



# **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



Urease inhibitor + DCD nitrification inhibitor



DMPP (not available in the US)

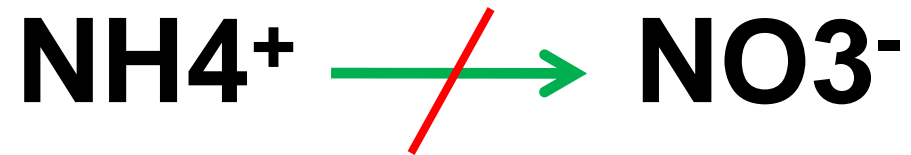


Nitrapyrin (not registered on vegetables)



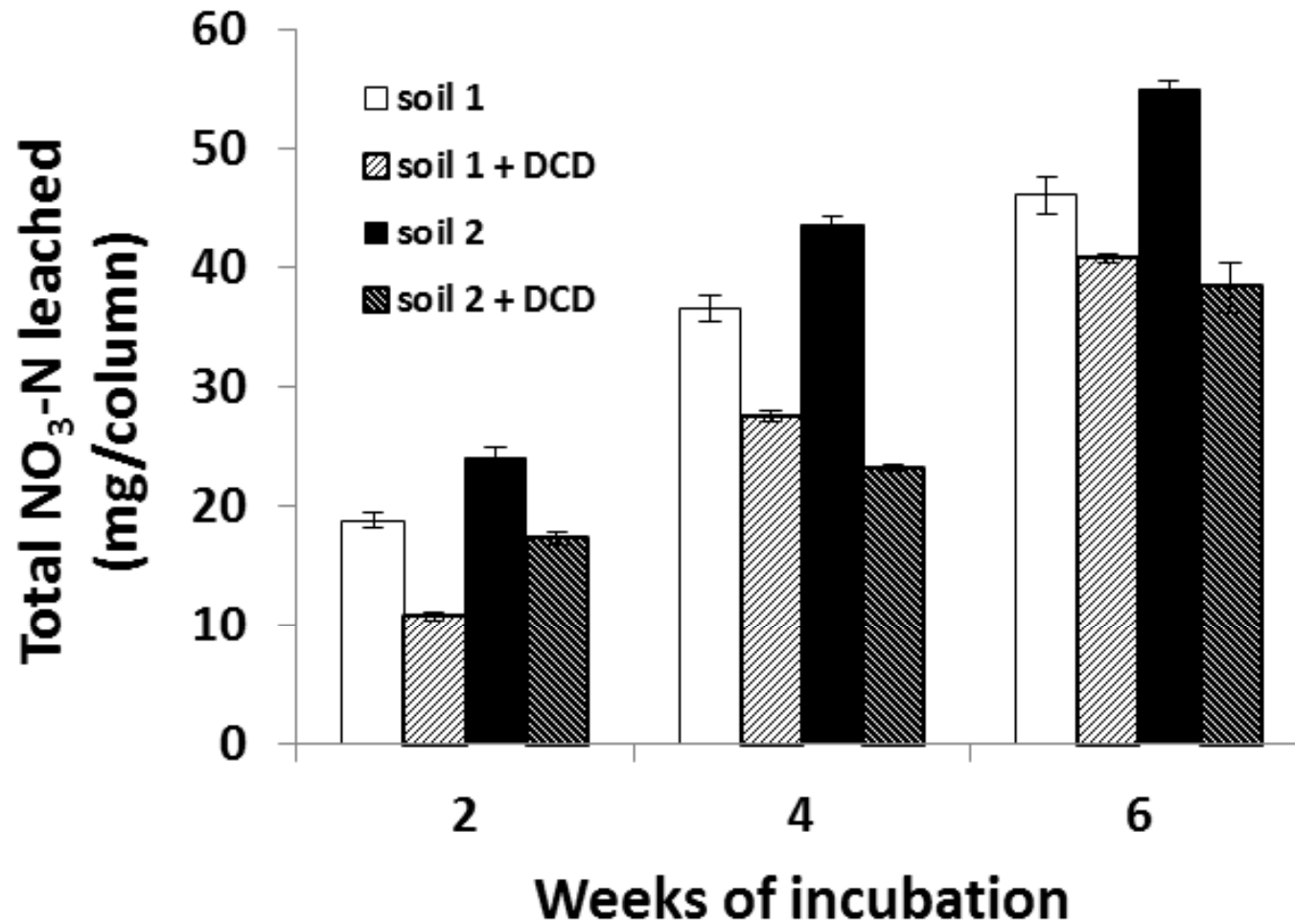
Nitrapyrin – low volatility formulation (not registered on vegetables)

# Nitrification Inhibitors



- 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



# Controlled Release Fertilizers



Coated urea prills (polyurethane and other coatings)



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

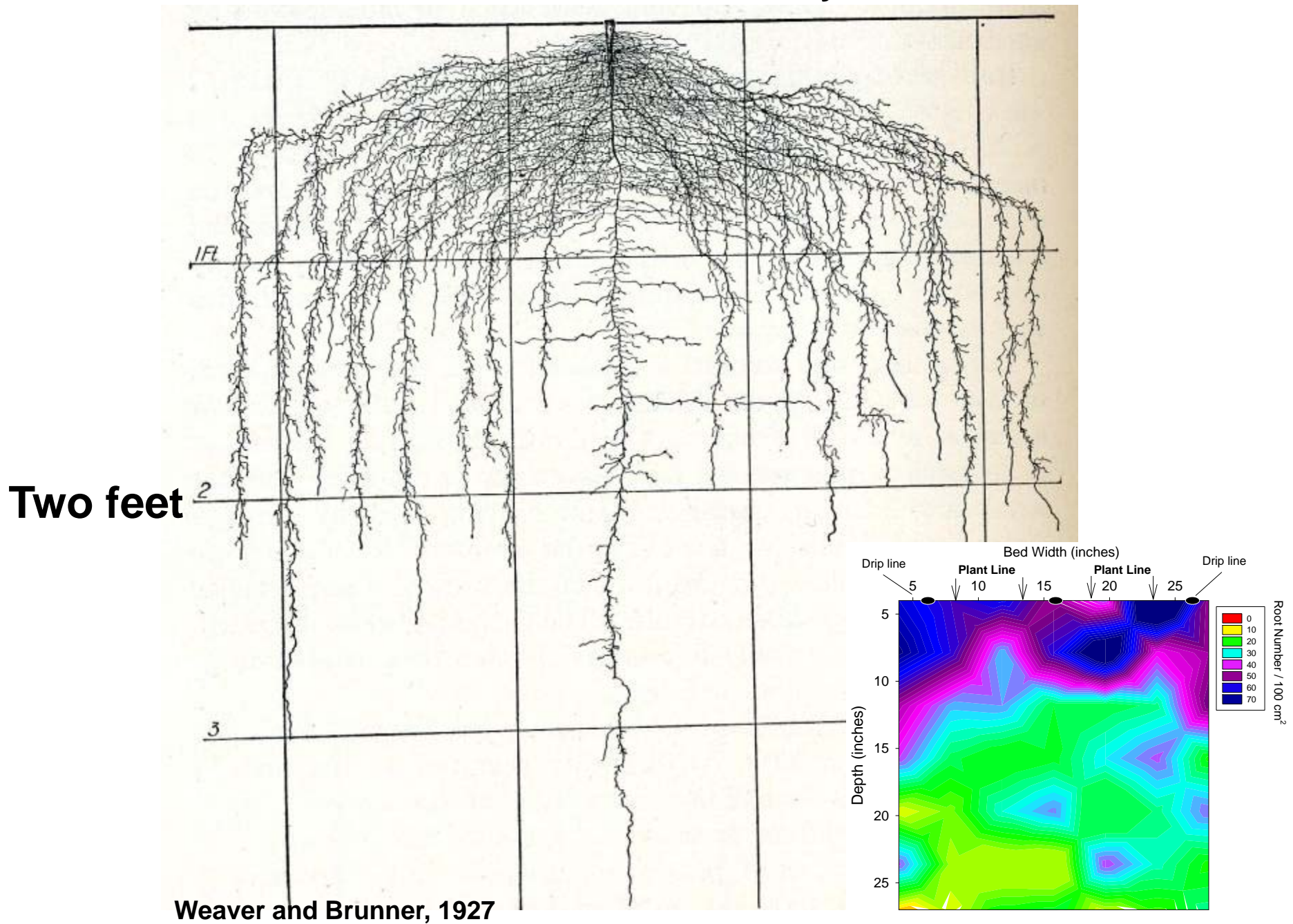
- **Irrigation management**
  - **The key driver in nitrate losses**
- **Shallow rooted crops**
  - **Narrow zone where the nitrate must remain in order to be used by the crop**
- **Short-term, high nitrogen demand**
  - **Difficult to supply large quantities of N for a short period of time without suffering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



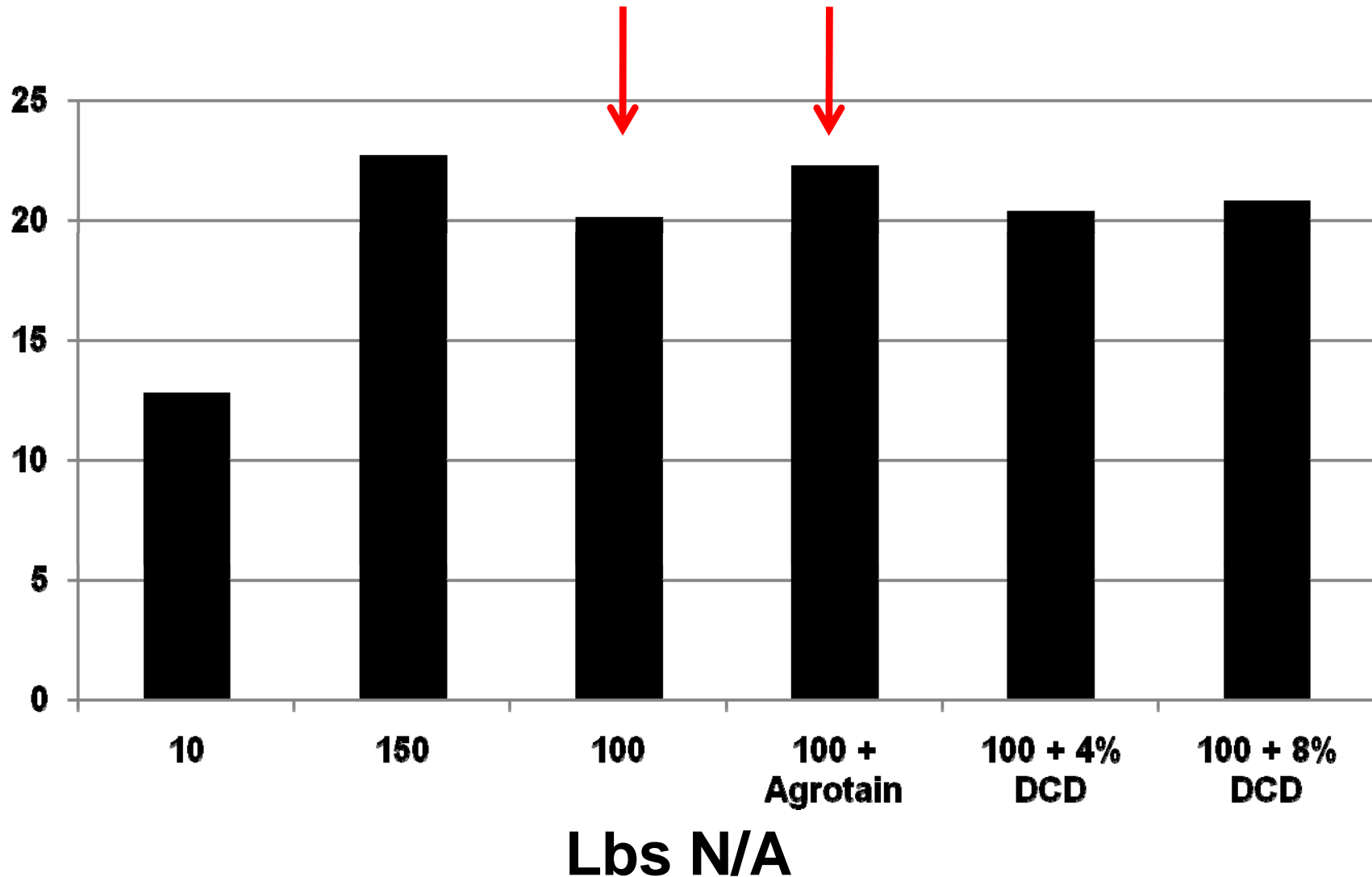
# Root Distribution of Lettuce - 60 days old



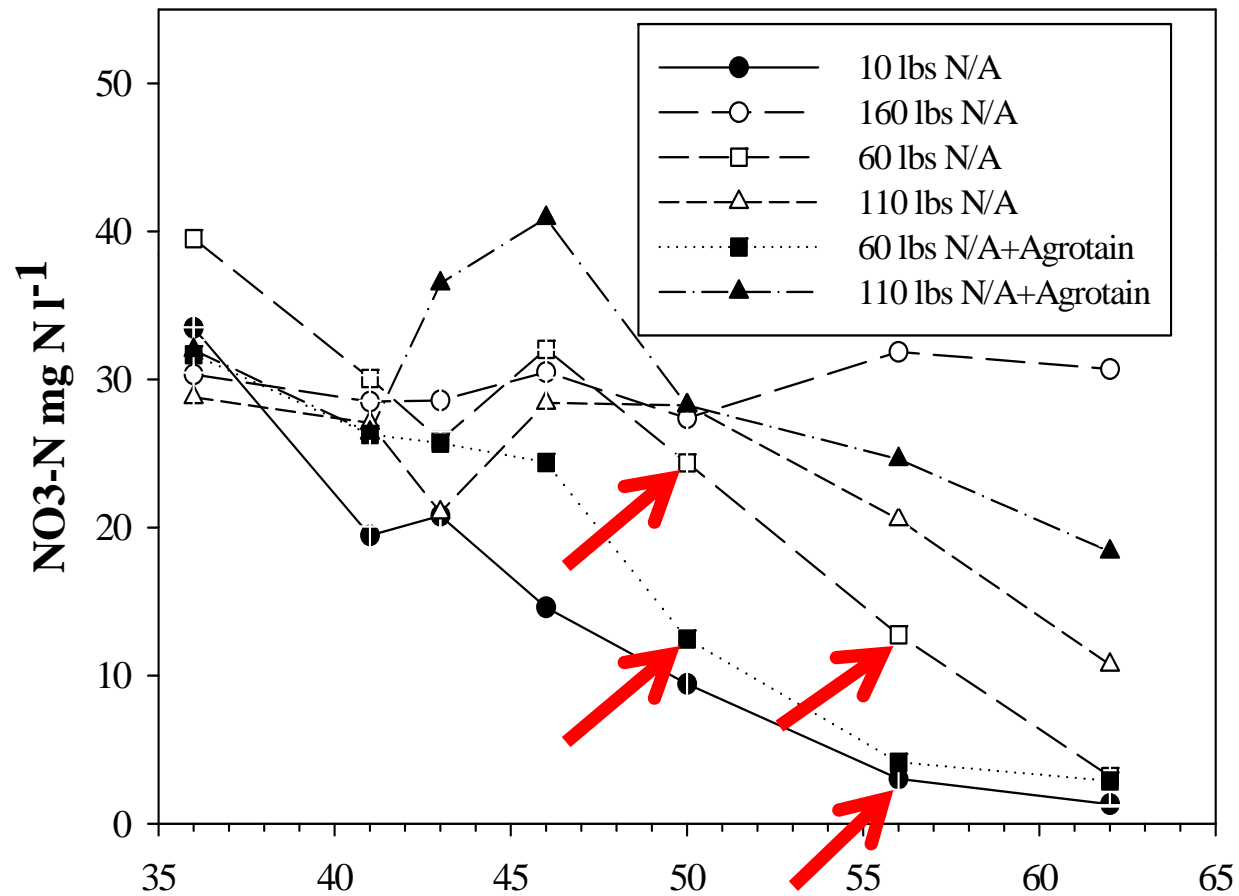
Weaver and Brunner, 1927

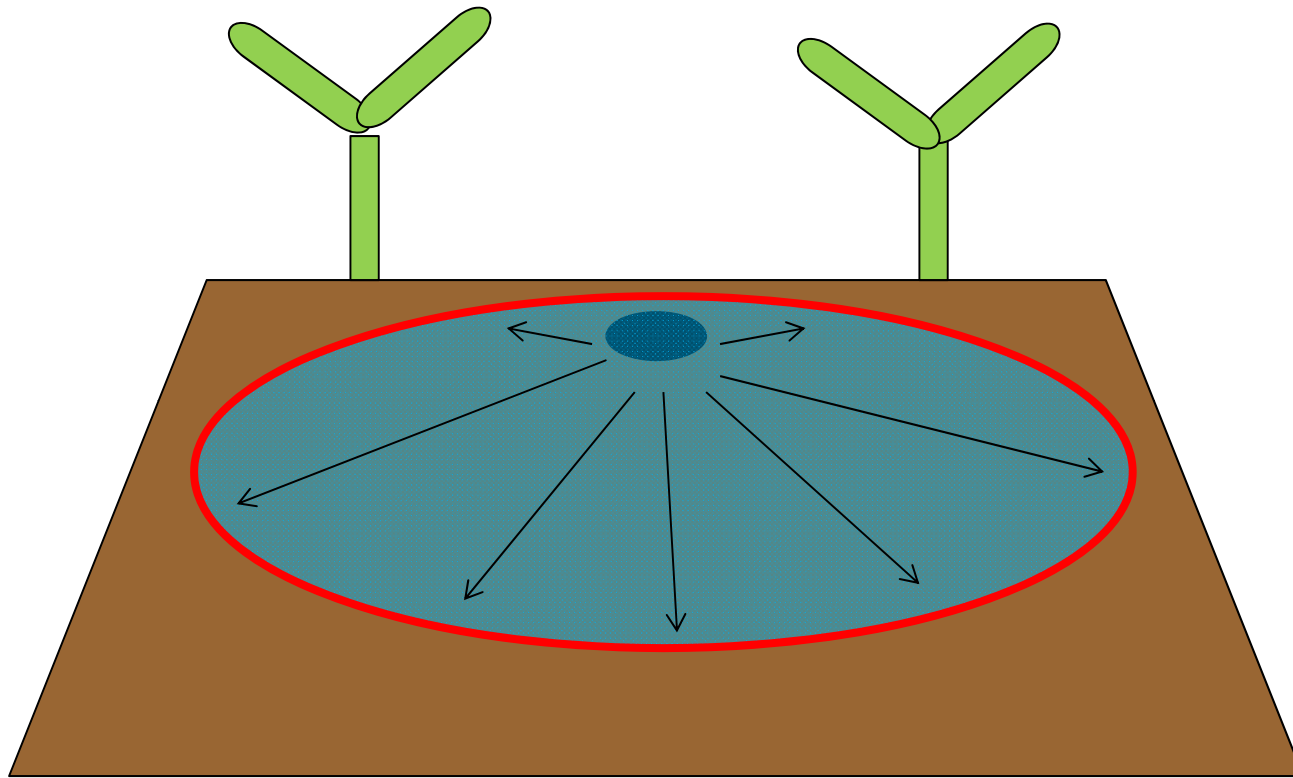
# **Recent Trials Evaluating Nitrogen Fertilizer Technology in Lettuce Production**

# 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	1 <sup>st</sup> fertigation		2 <sup>nd</sup> 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 1<sup>st</sup> 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



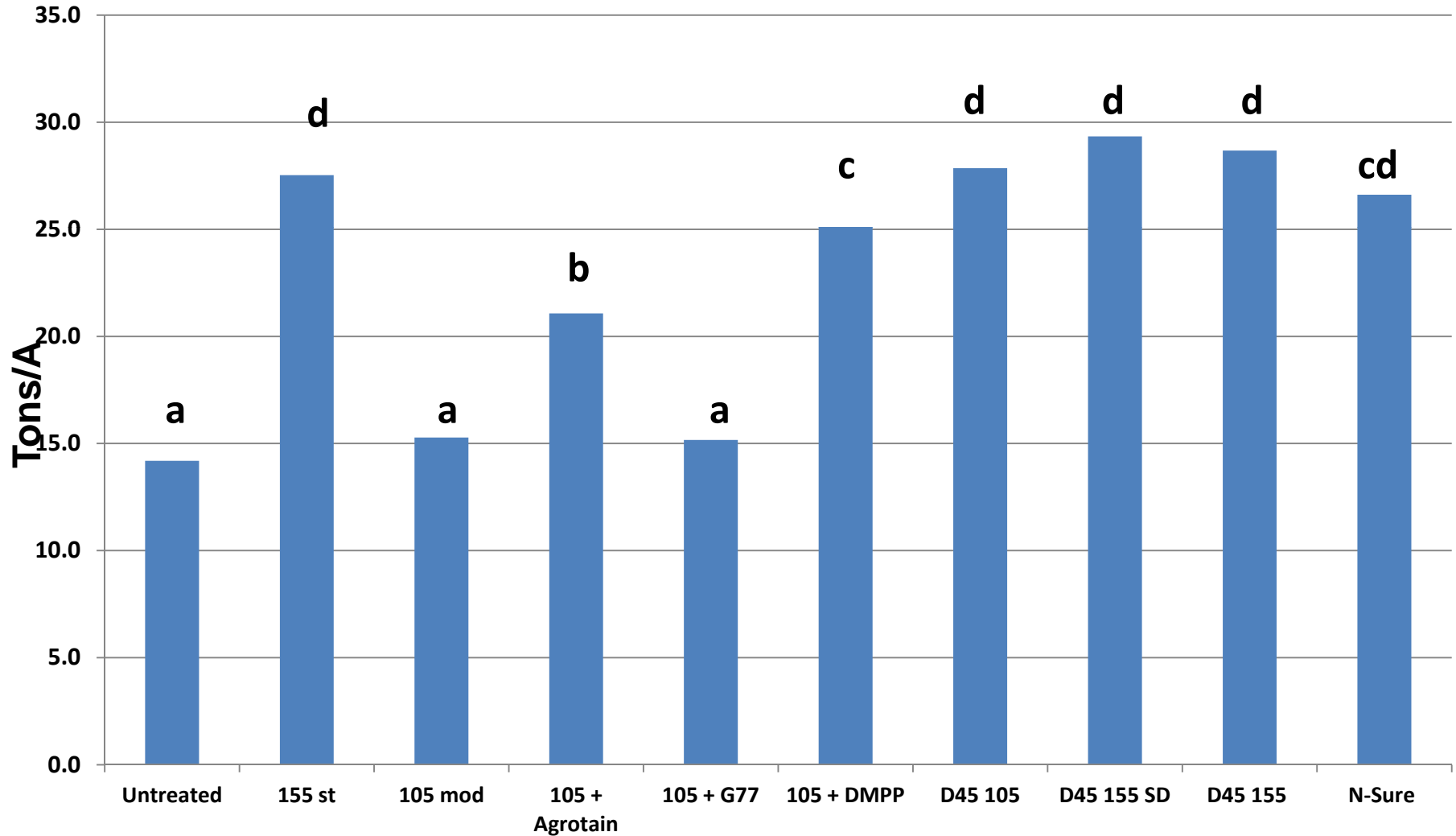
# Excellent Response to Fertilizer



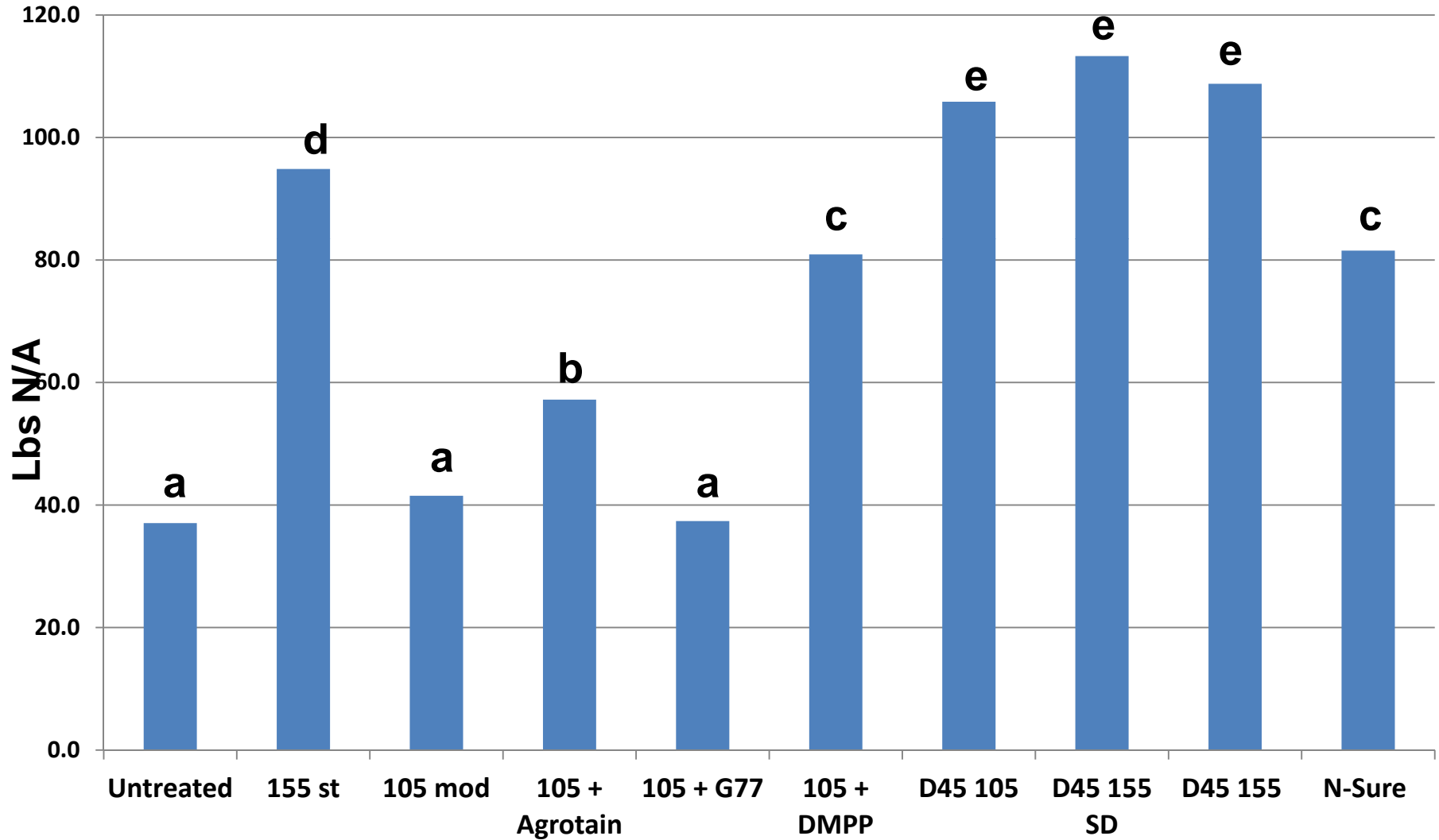
**Untreated**

**Standard**

# Yield Evaluation

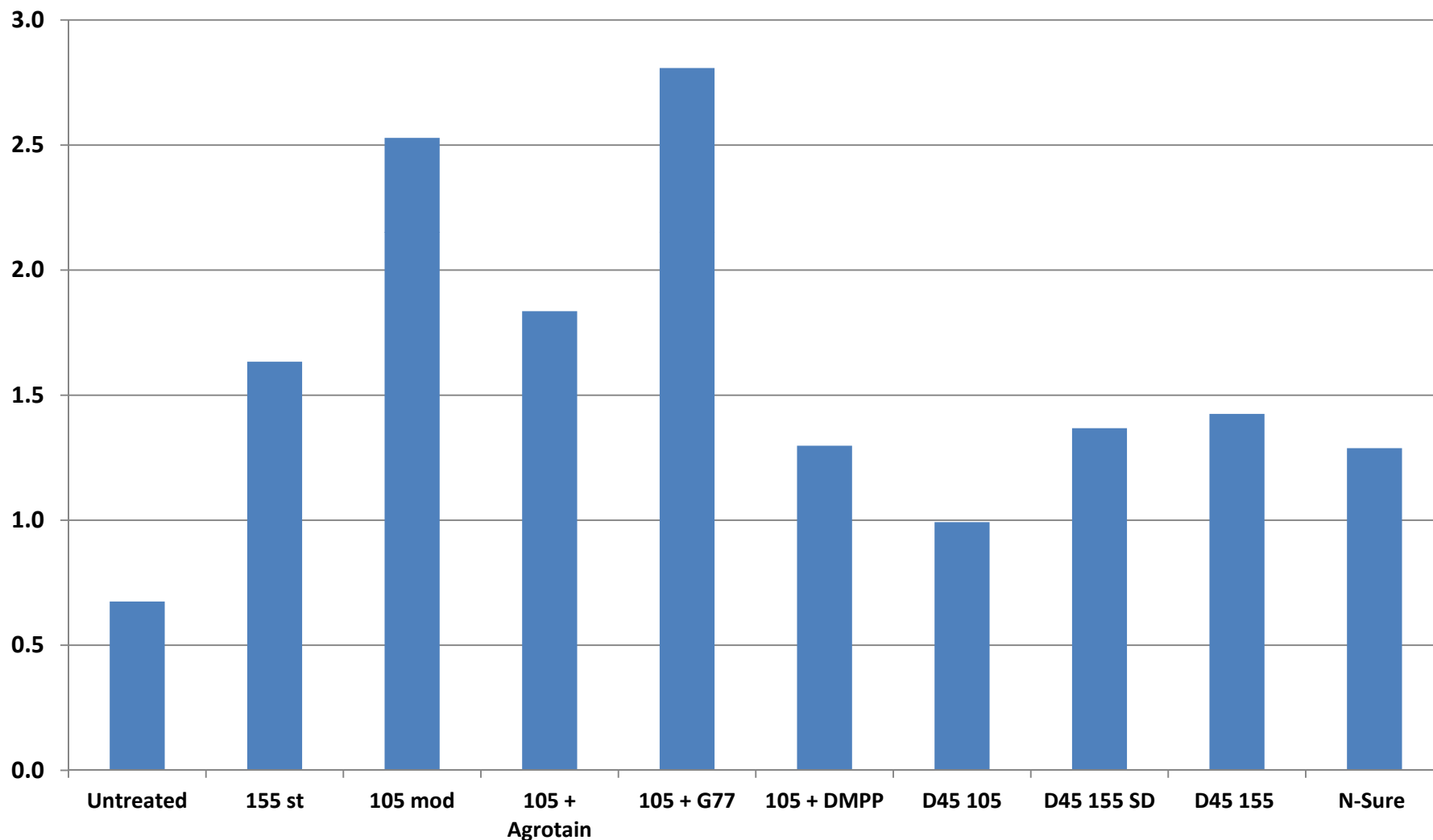


# Nitrogen Uptake by Lettuce at Harvest

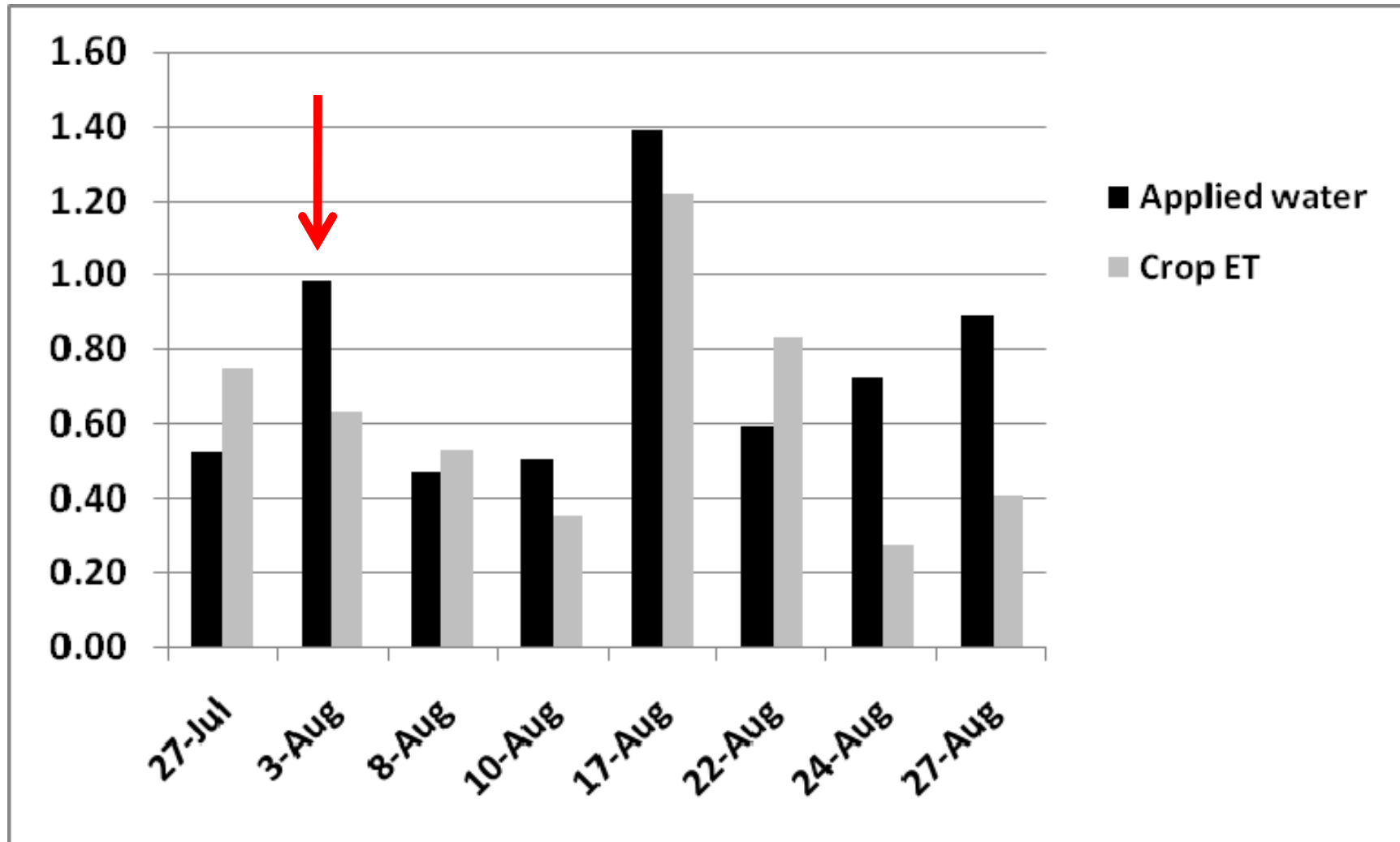


# Applied N/Uptake N Ratio

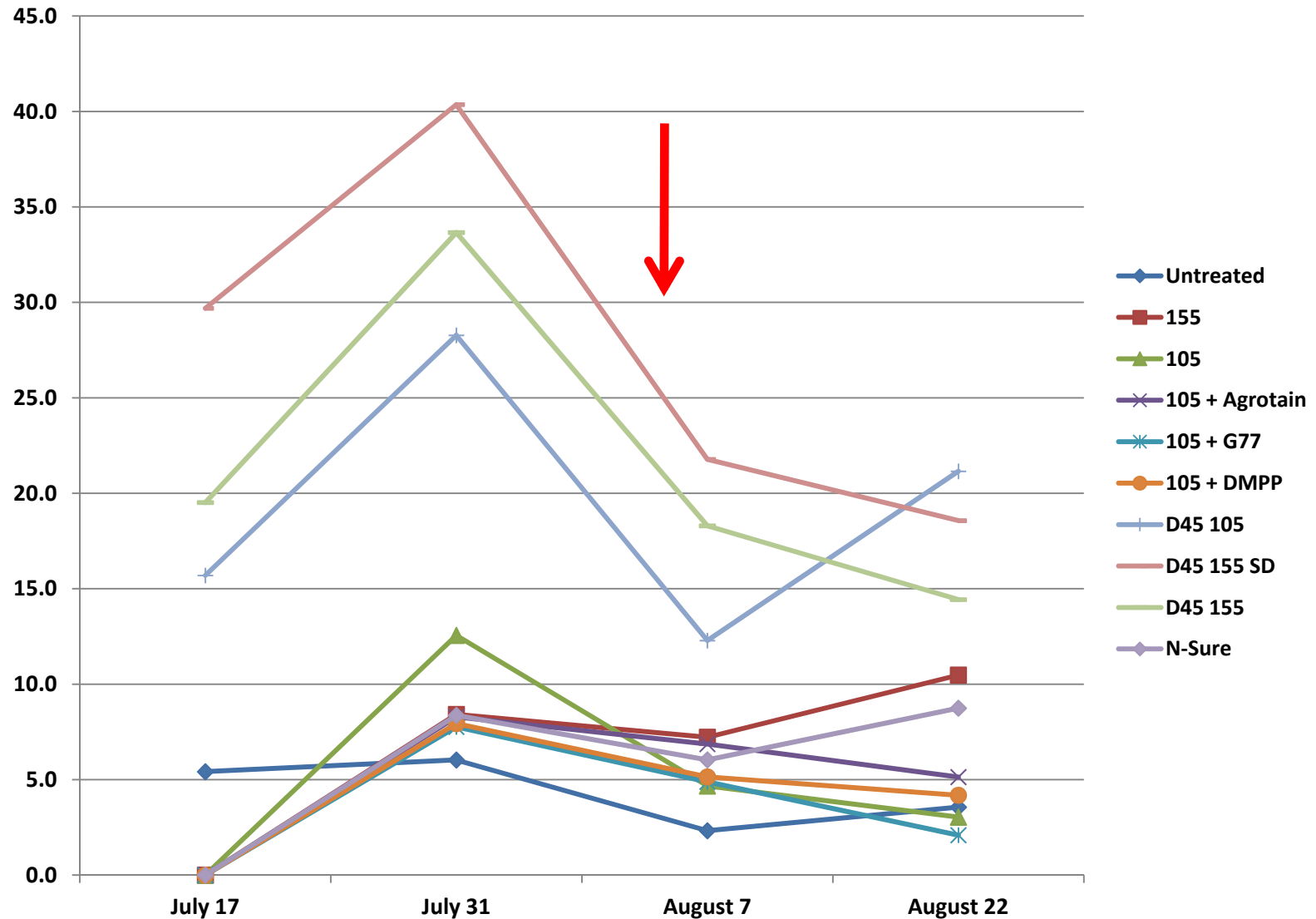
Does not account for soil N or leaching losses



# Irrigation Events in Relation to Crop ET from Thinning to Harvest



# Nitrate-N in Soil on Four Dates

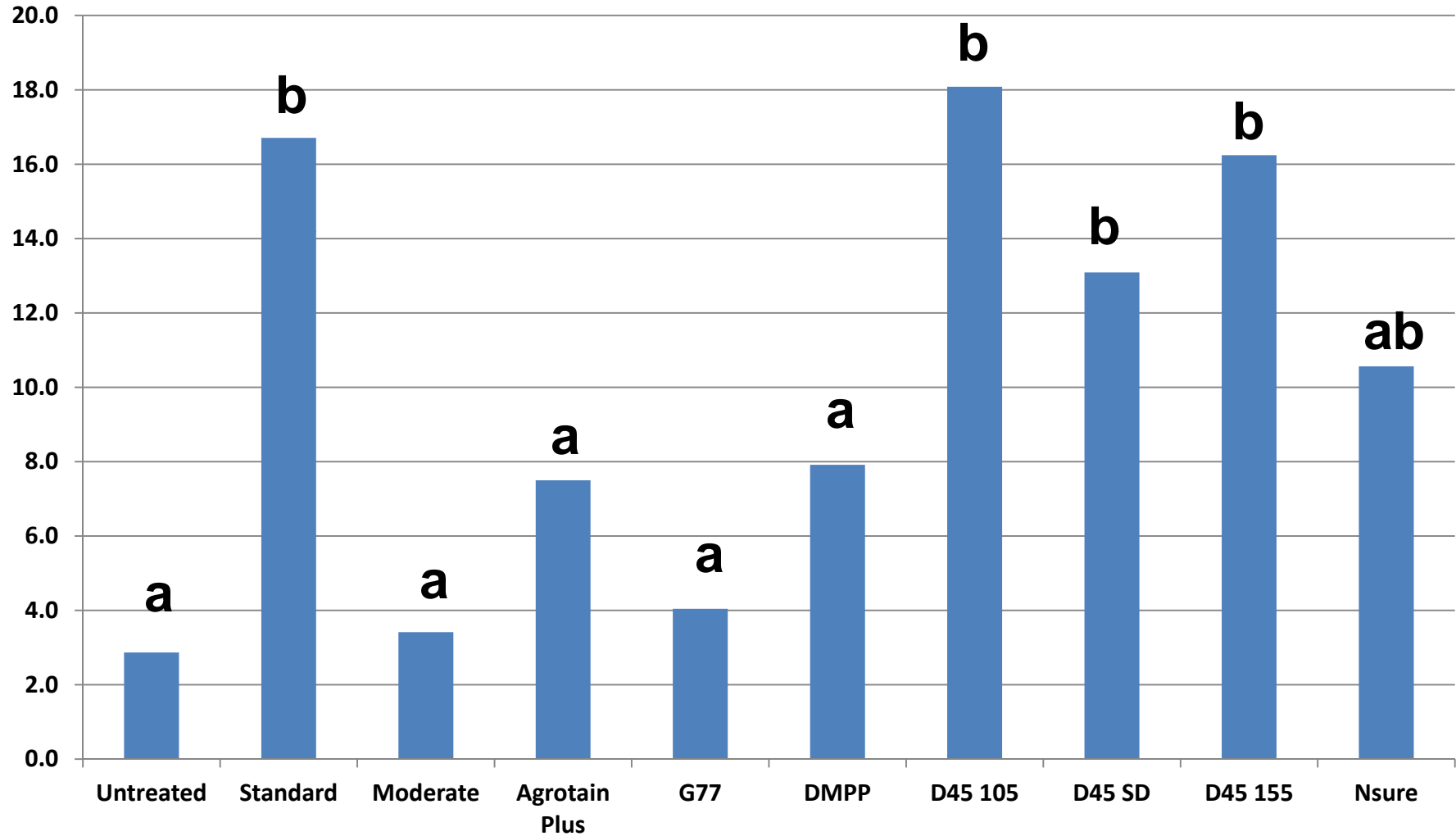




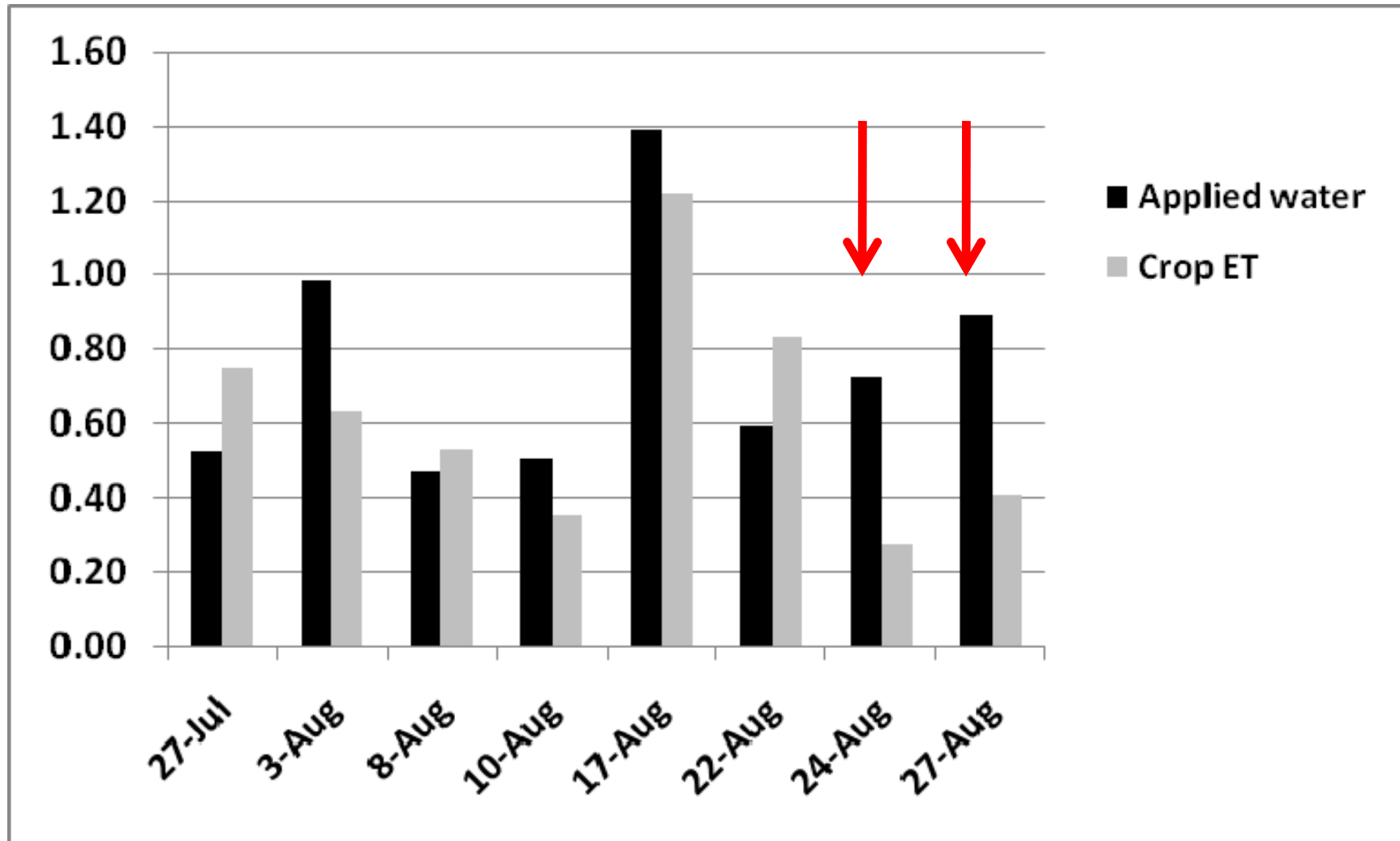
# Nitrate-N at 2 – 3 Feet in Soil

## August 15

Average at start of trial (July 2) = 1.6 ppm

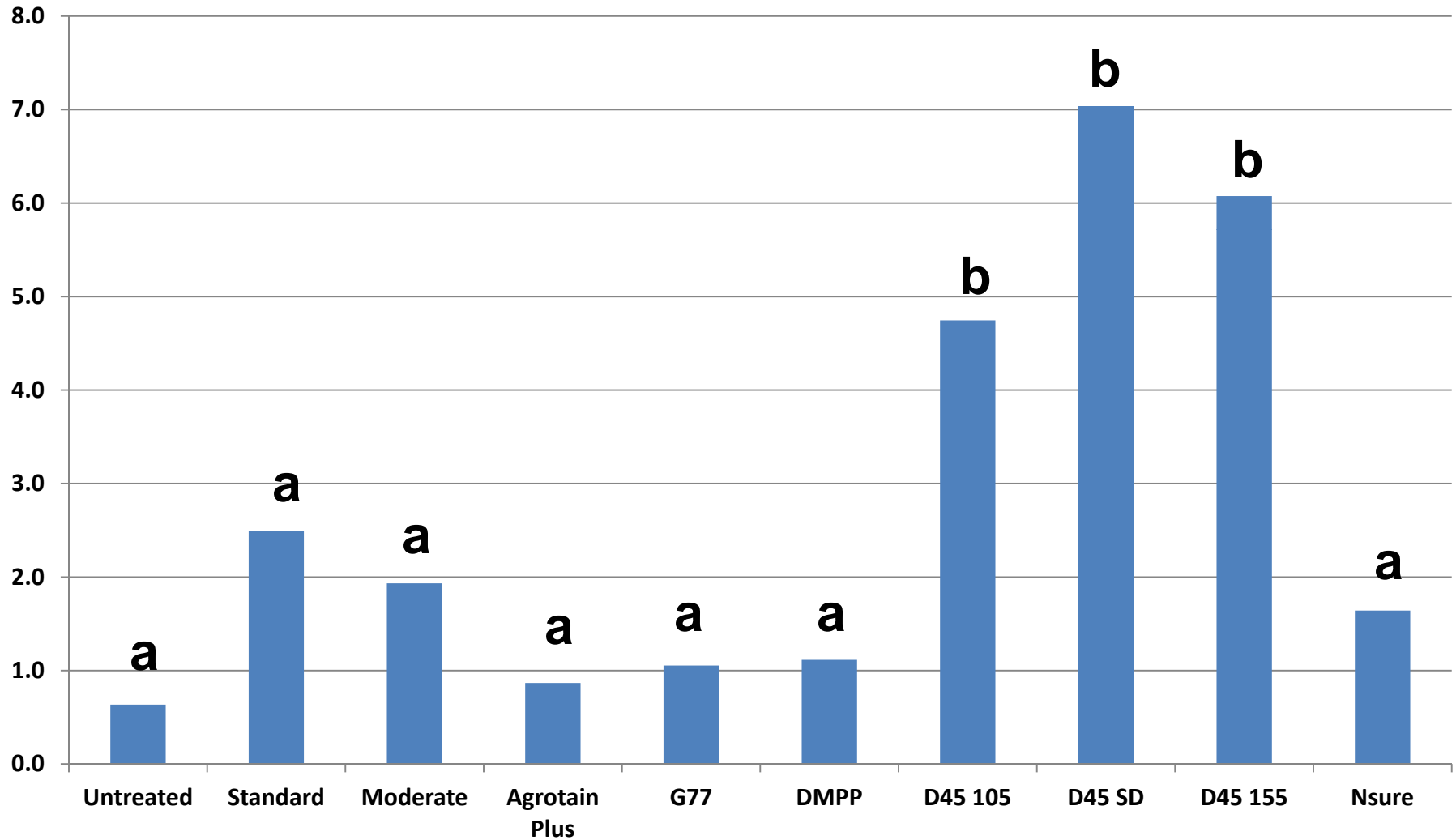


# Irrigation Events in Relation to Crop ET from Thinning to Harvest



# 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**