



Nitrogen Fertilizer Technology Evaluations and Nitrogen Uptake by Vegetables

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The Nitrate Dilemma

- **Nitrate is just one of the sources of nitrogen used for crop growth**
- **It comes from nitrate in the fertilizer and from mineralization of urea and ammonium in fertilizer**
- **It also comes from mineralization of crop residues and soil organic matter**

The Nitrate Dilemma

- **Nitrate has a negative charge and is not absorbed by the clays or organic matter in the soil**
- **Ammonium has a positive charge and is attracted to the negative charges on clay and organic matter**

The Nitrate Dilemma

- **The issue is that once soils warm in the spring to >60 F**
- **Soil microbes convert ammonium to nitrate within 7-14 days**
- **Ammonium-N levels are typically in the 1-2 ppm range in the summer**
- **Nitrate-N levels vary greatly but can be quite elevated (20 - 40 ppm)**

The Nitrate Dilemma

- **If we could keep more of the plant available N as ammonium or protect it some other way, there may be an opportunity to increase the nitrogen use efficiency of applied N**
- **We could also reduce leaching losses from big irrigation events (i.e. germination phase of crops)**

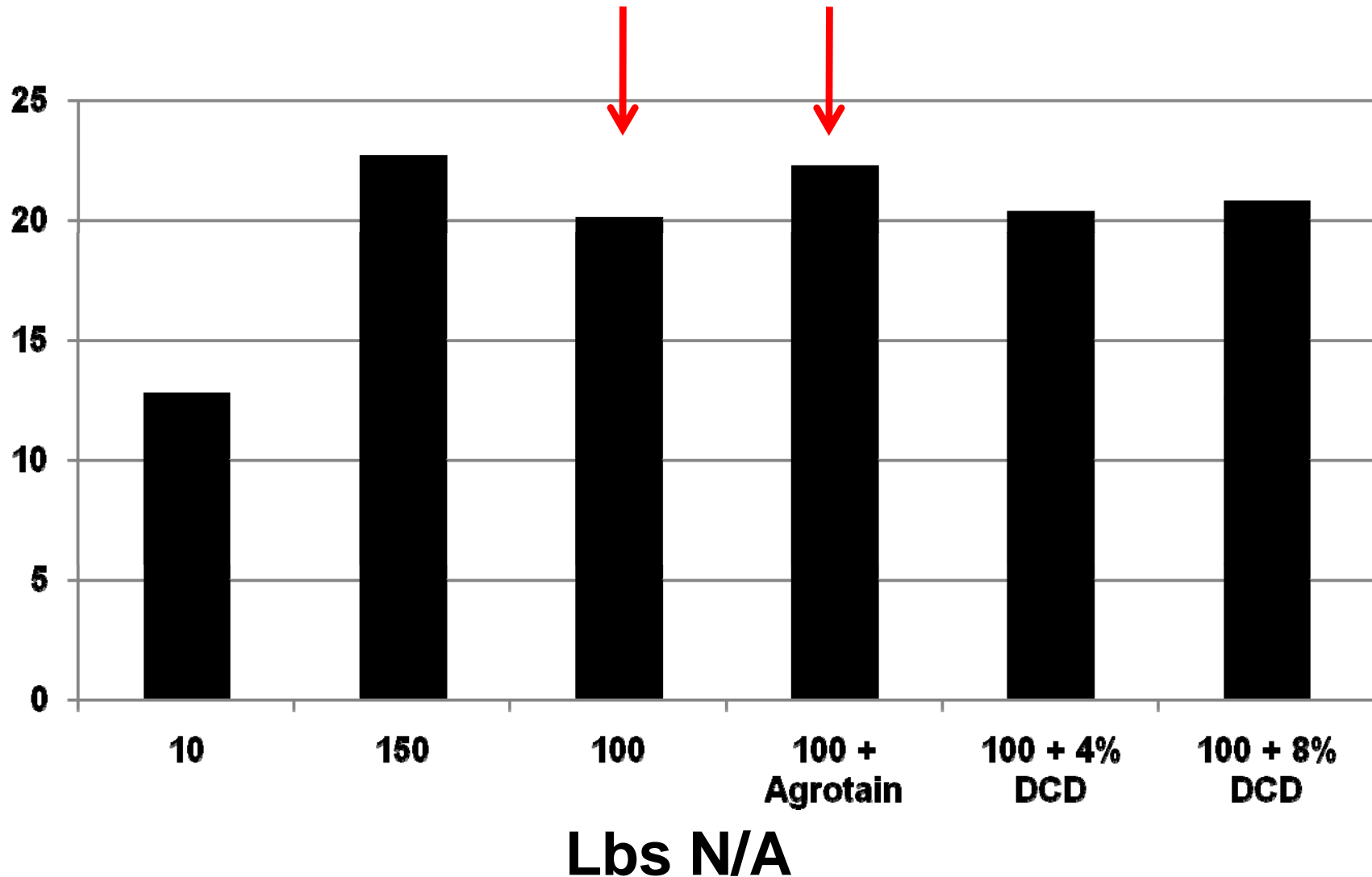
Nitrogen Fertilizer Technology

- **There are fertilizer technologies that can help in this regard:**
 - **Nitrification inhibitors**
 - DCD (Agrotain Plus, Koch Industries)
 - Nitropyrin (Instinct, Dow AgroSciences)
 - DMPP (Entec, BASF – used in Europe)
 - **Controlled & slow release fertilizers**
 - Coated prills (Duration, ESN)
 - Chains of urea (Nitamin, N-Sure, Greenfeed)

Fertilizer Technology

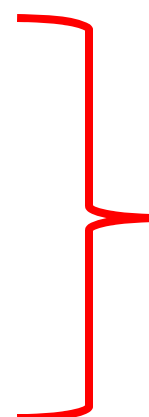


2011 Lettuce Yield (T/A) Nitrification Inhibitor Trial



2012 Lettuce Fertilizer Trial

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



Fertilizer additives
or slow release
fertilizers at the
moderate fertilizer
rate



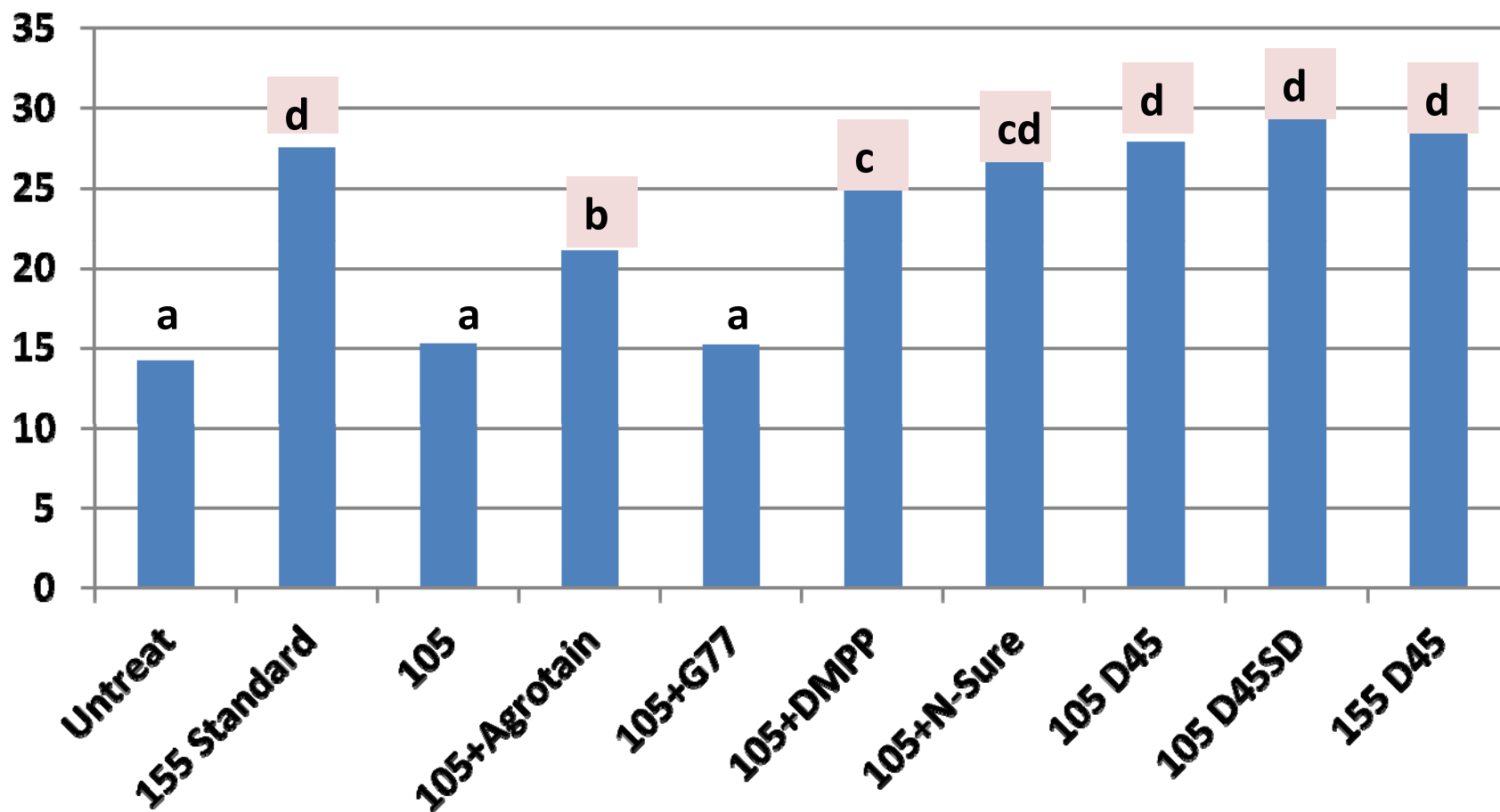
Injection of fertilizer treatments:

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



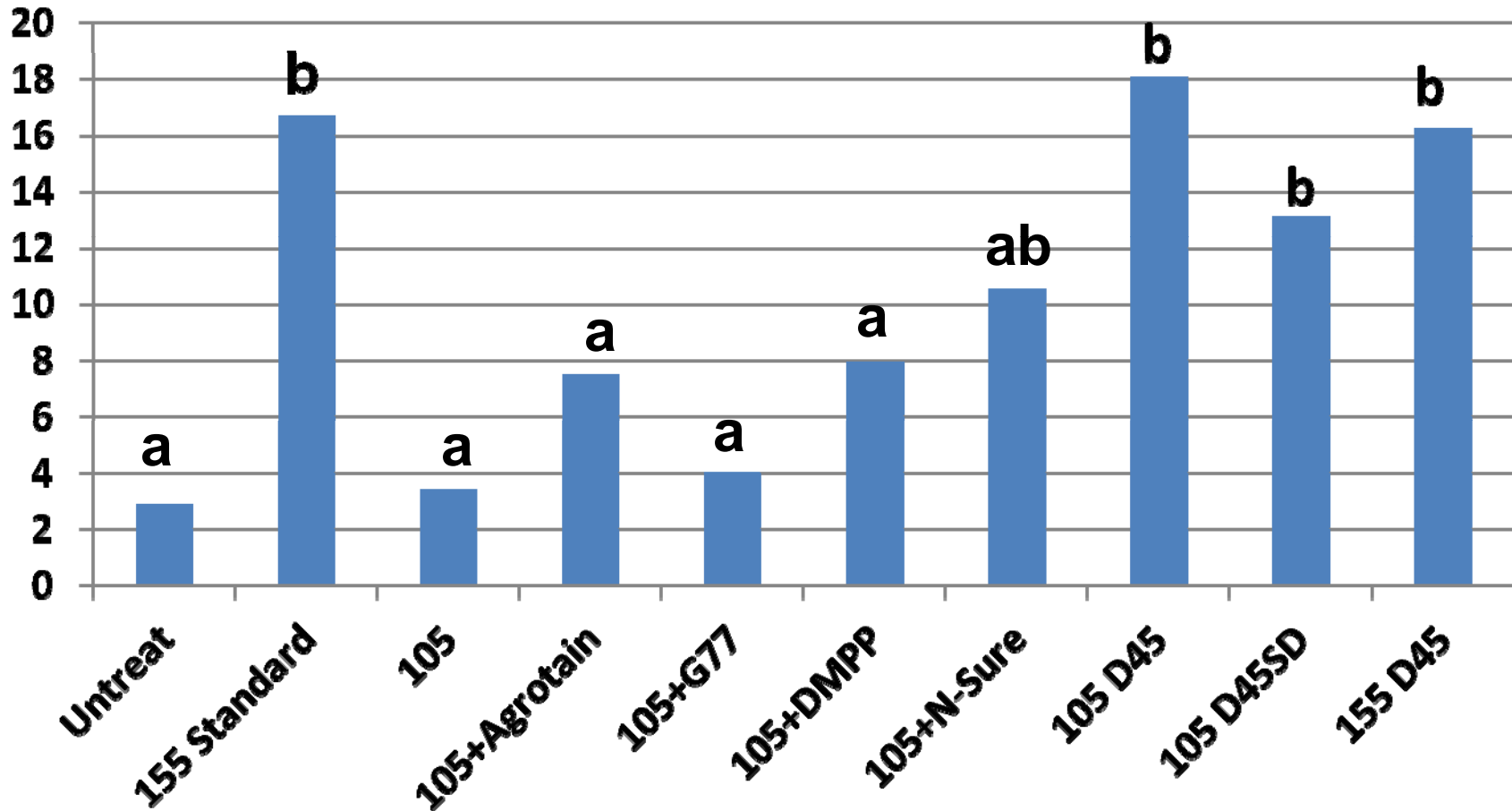
Yield Evaluation

Tons/A



Nitrate-N at 2 – 3 Feet in Soil

August 15



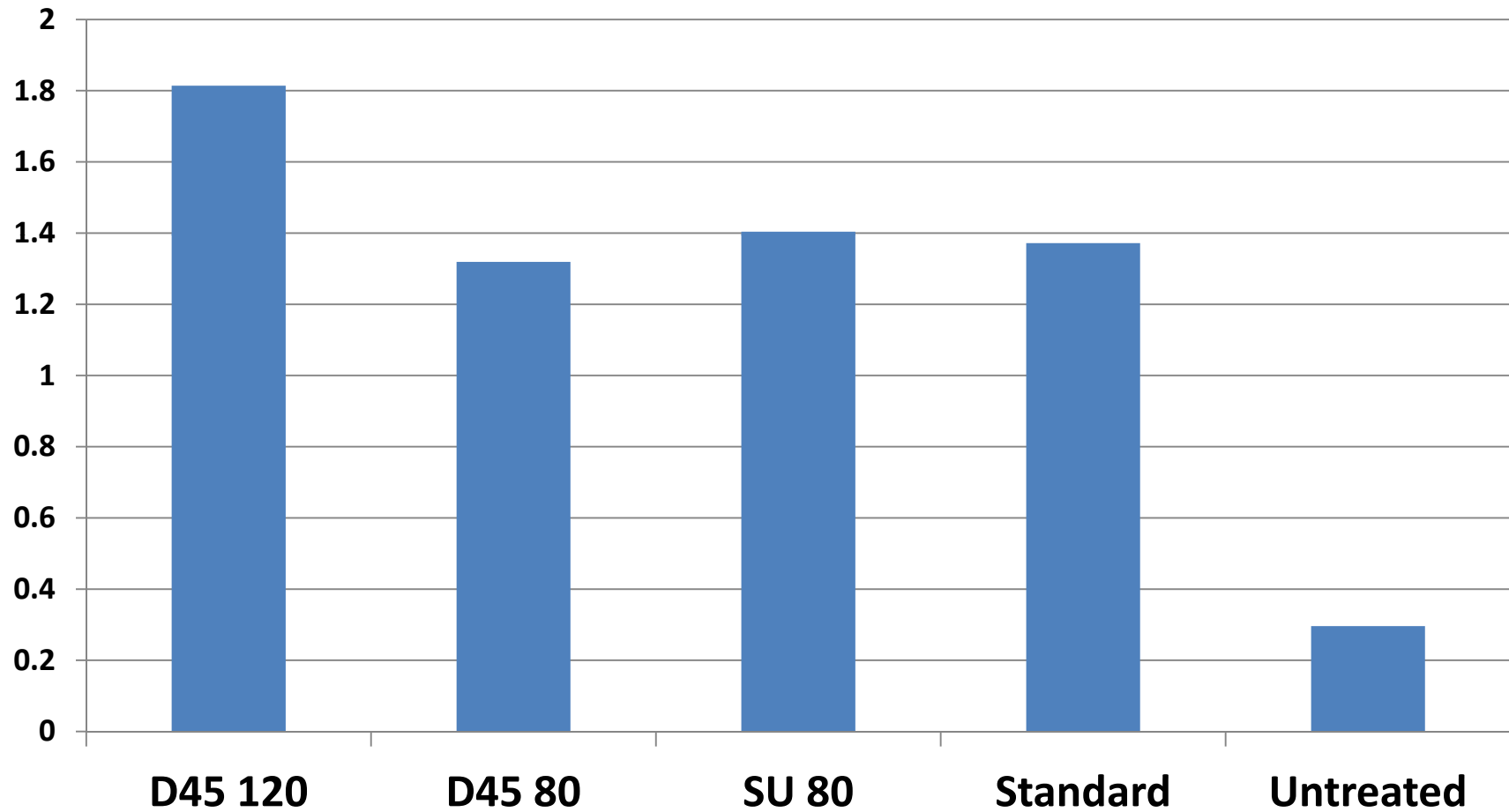
Average at start of trial (July 2) = 1.6 ppm

2012 Spinach Evaluation



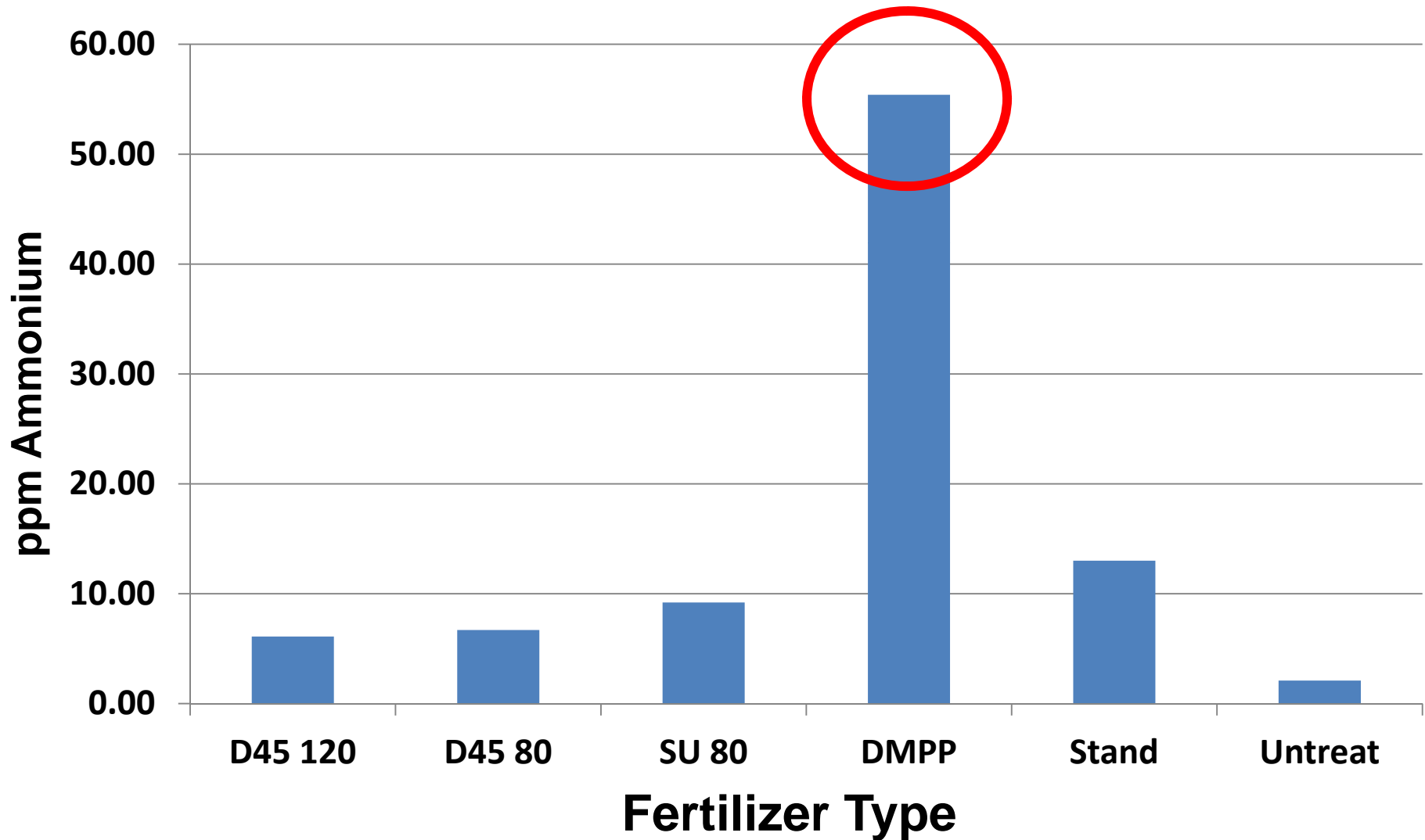
Spinach Biomass Evaluation

26 days after germ water



Ammonium-N in Soil

18 days after germ water



Nitrogen Technology Summary

- **These trials showed tremendous potential for these fertilizer technologies**
- **We will be very interested in the progress of Instinct as Dow AgroSciences pursues registrations of Instinct on lettuce and other cool season crops**

Nitrogen Uptake by Cool Season Vegetables

Nitrogen Uptake by Broccoli, Cauliflower and Cabbage

- Research funded by the Fertilizer Research and Education (FREP) Program to determine the nitrogen uptake by cole crops



Nitrogen Uptake by Broccoli, Cauliflower and Cabbage

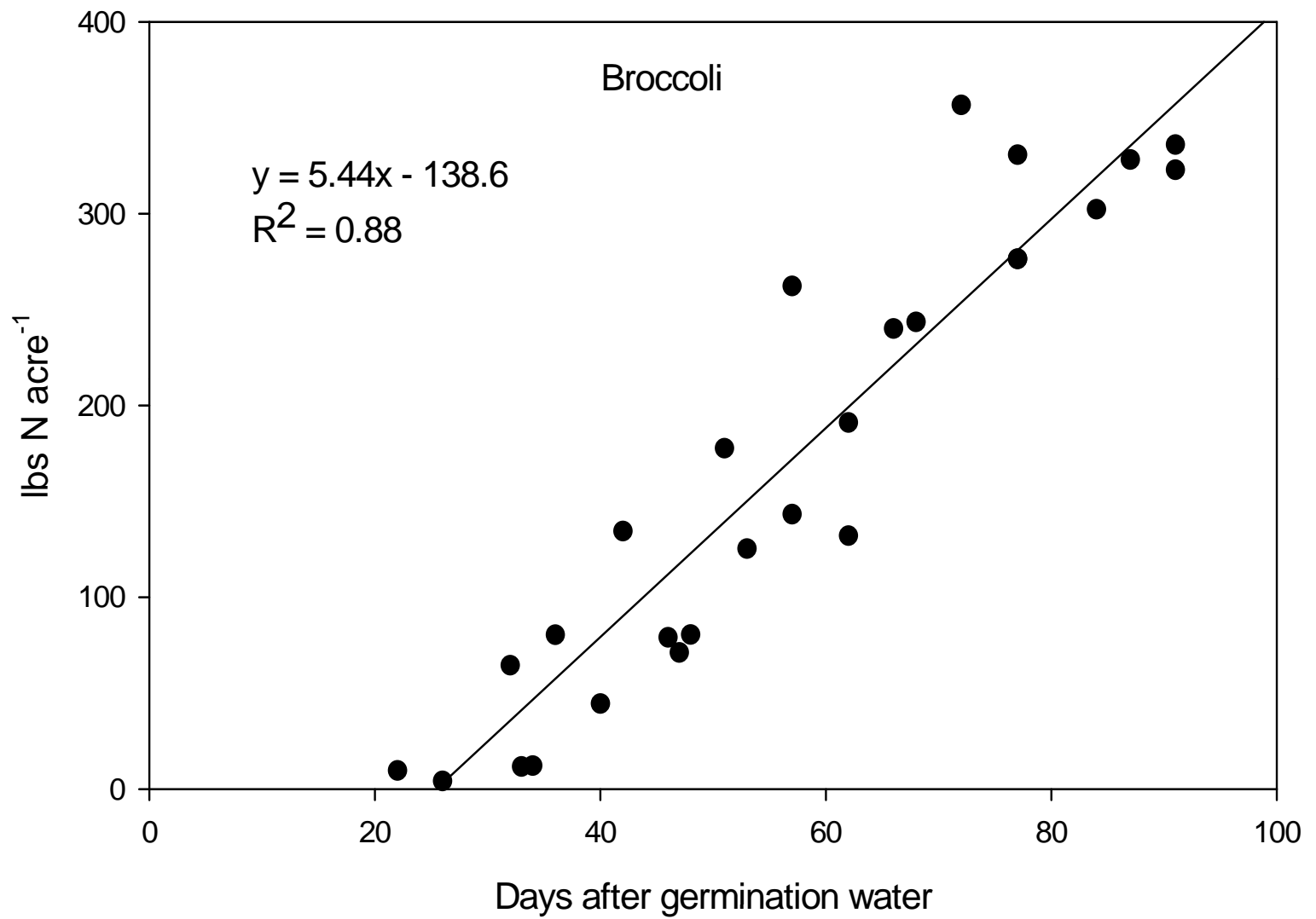
- **A survey of 32 highly productive fields are being surveyed in 2012-13 to determine the total N uptake by these crops**
- **Also the rate of uptake is being evaluated and will ultimately be added to the CropManage program**
- **About half of the survey fields have been completed**

Fates of Nitrogen in Cole Crops

Production and Harvest

2012 Survey Results

Crop	Fertilizer applied	Crop Uptake	Scavenged from soil	Removed in harvest	Residue after harvest
Broccoli	181	323	141	80	243

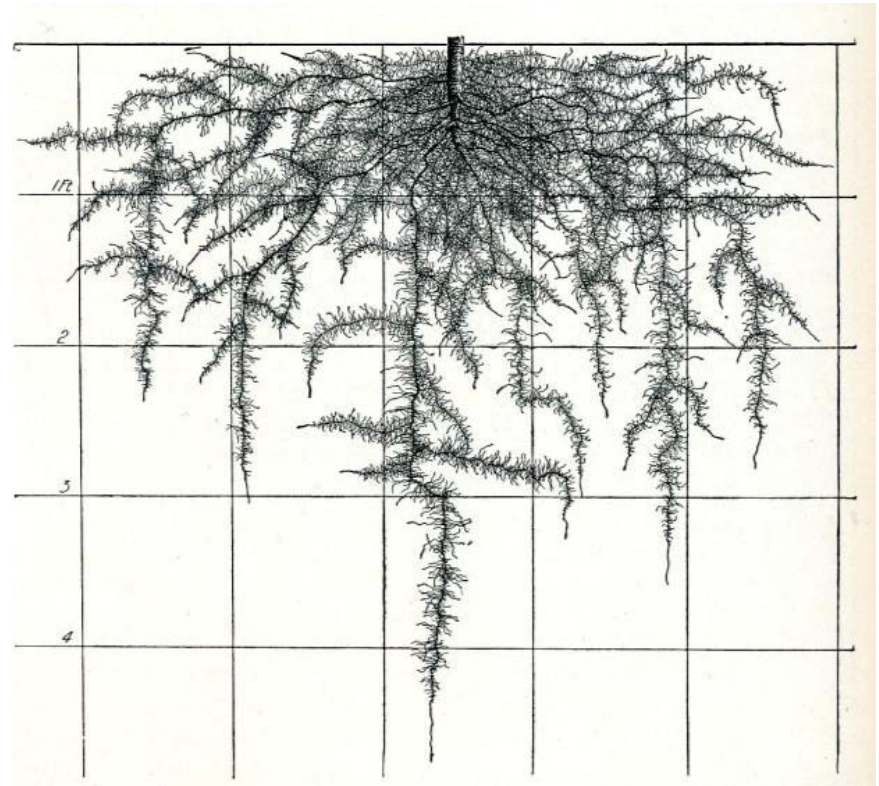


Broccoli Nitrogen Uptake Dynamics

- **The total biomass of broccoli averaged 4.1 tons/A**
- **Percent N in the tissue averaged 4.1%**
- **These two factors drive the total N uptake to over 300 lbs N/A**

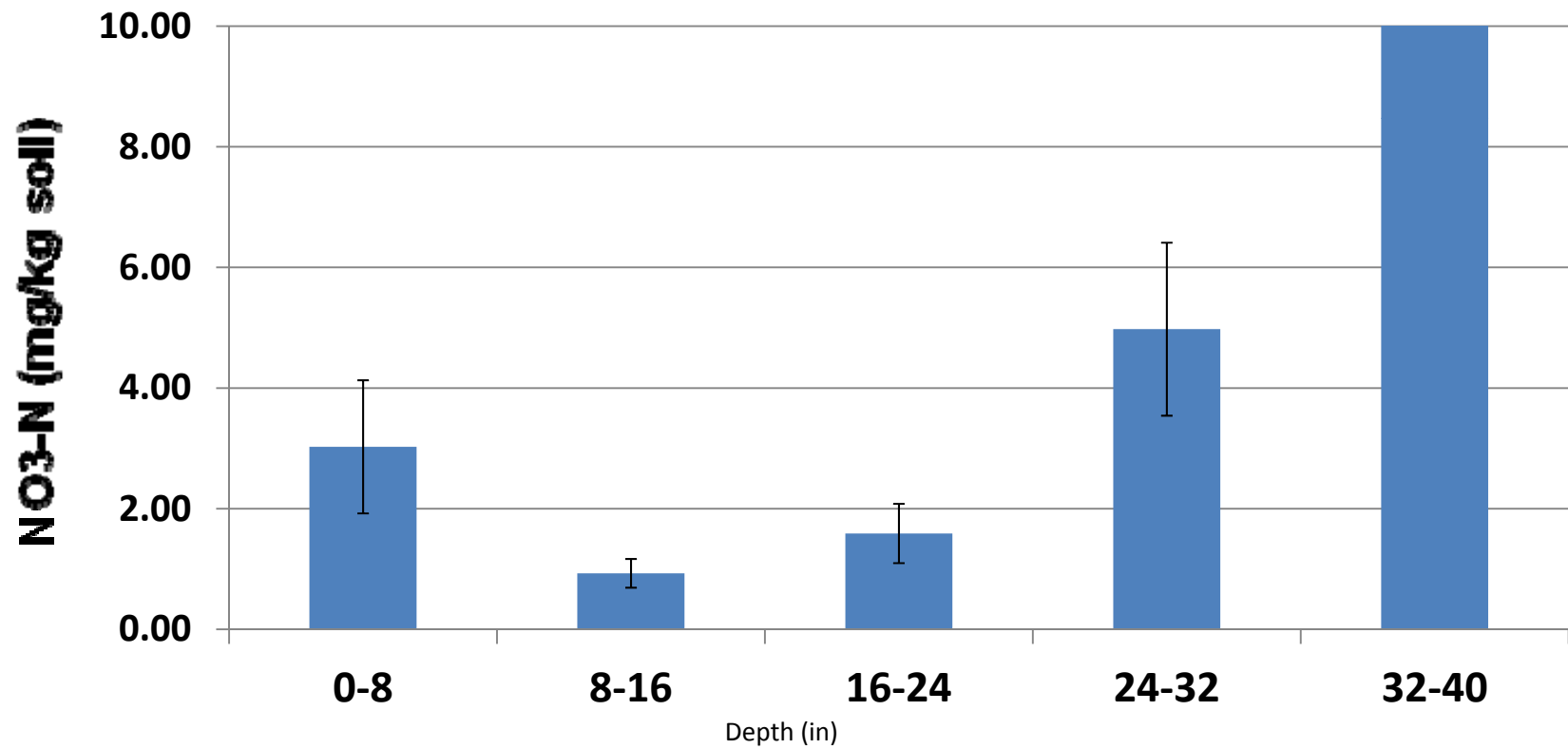
Broccoli Nitrogen Uptake Dynamics

- The question is: where is the non-fertilizer N coming from?
- Broccoli may have more efficient and deep root systems than we realize



90 Day Old Cauliflower Roots
(note roots down to 3-4 feet)

Nitrate-N in the Root Zone of Broccoli



Broccoli Nitrogen Uptake Dynamics

- **To fully understand the fertility dynamics of broccoli, we will have to measure the nitrate levels down deeper than the one foot level**

Implications of Broccoli Nitrogen Uptake

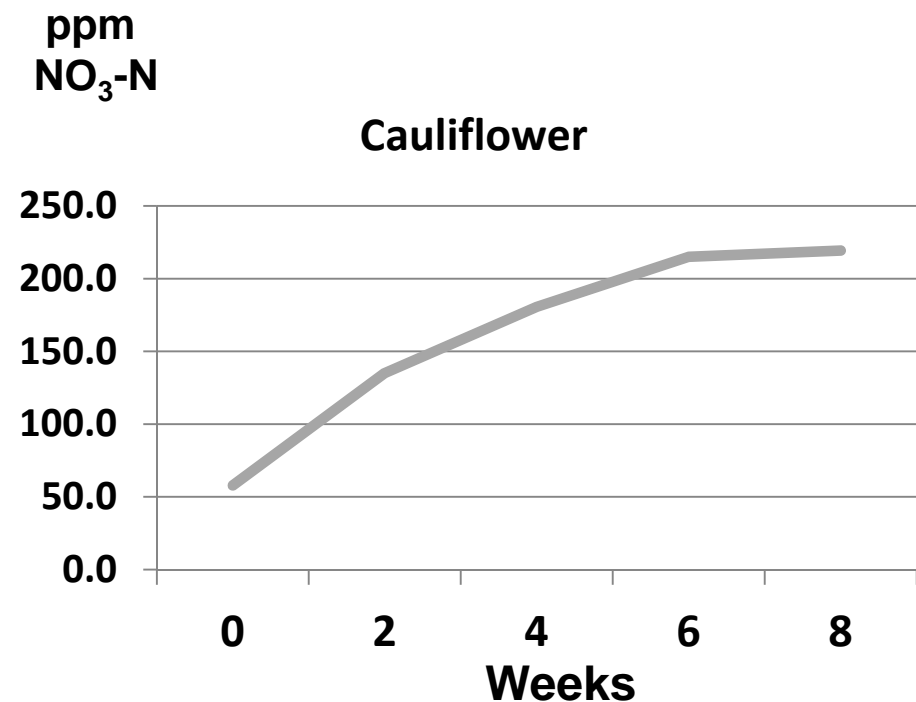
- **Broccoli N uptake will affect the 1.0 nutrient applied to uptake ratio put forth in the Ag Order**

Implications of Broccoli Nitrogen Uptake

- In addition, the nitrogen taken up by broccoli may potentially be keeping nitrogen that would otherwise be lost to leaching “in play” and provide another opportunity to utilize it for crop growth**
- Broccoli as a rotational crop for lettuce may be retrieving unused that may be at risk of leaching from the soil and keeping it higher in the soil profile**

Nitrogen in Broccoli Residue

- The tricky issue is that broccoli residue contains as much as 240 lbs N
- More than half of the N in the residue can mineralize in 4-6 weeks



Nitrogen in Broccoli Residue

- **The nitrate released from broccoli residue can be measured and taken into account with use of the nitrate quick test**

Fates of Nitrogen in Cole Crops

Production and Harvest

Crop	Fertilizer applied	Crop Uptake	Scavenged from soil	Removed in harvest	Residue after harvest
Cauliflower	260	264	5	57	207
Cabbage	249	328	81	178	149

Summary

- **Looking at cole crops as a scavenging crop may change the way we look at ways to improve nitrogen use efficiency in our leafy green production system**
- **Effectively managing and utilizing residual N left behind following cole crops will be important for closing the loop**