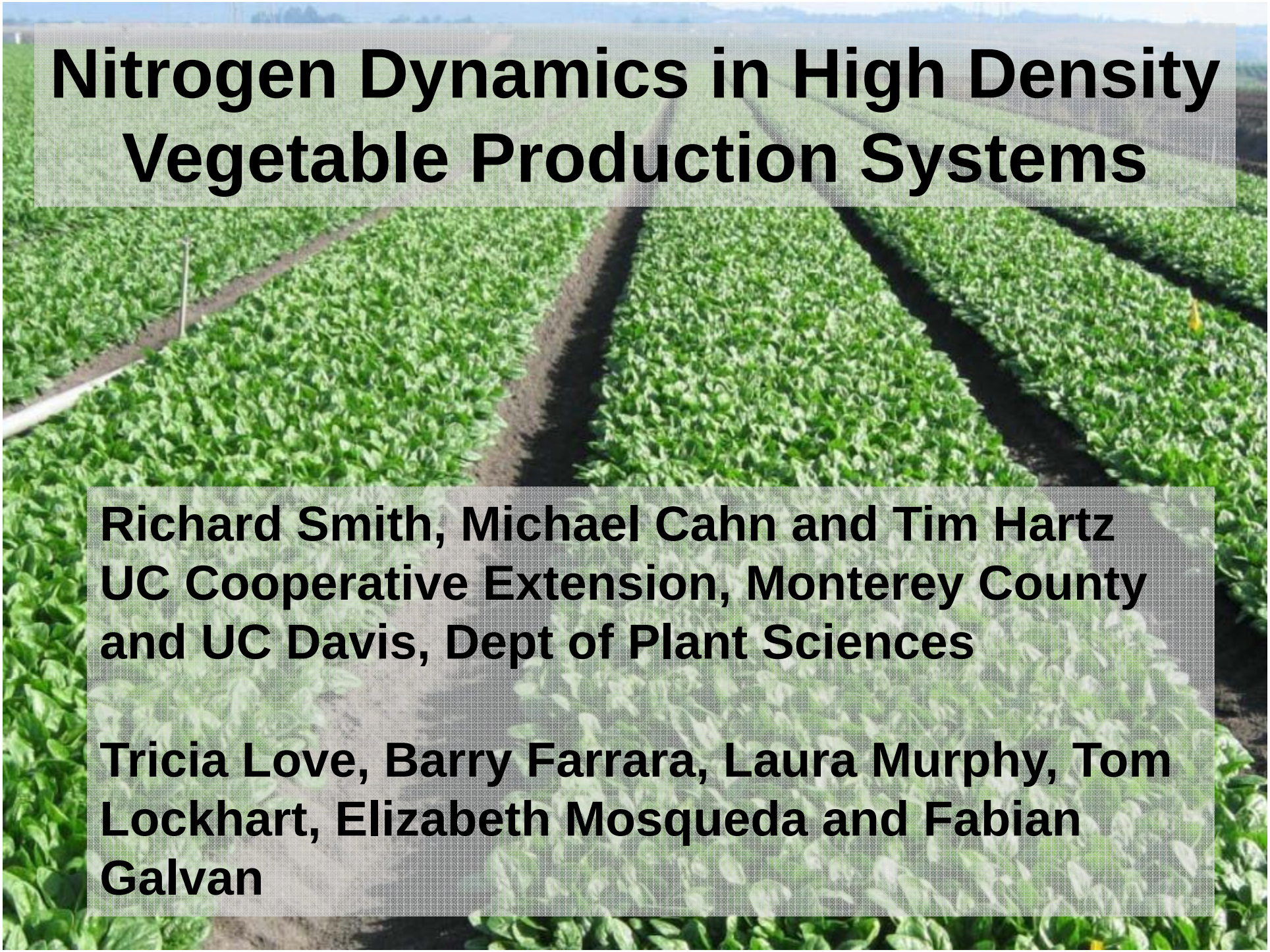
2015 Irrigation and Nutrient Management Meeting

- 1.5 CDPR Continuing Education Credits
  - All other category
  - M-0372-15
- 4.5 CCA Credits
  - 2.5 Nutrient Management
  - 1.0 Soil and Water Management
  - 1.0 Integrated Pest Management
  - CA 53144
- Please put phones on SILENT MODE



Nitrogen Dynamics in High Density Vegetable Production Systems

Richard Smith, Michael Cahn and Tim Hartz
UC Cooperative Extension, Monterey County and UC Davis, Dept of Plant Sciences

Tricia Love, Barry Farrara, Laura Murphy, Tom Lockhart, Elizabeth Mosqueda and Fabian Galvan

Nitrogen Management of High-Density Leafy Vegetables

- **Nitrogen use in vegetable production in the coastal production district is now being monitored by the Central Coast Regional Water Quality Control Board**
- **Growers are looking for practices to bring N application rates closer to crop N uptake**

Acreage and Value of High-Density Vegetables in California

- Acreage of high density crops
  - 27,976 acres – spinach
  - 21,884 acres - spring mix
  - 4,317 acres - cilantro
  - 21,400 acres - baby lettuce
- Combined value* of $453,757,000

* Baby lettuce value not available

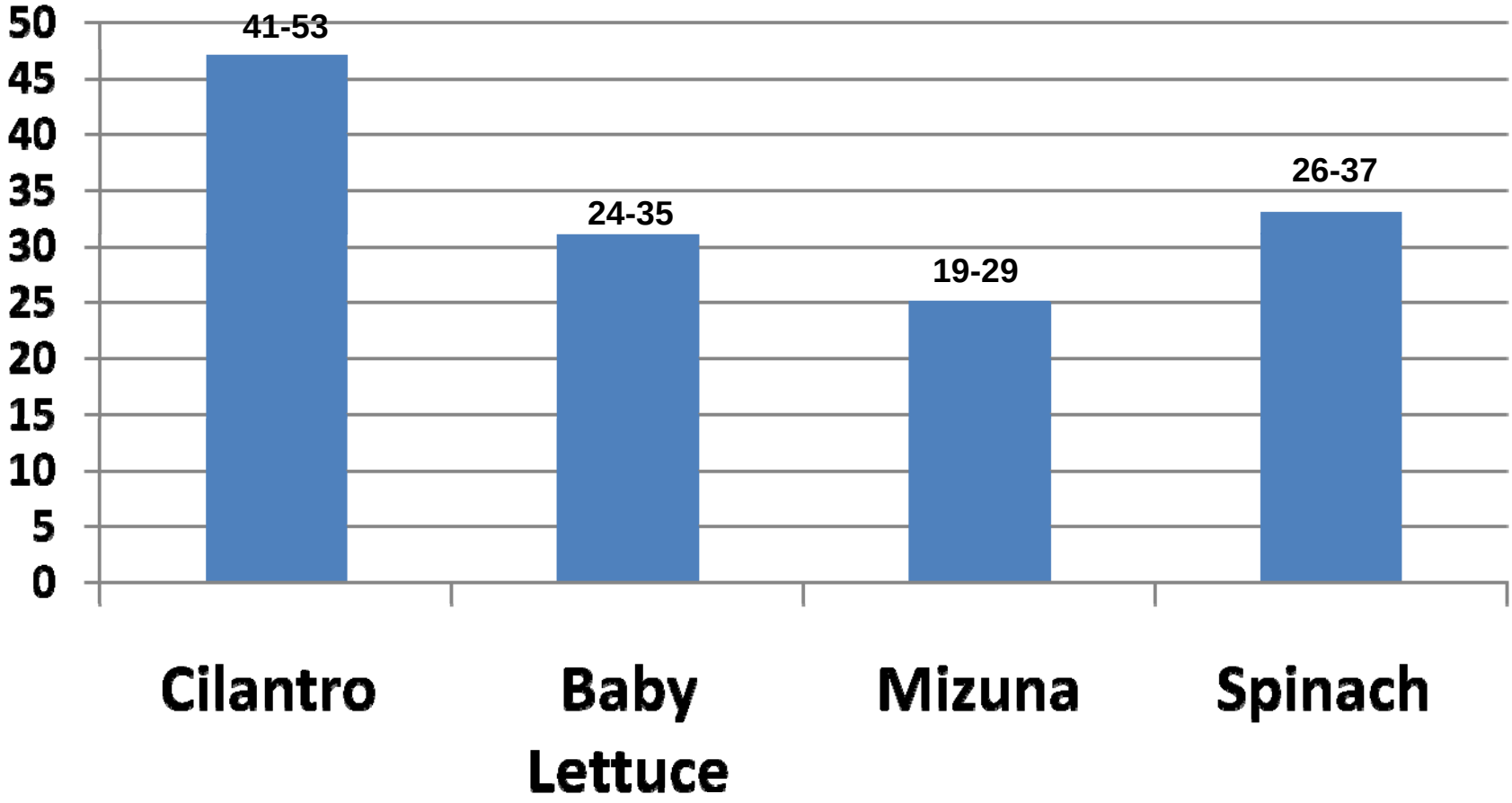
High-Density Vegetable Crops

- Eighty-inch wide beds present a particular challenge for managing nitrogen and water
- Crops are planted densely with 24 - 32 seedlines across the wide bed top using 2 to 4 million seed per acre
- The crops are typically fast maturing, shallow rooted and exclusively sprinkler irrigated
- These characteristics create difficulties for achieving high N-use efficiency
- Growers are under pressure to meet strict quality standards from buyers for these leafy vegetables

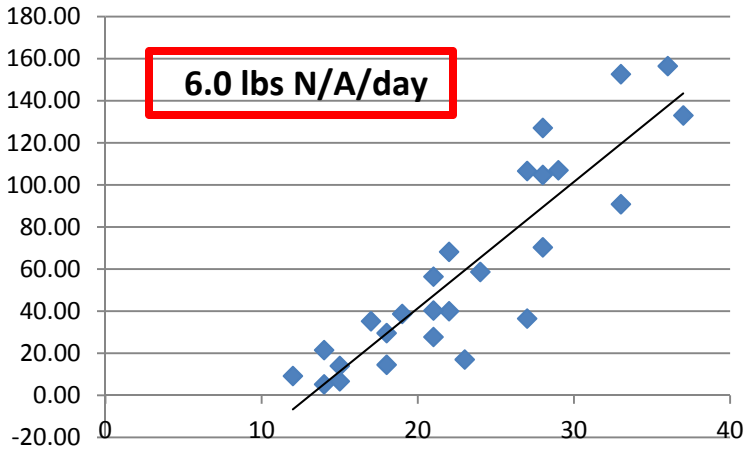
Objectives of this Study

- Document the rate of N uptake and total N uptake of spinach, baby lettuce, mizuna and cilantro
- Evaluate quantities of irrigation water applied to these crops over the course of the growth cycle
- Evaluate the rooting depth over the growing season
- Evaluate fertilizer additives such as urease and nitrification inhibitors with pre/at-planting fertilizer applications to improve N use efficiency
- Utilize the information gained on nitrogen uptake, water needs and rooting depth to refine the algorithms in the CropManage

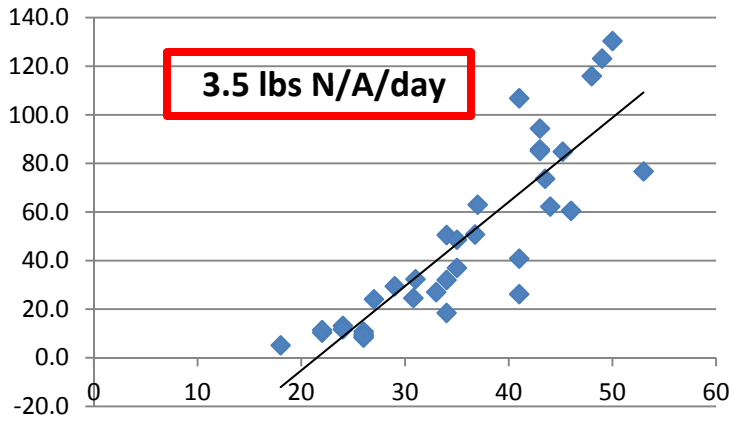
Days to Harvest



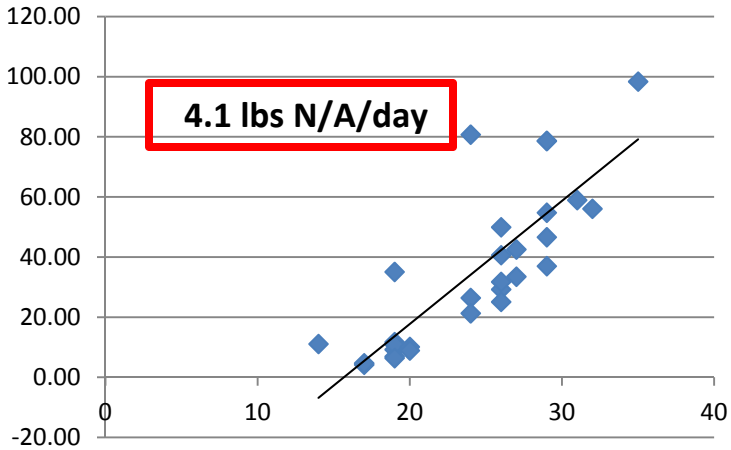
Nitrogen Uptake



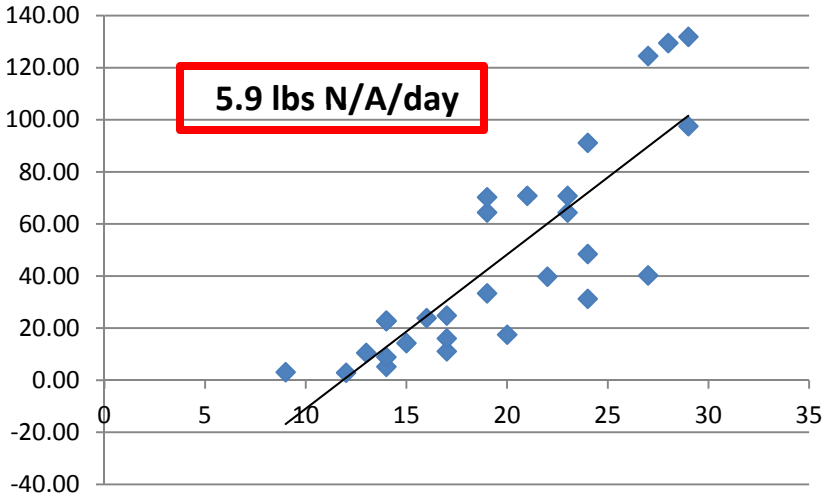
Spinach



Cilantro



Baby Lettuce



Mizuna

Biomass and Nitrogen Uptake

Crop	Dry Biomass lbs/A	N total uptake lbs/A	N fertilizer lbs/A	N applied/ uptake ratio
Cilantro	2,054	104	208	2.0
B. lettuce	1,210	64	184	2.9
Mizuna	1,722	99	179	1.8
Spinach	2,197	128	180	1.4

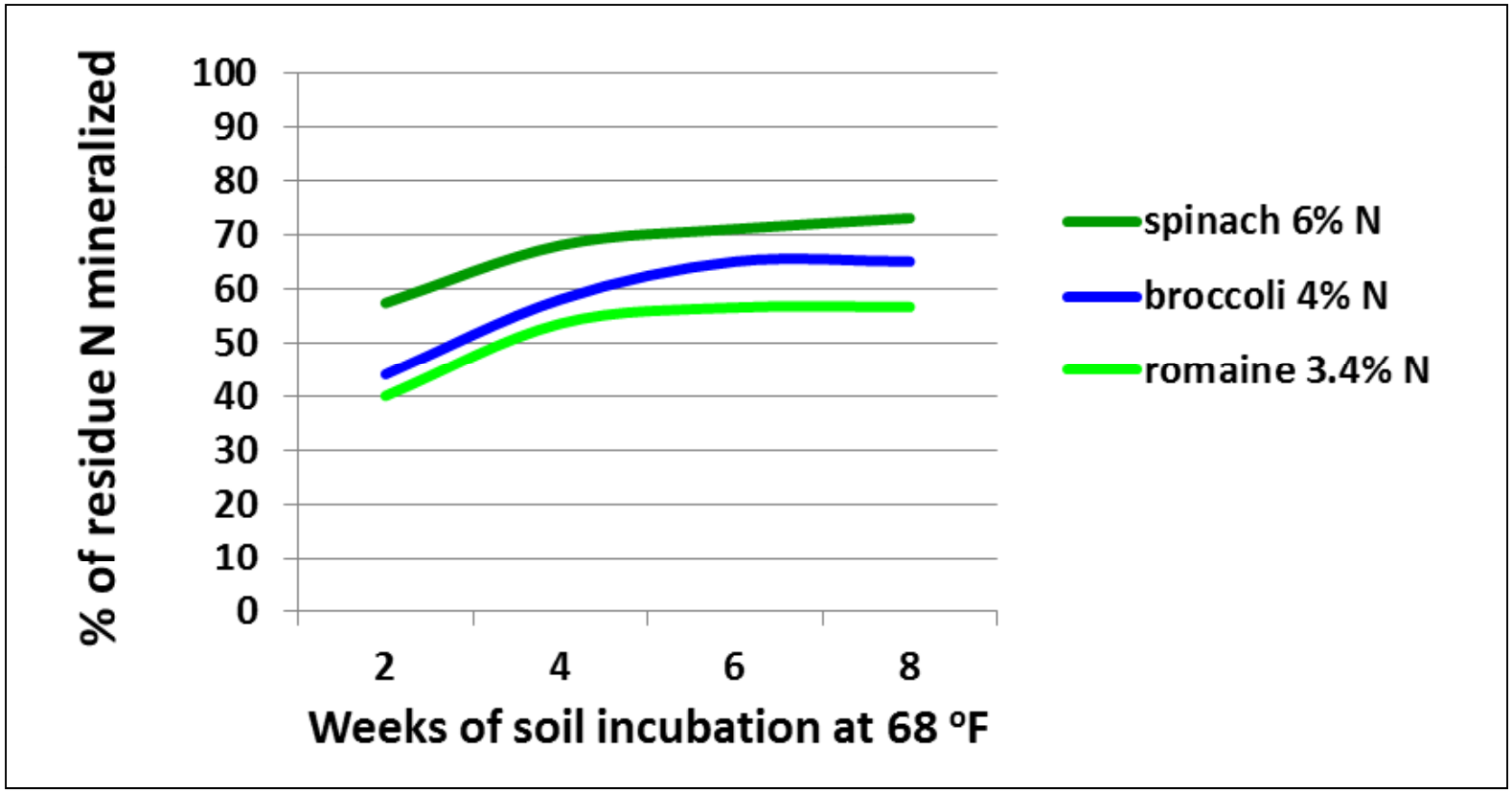
Nitrogen Uptake and N in Crop Residue after Harvest

Crop	N total uptake lbs/A	N in residue lbs/A	% N uptake in residue
Cilantro	104	47	45
Baby lettuce	64	24	38
Mizuna	99	41	41
Spinach	128	40	31

Baby lettuce residue

Mineralization of Crop Residue

most breakdown is complete in 4-6 weeks



Hartz, 2013

Available N from Vegetable Crop Residue after 8 Weeks

Crop Residue	N content	N in crop residue	Net N mineralization after 8 weeks	Net N mineralization after 8 weeks
	Percent	lbs N/A	Percent	lbs N/A
Spinach	6.2	40	82	33
Romaine	3.4	70	57	40

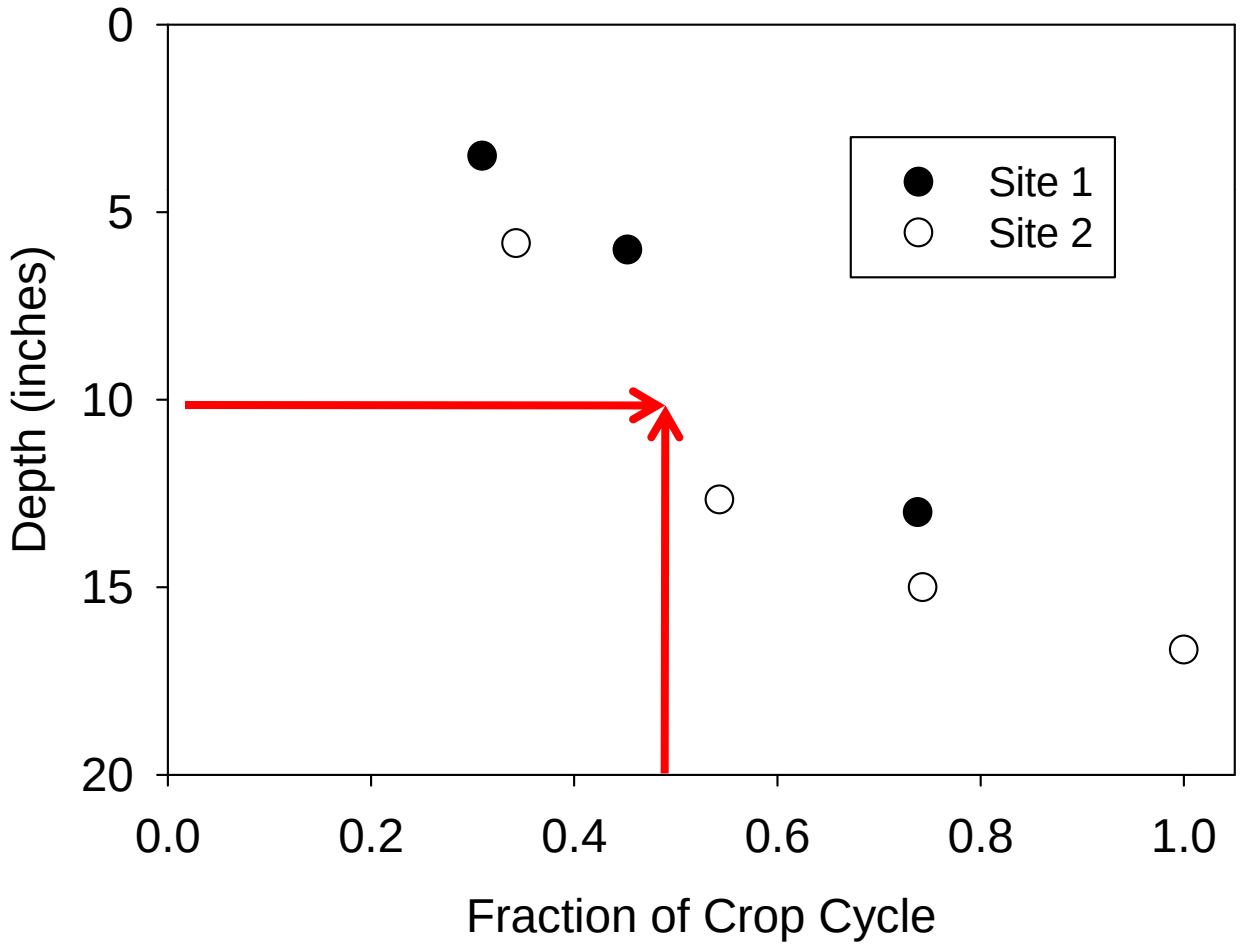
These crops residues mineralize so quickly that the quantity of N that they provide can best be assessed with a soil test

Phosphorus and Potassium Uptake

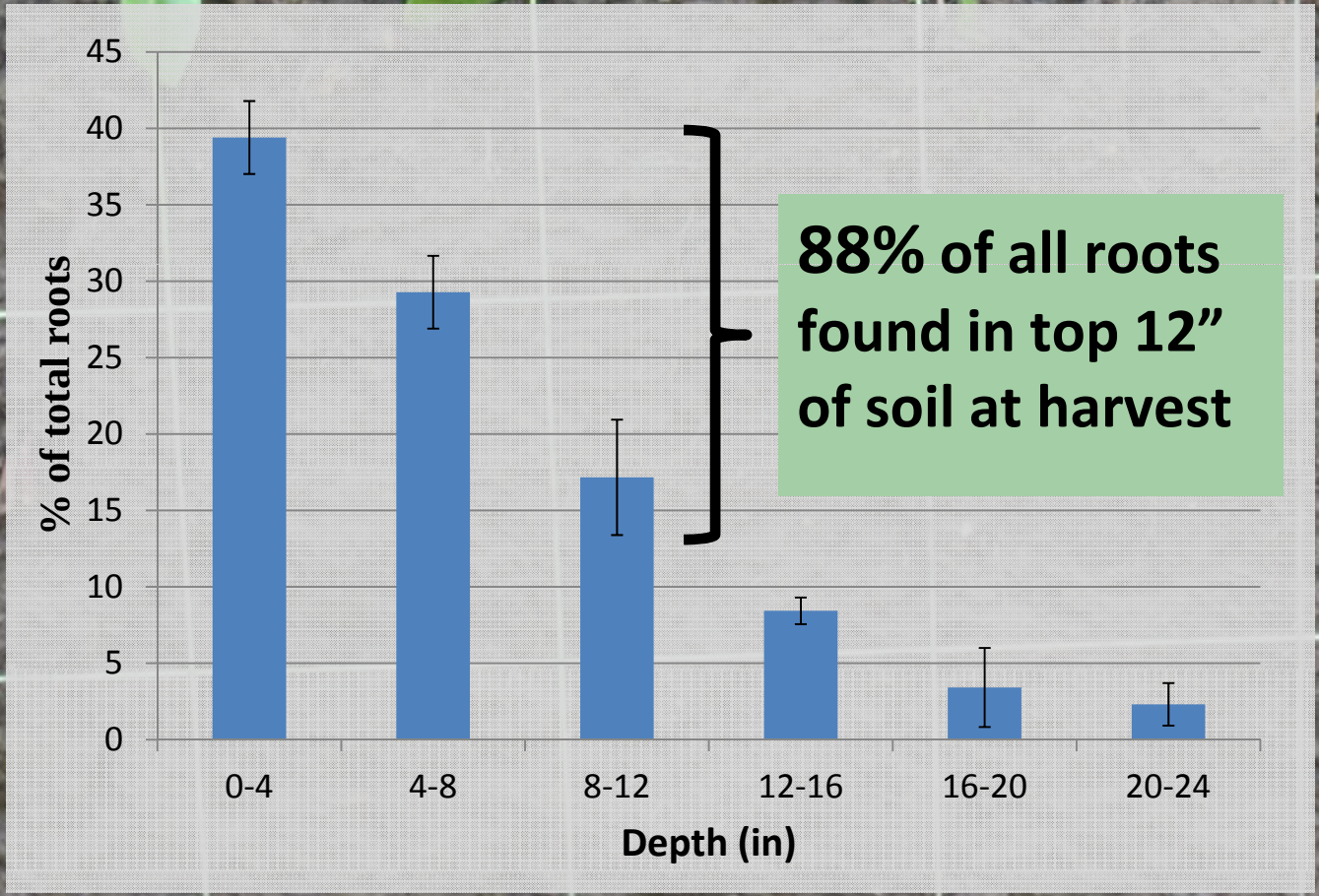
Crop	Percent P at harvest	P uptake lbs/A	Percent K at harvest	K uptake lbs/A
Cilantro	0.3	6.7	6.9	141
Baby lettuce	0.5	7.1	7.8	105
Mizuna	0.6	9.5	5.3	97
Spinach	0.7	15.0	9.3	203

Rooting Depth of Spinach

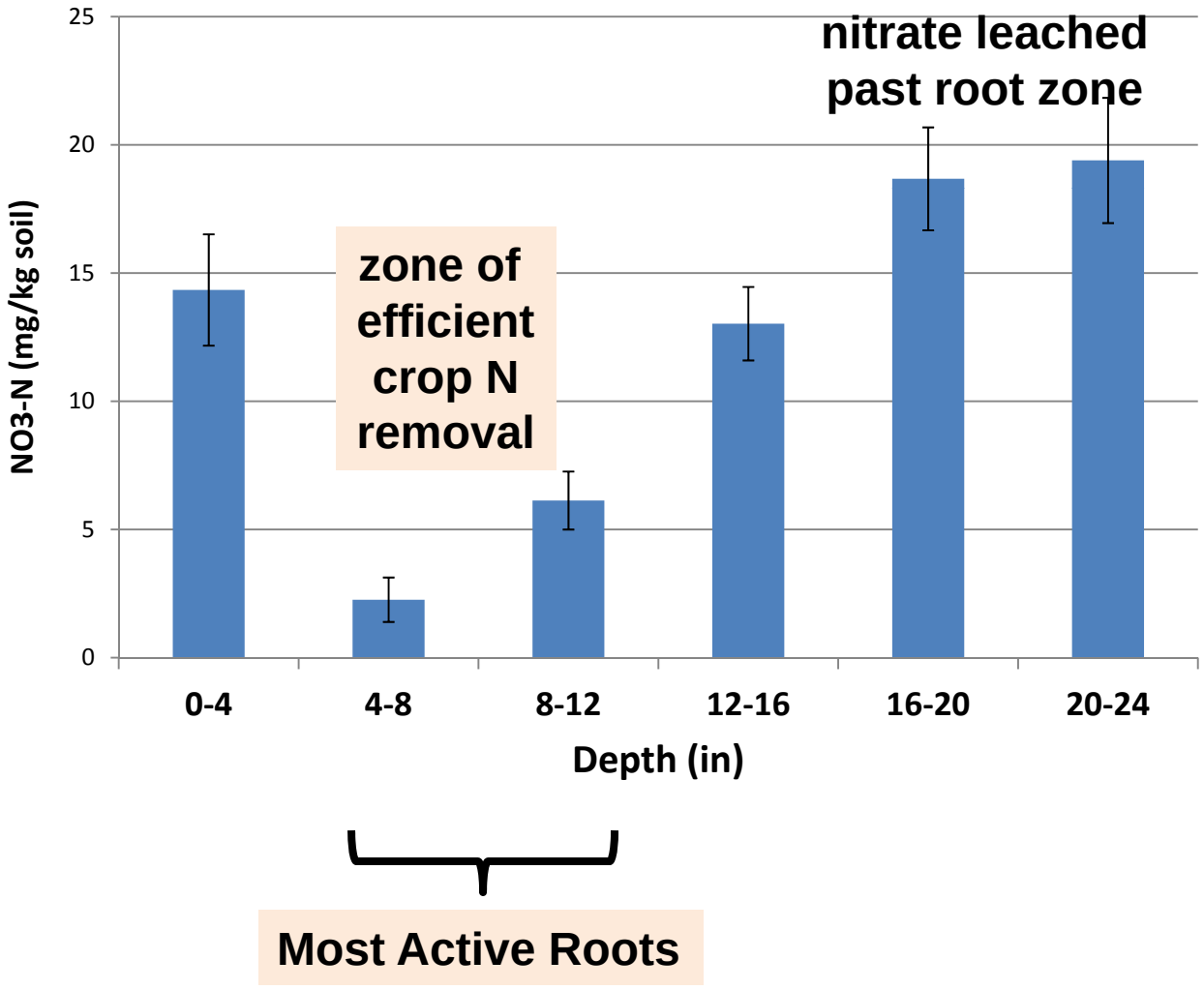
In the first 15 days of the crop cycle the roots only reached to 10 inches



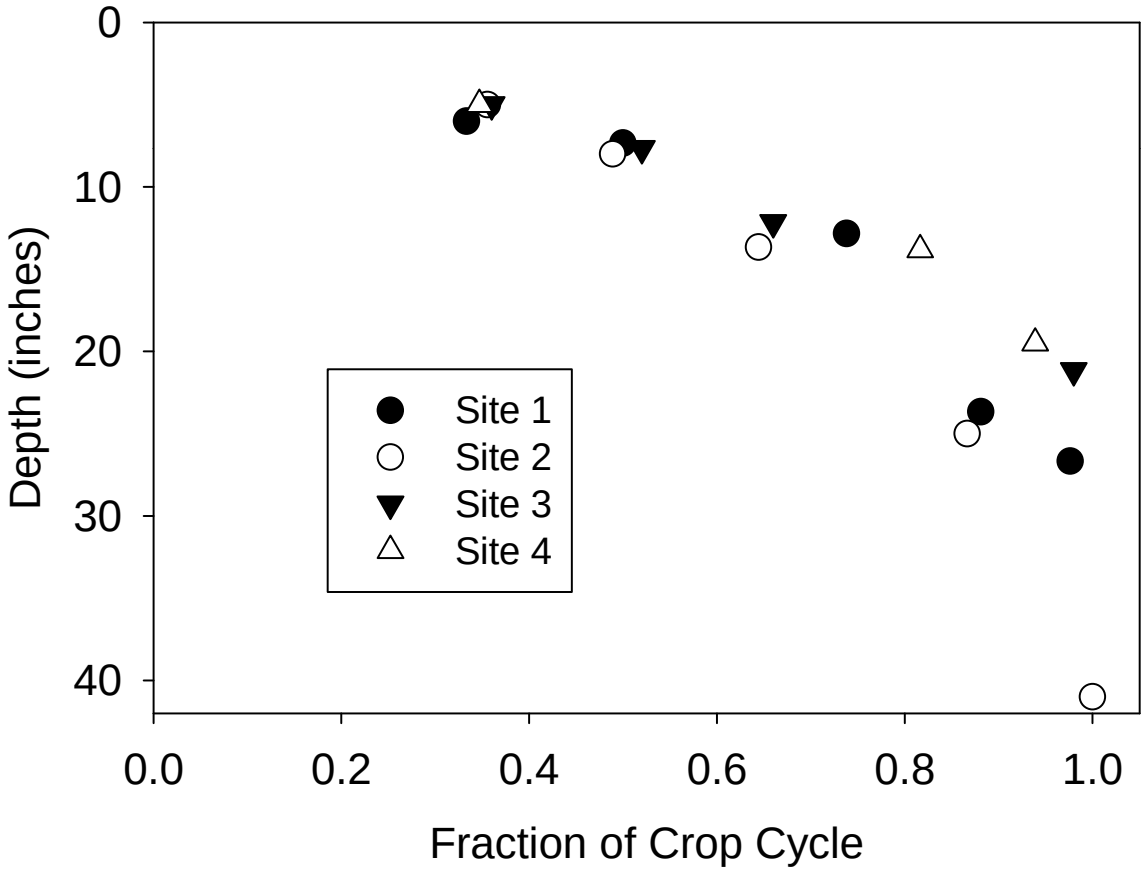
Rooting Depth of Spinach



Nitrate Distribution in Spinach Beds After Harvest

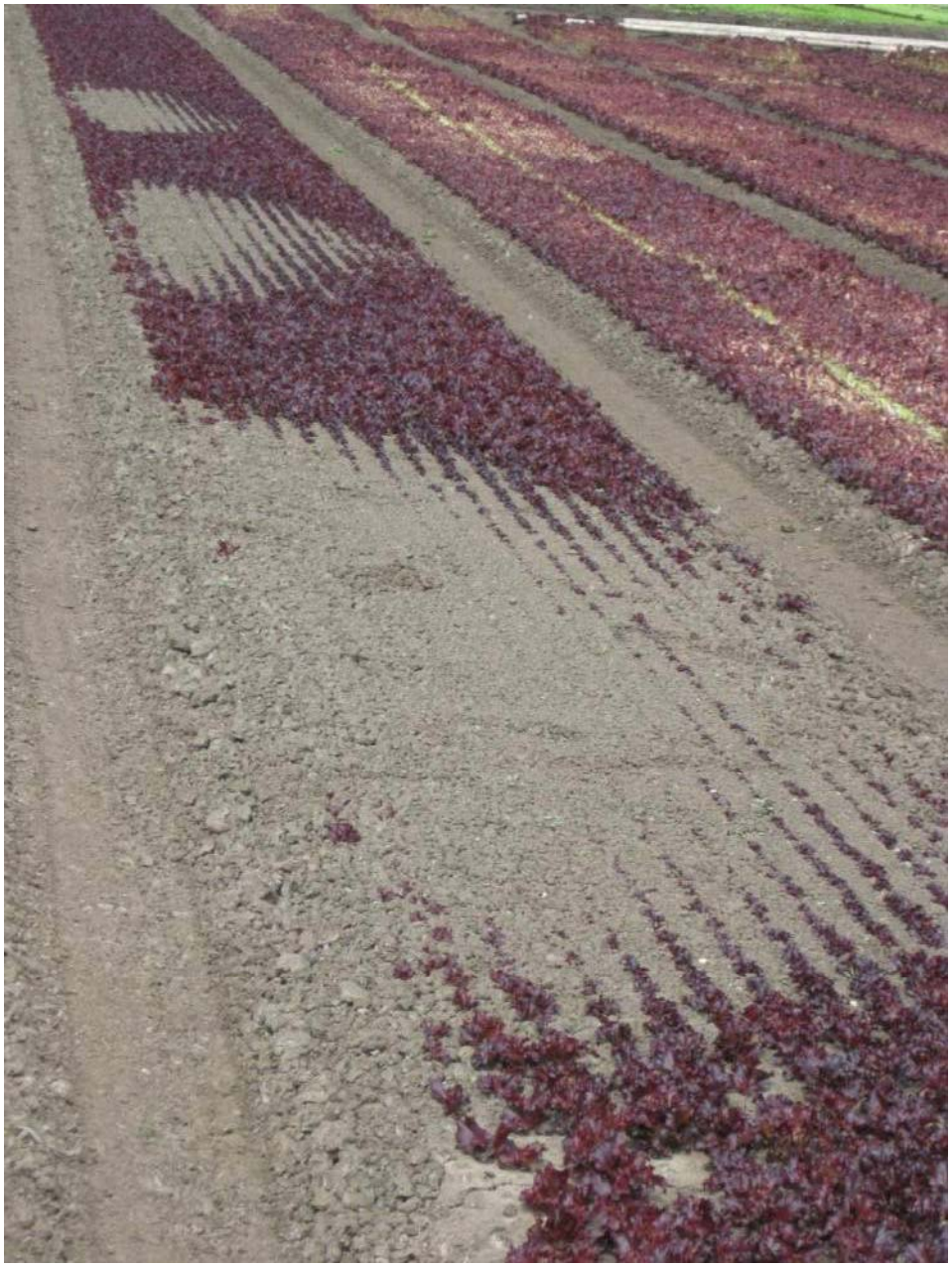


Cilantro roots grow at the same rate as spinach but reached deeper into the soil presumably because of the longer crop cycle (47 vs 33 days)



Water Use by High-Density Crops

Crop	Applied water inches	Crop ET inches	Applied water/ETc
Cilantro	5.8	3.7	156
Baby lettuce	12.5	4.3	283
Mizuna	4.1	3.1	148
Spinach	7.7	3.1	245

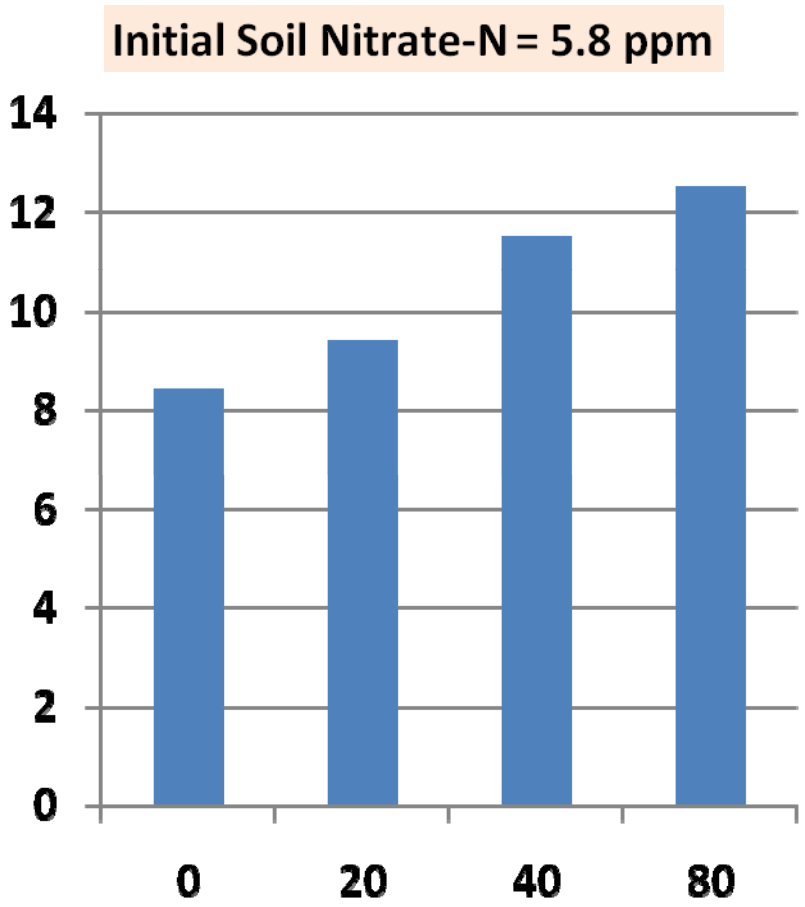


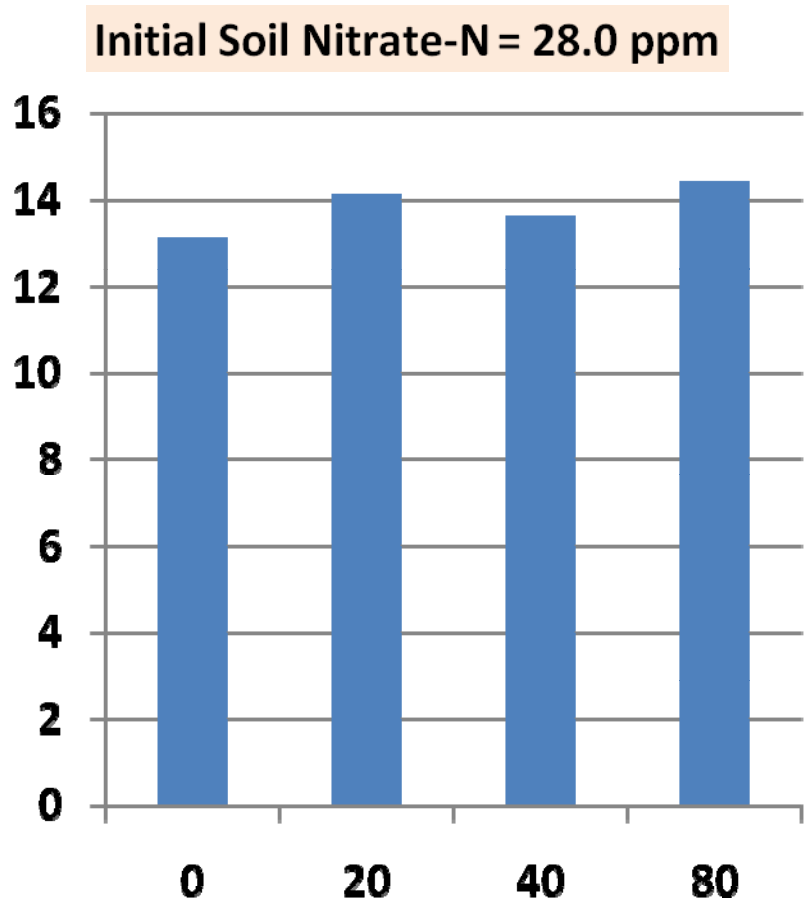
- **High-density 80-inch wide beds are exclusively sprinkler irrigated**
- **Uniformity of size and quality is critical for these machine-harvested crops**
- **Growers are careful to avoid sprinkler patters**
- **This may increase water use on these crops**

Improving Nitrogen Use Efficiency

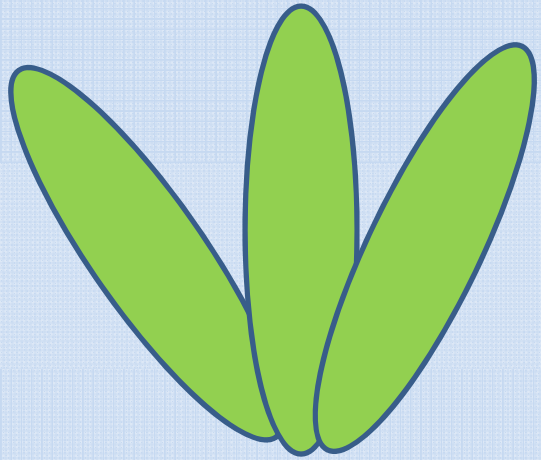
- **Accounting for residual soil nitrogen**
- **Managing water to keep nitrate where most of the active roots occur**
- **Use of nitrogen technology**

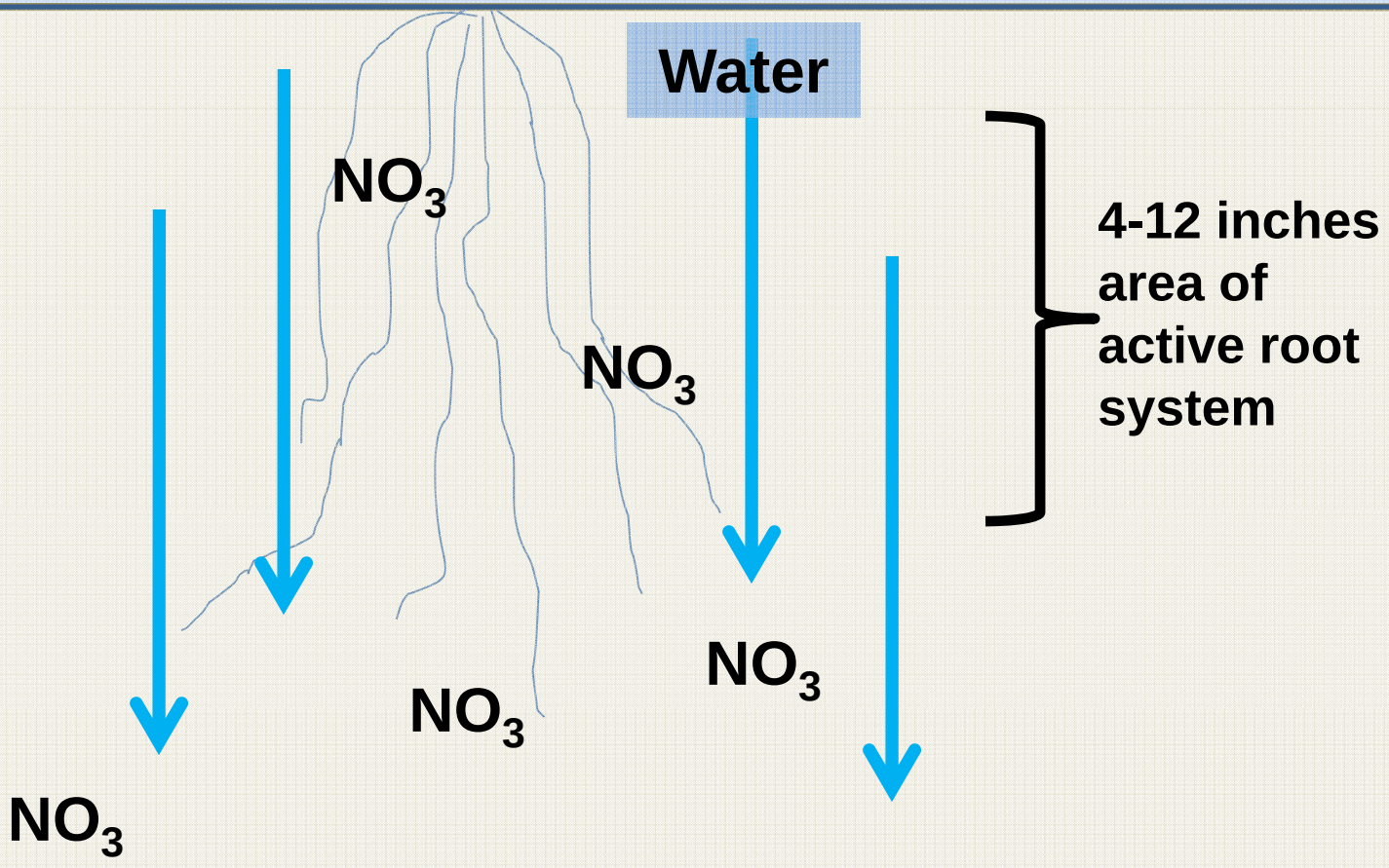
Effect of Residual Soil Nitrate on Spinach Yield



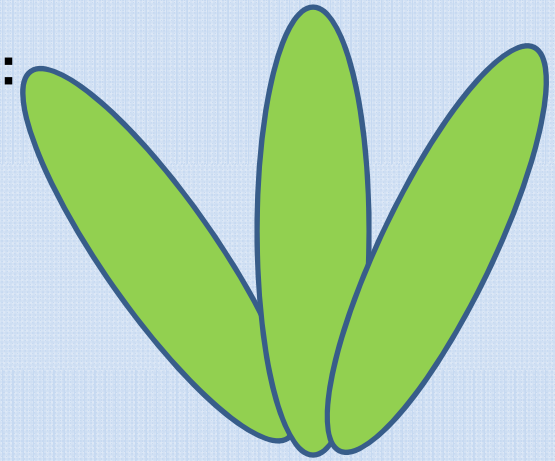


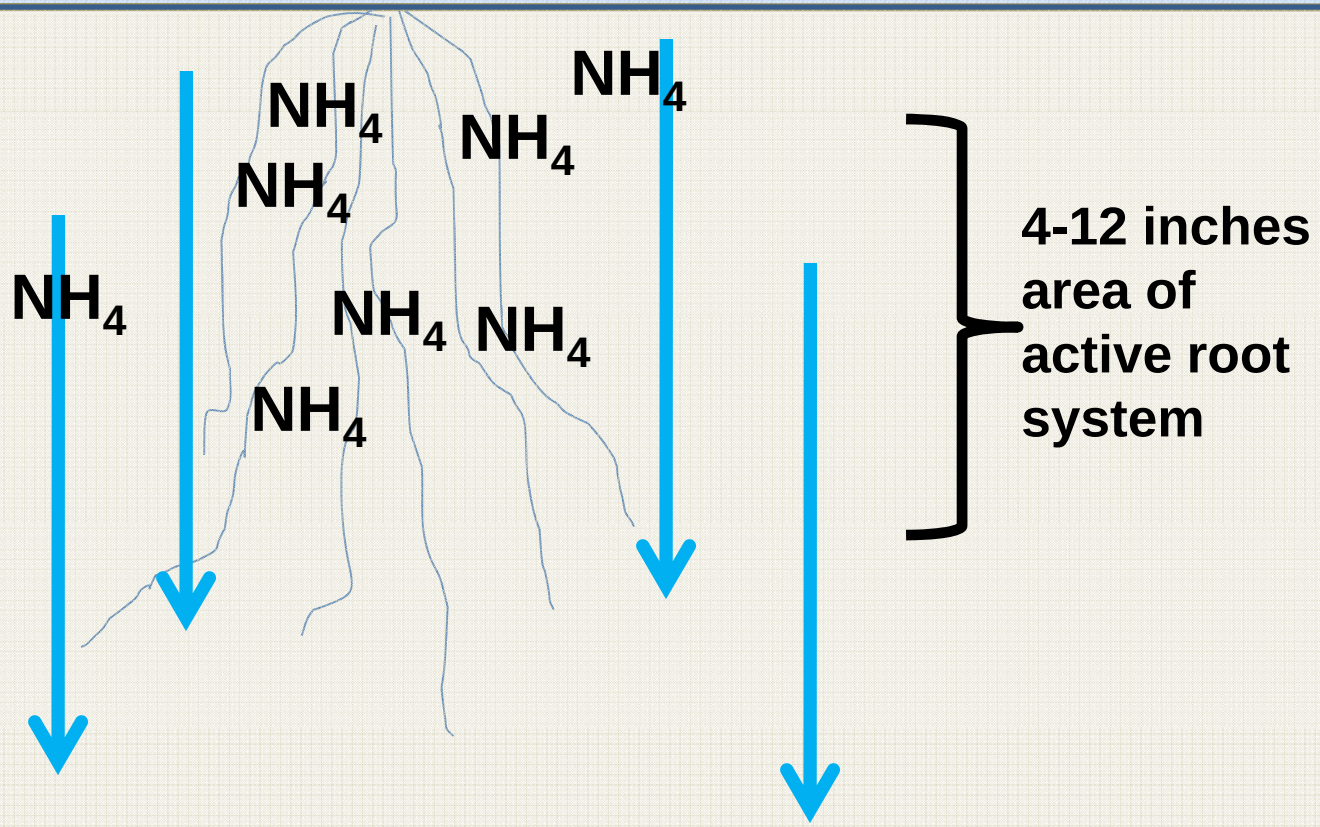
Shallow root system and high water use makes it difficult to keep a high percent of soil nitrate in the area of active roots



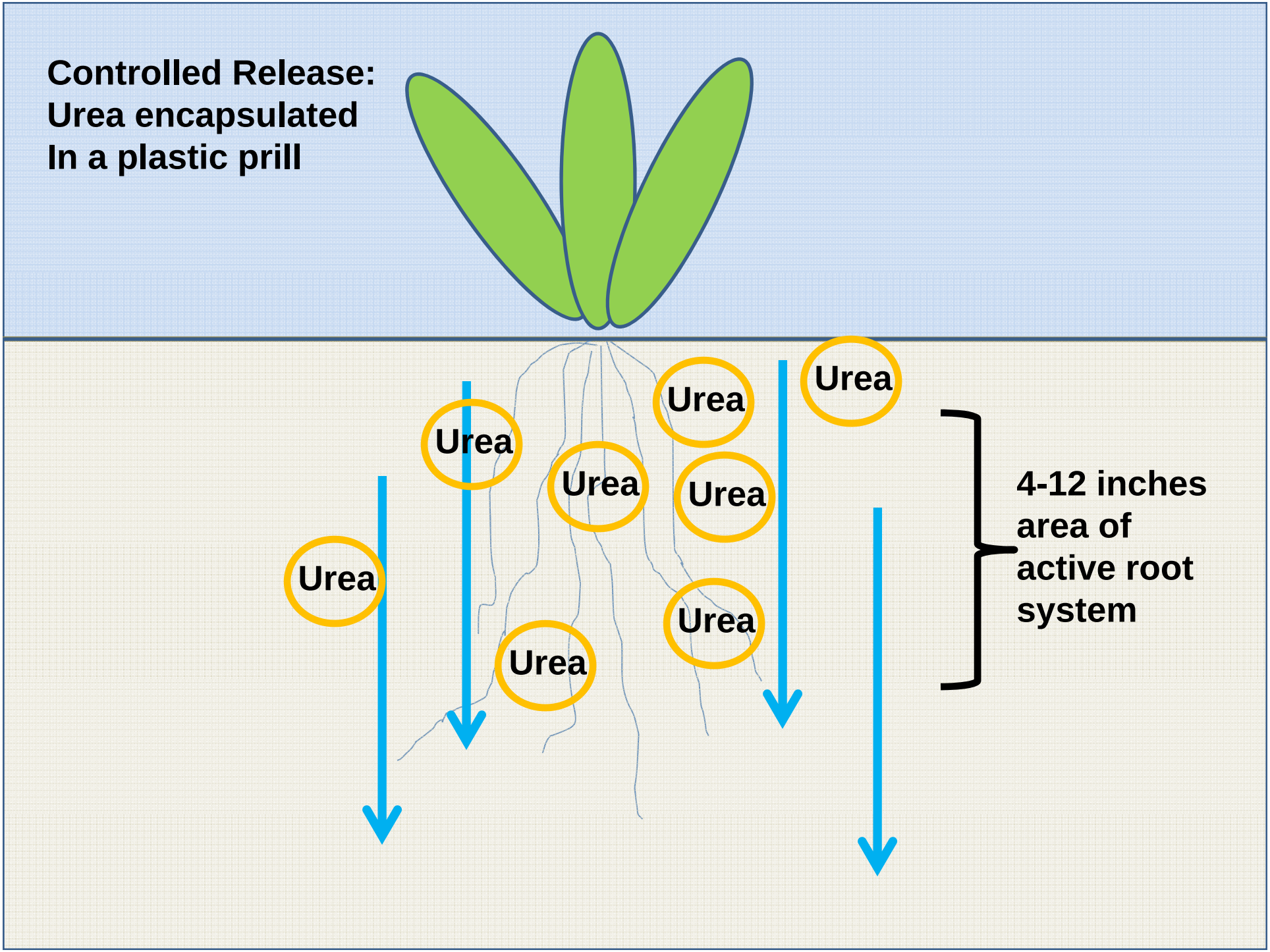


Nitrification inhibitor: Keeps ammonium from converting to nitrate for a brief period of time





Controlled Release:
Urea encapsulated
In a plastic prill



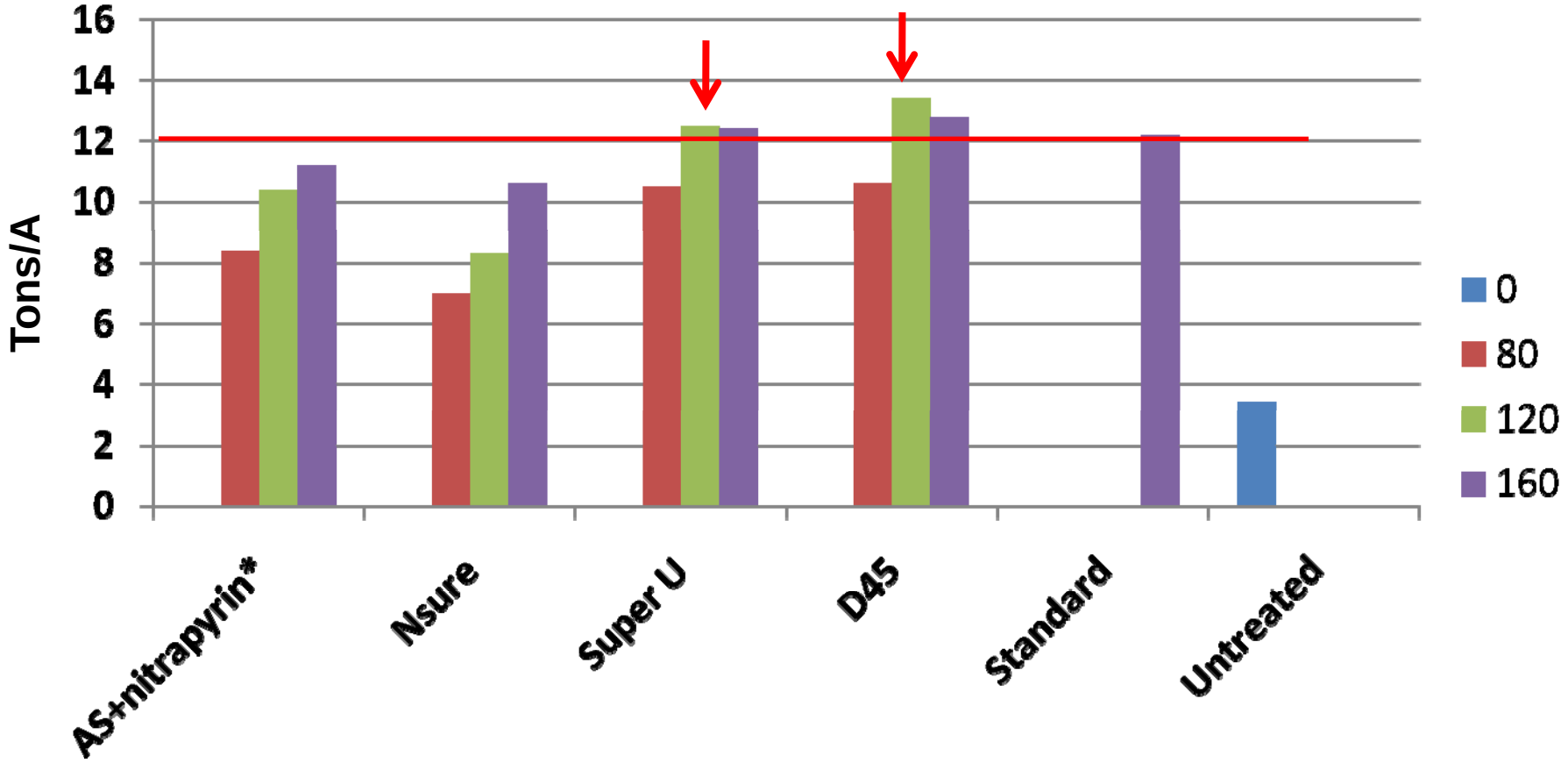
Nitrogen Technology Trial Update

- **A total of 7 trials have been conducted over the past two years on spinach and baby lettuce**
- **All trials were conducted on commercial production fields using standard practices**
- **These trials are difficult on grower's fields due to high levels of residual N in the soil and the common practice of applying N through the sprinkler irrigation system**

Materials Tested

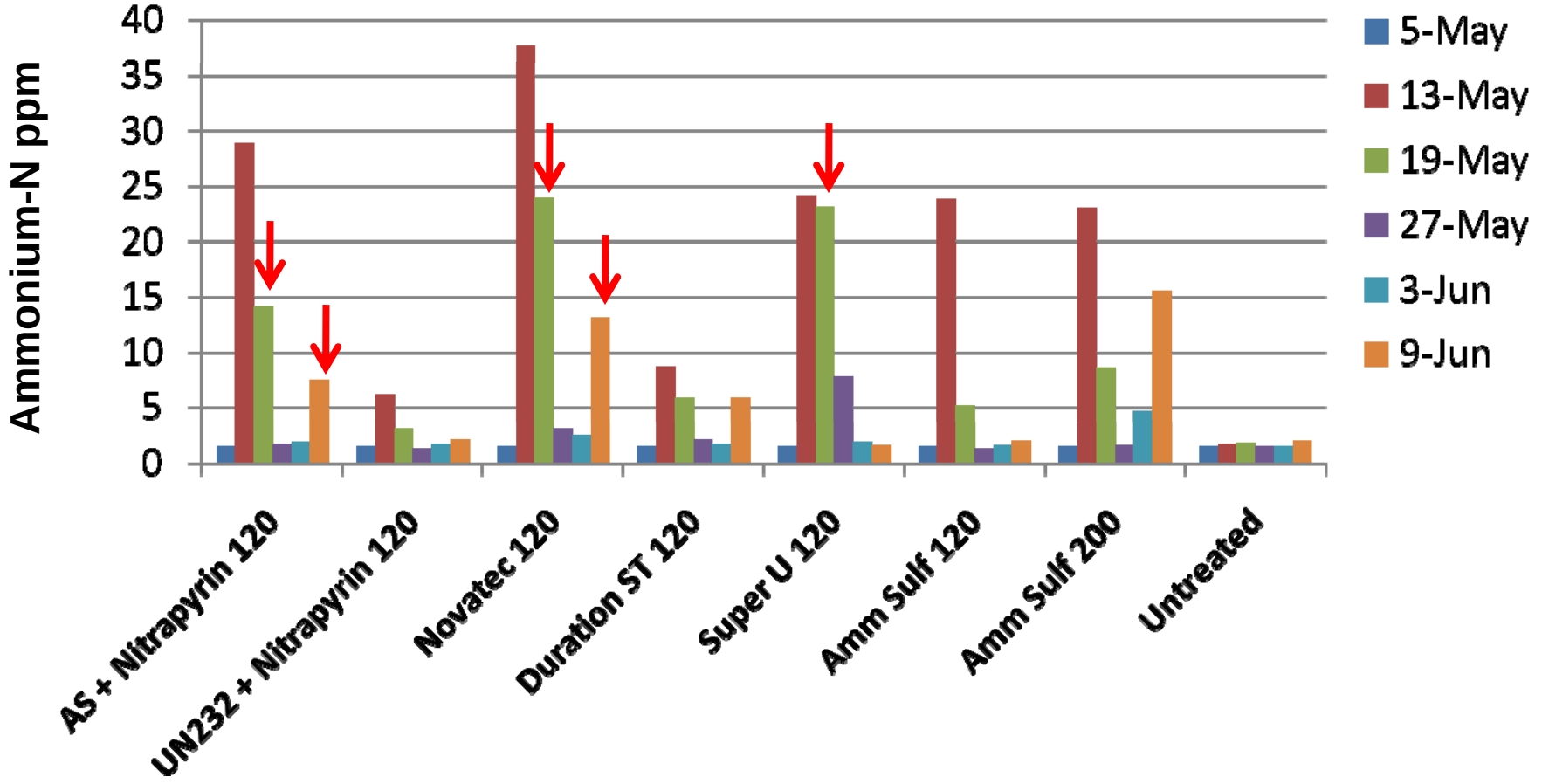
- **Controlled release materials:**
  - **Coated Urea – Duration**
  - **Triazone - NSure**
- **Nitrification inhibitors:**
  - **Nitrapyrin - Instinct**
  - **DMPP - Novatec**
  - **DCD – Super U**

2013 Trial

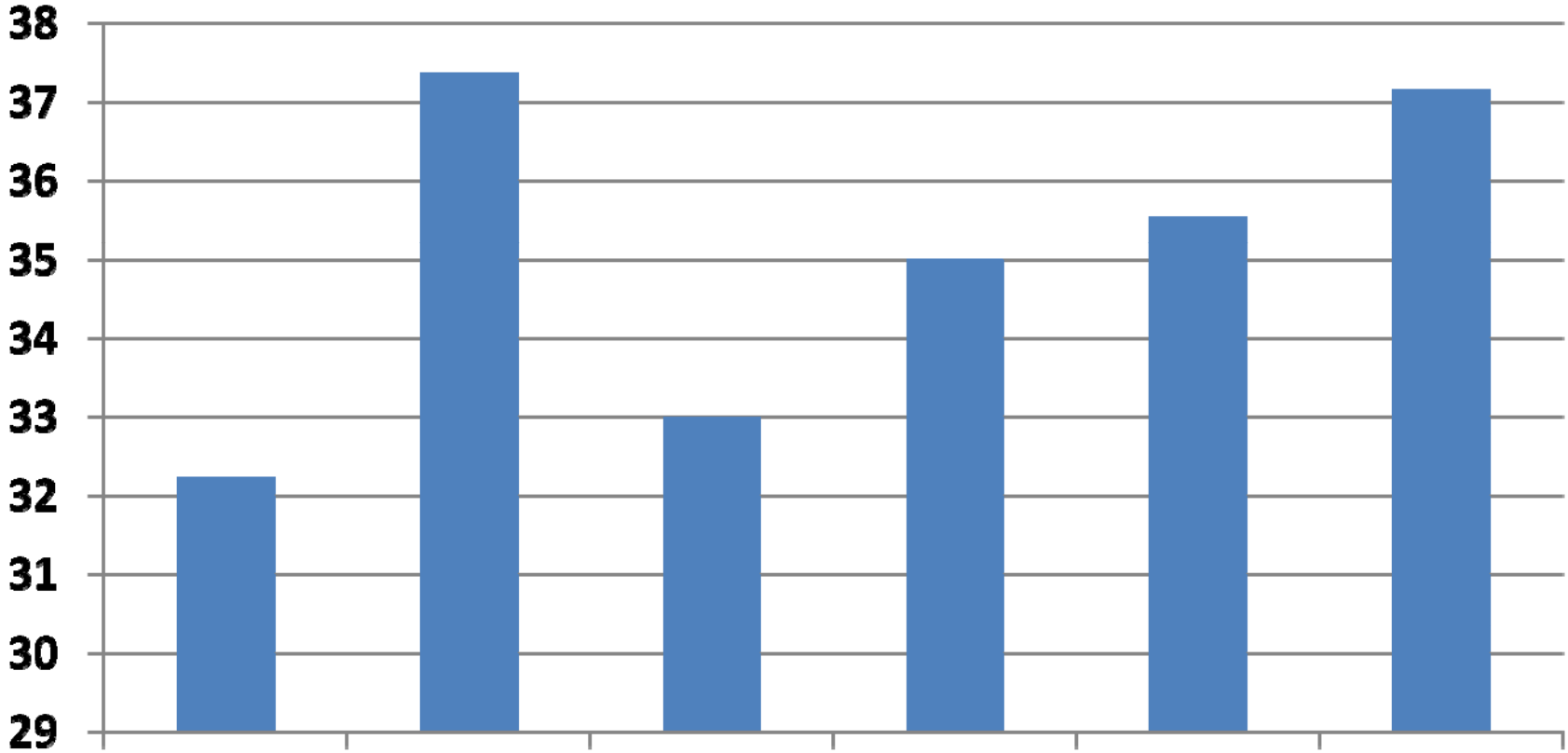


*** Material sprayed over spread ammonium sulfate and then mulched into bed**

2014 Soil Ammonium Levels



Yield of Romaine
Drip Applied UN32 with Fertilizer Additives
Spence, 2014



Fertilizer Trials Summary

- These trials have provided an opportunity to test established products and new materials that are not presently used commercially
- We have also had a chance to test methods of application of some of the materials
- It has been difficult to get significant differences in small plot trials in commercial conditions
- Under certain conditions, fertilizer technologies have shown to be useful in giving a boost to a low amount of nitrogen equal to the standard amount

Algorithms Developed for CropManage

- **Nitrogen uptake curves**
  - **Used to make nitrogen fertilizer recommendations**
- **Crop canopy development**
  - **Used to calculate crop coefficient at all stages of the crop cycle**
  - **Used to estimate irrigation requirements**
- **Root development**


Thank You for Your Attention