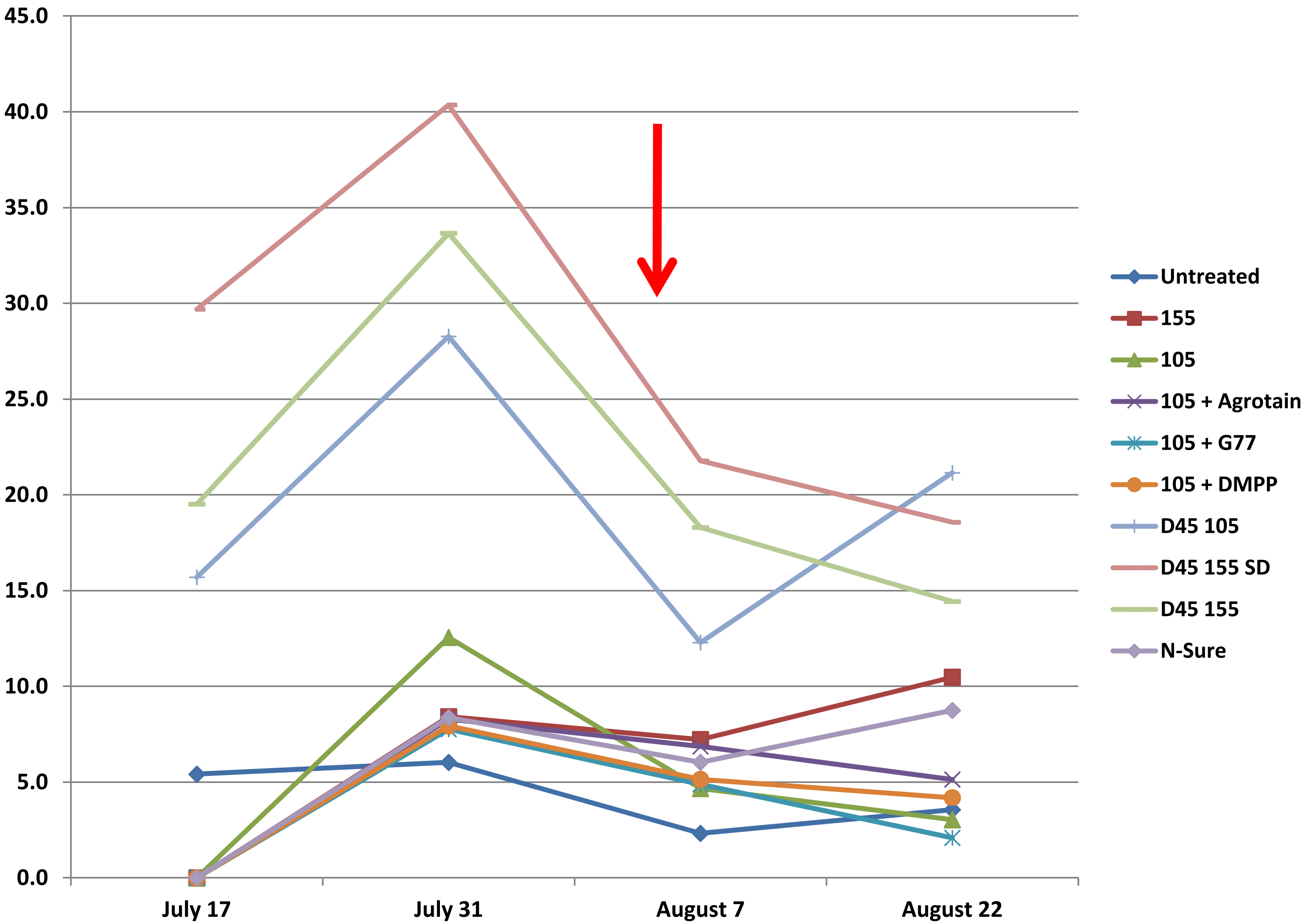
Does not account for soil N or leaching losses



Irrigation Events in Relation to Crop ET from Thinning to Harvest

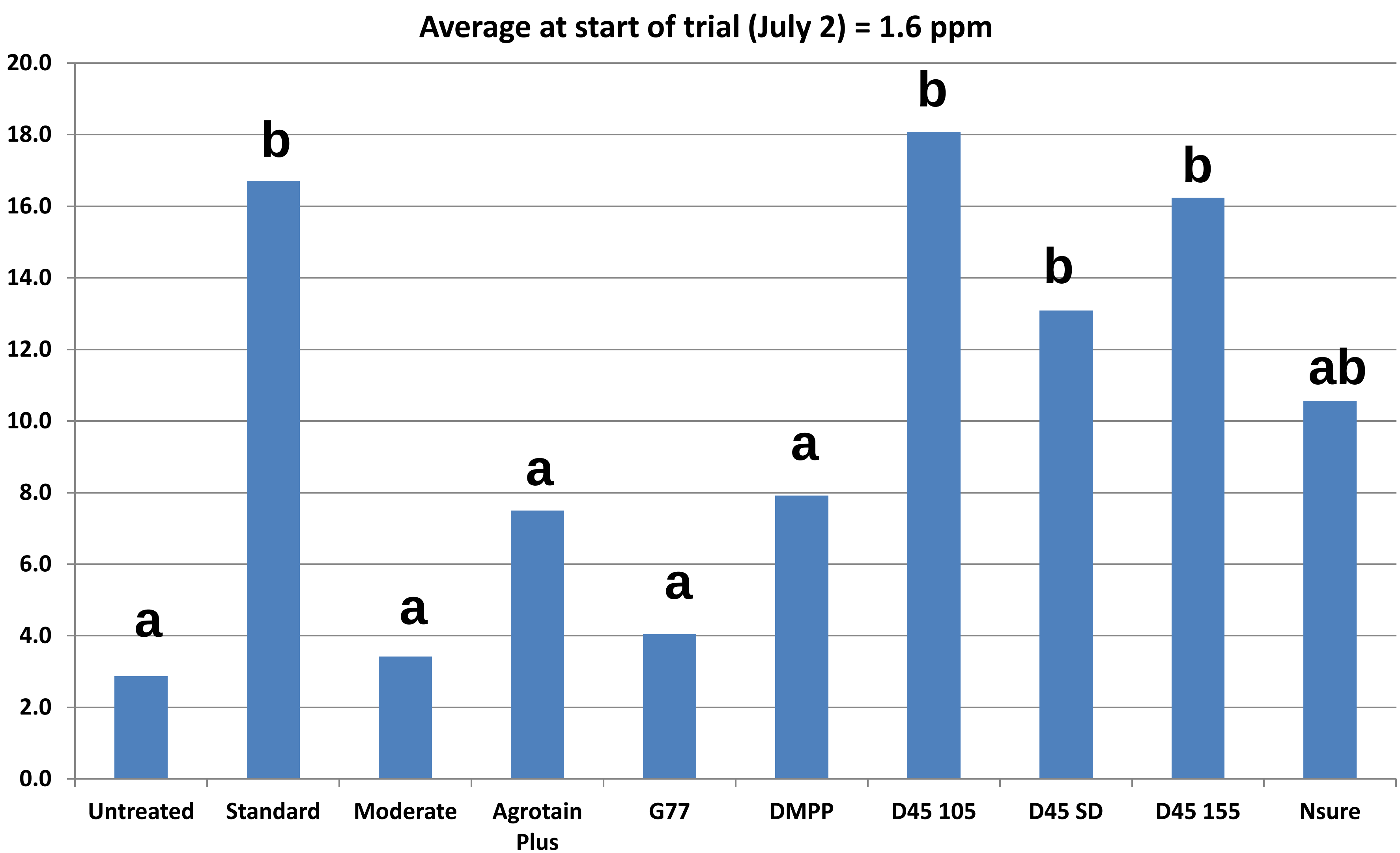


Nitrate-N in Soil on Four Dates

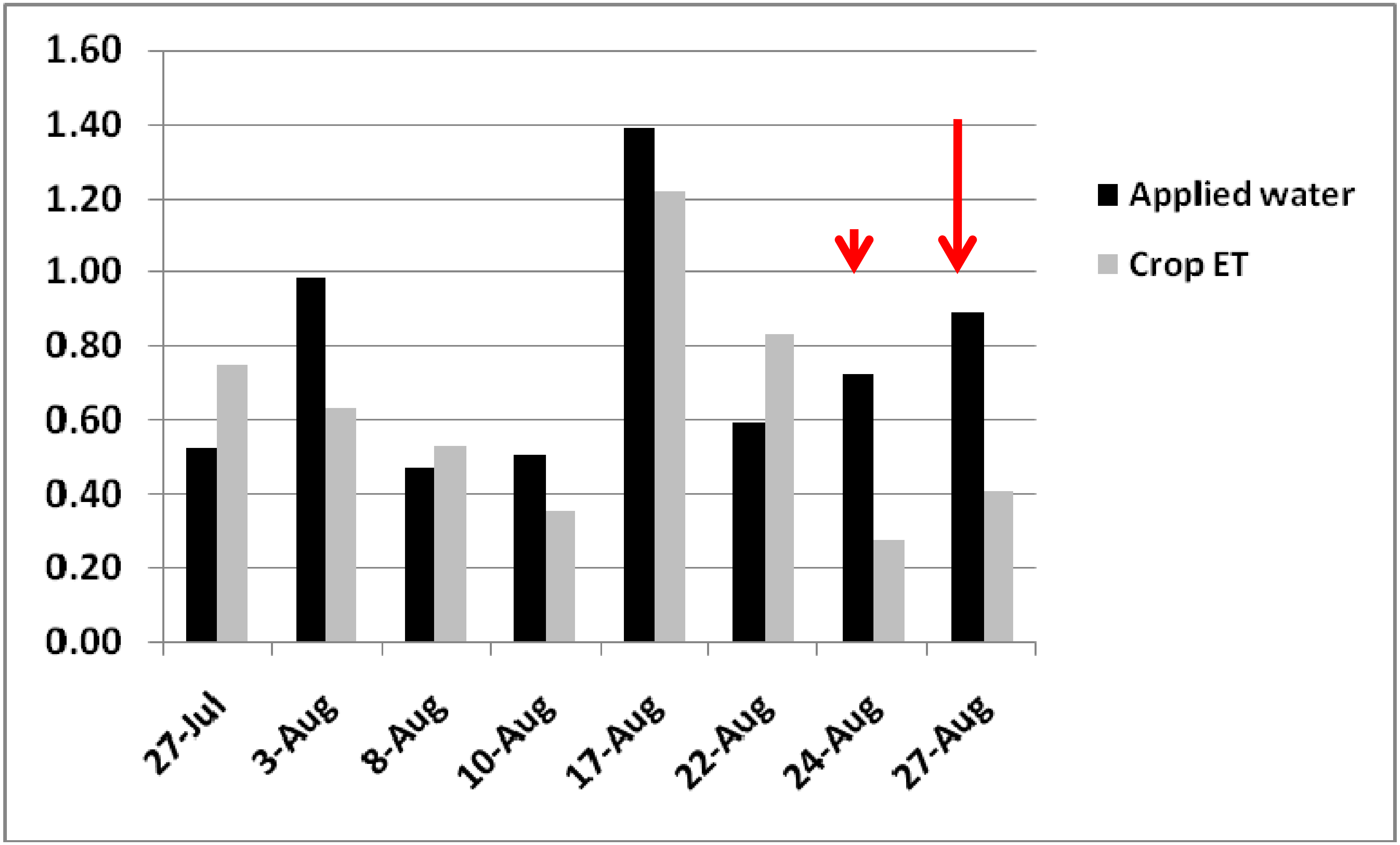


Nitrate-N at 2 – 3 Feet in Soil

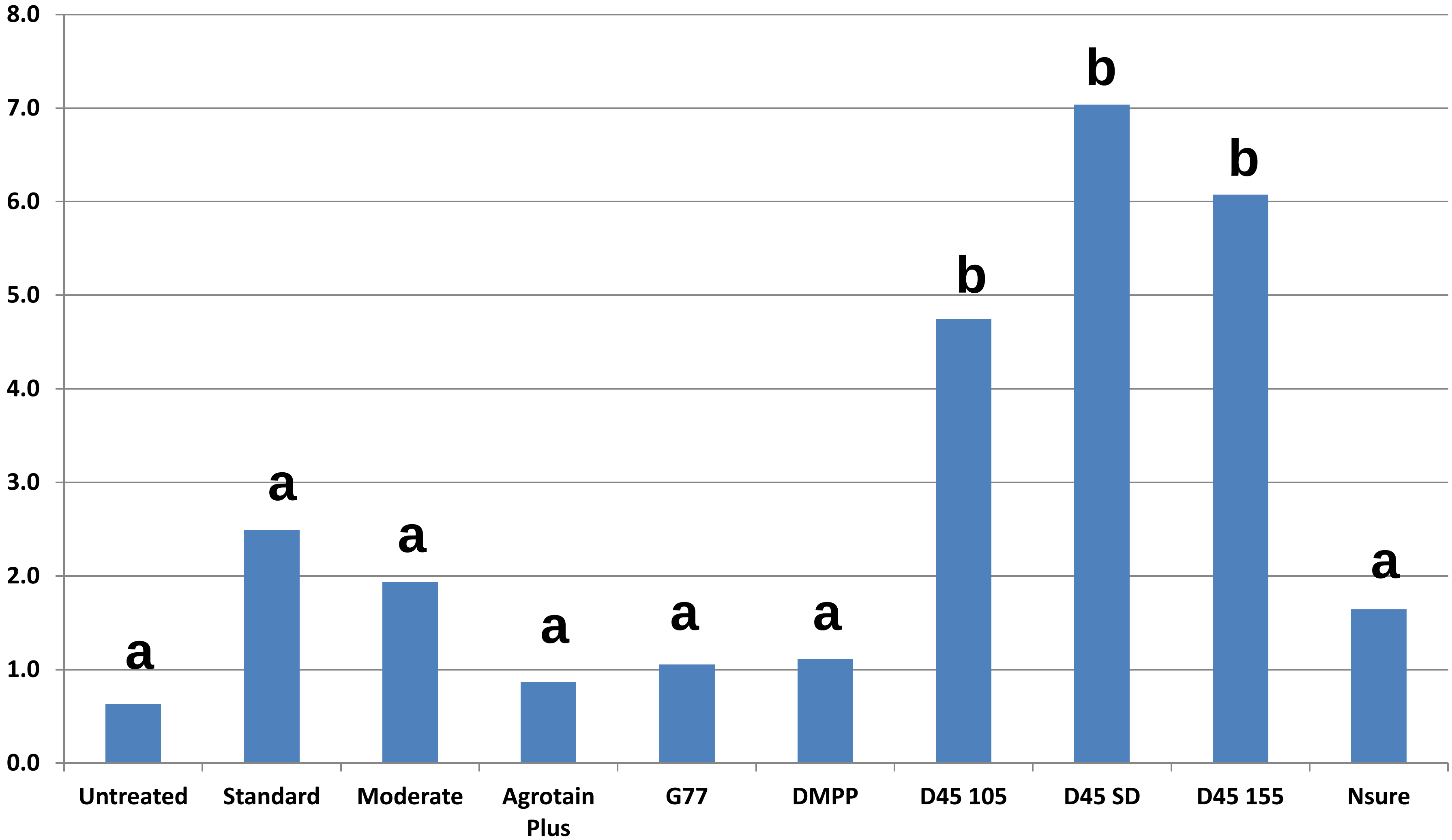
August 15



Irrigation Events in Relation to Crop ET from Thinning to Harvest



Nitrate-N at 2 - 3 Feet in Soil
August 31



Summary

- All nitrogen technologies showed great promise for improving nitrogen use efficiency
- Moderate level of N fertilization had improved yield with Agrotian Plus, DMPP, D45 and N-Sure under the conditions in this trial

Summary

- Given the great NUE of the CRF, the rates should be examined to see if we can reduce the loss of nitrate beyond the rootzone observed in this trial

Summary

- The use of these technologies does not preclude the need for good irrigation management