

University of California

# Nitrogen Management Training

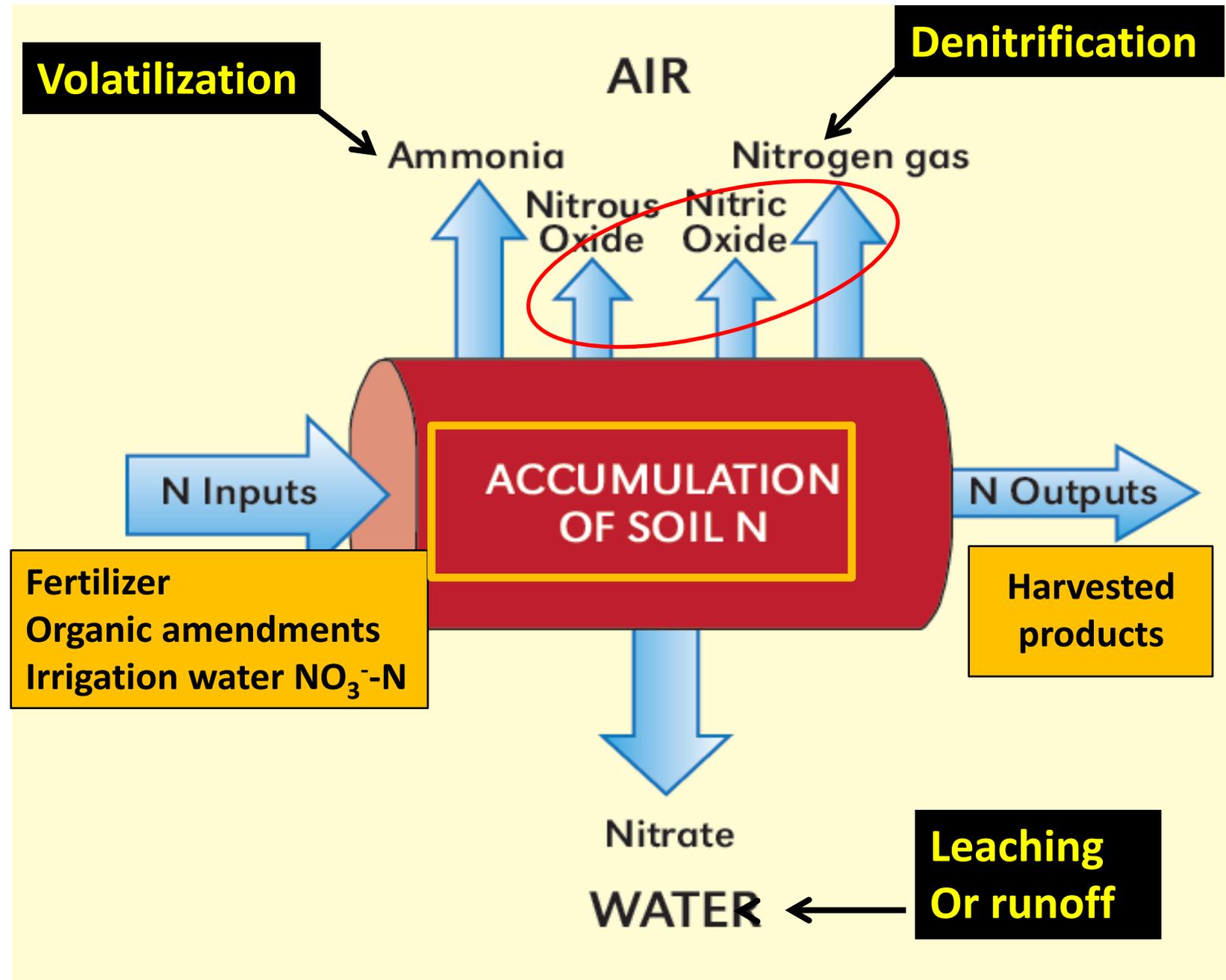
for Certified Crop Advisers

## Nitrogen Management in Cole Crops and Leafy Greens



University of California  
Agriculture and Natural Resources

# N Loss Pathways in Agricultural Systems:



# **Growth and N Demand Rates in Cole Crops and Leafy Greens**

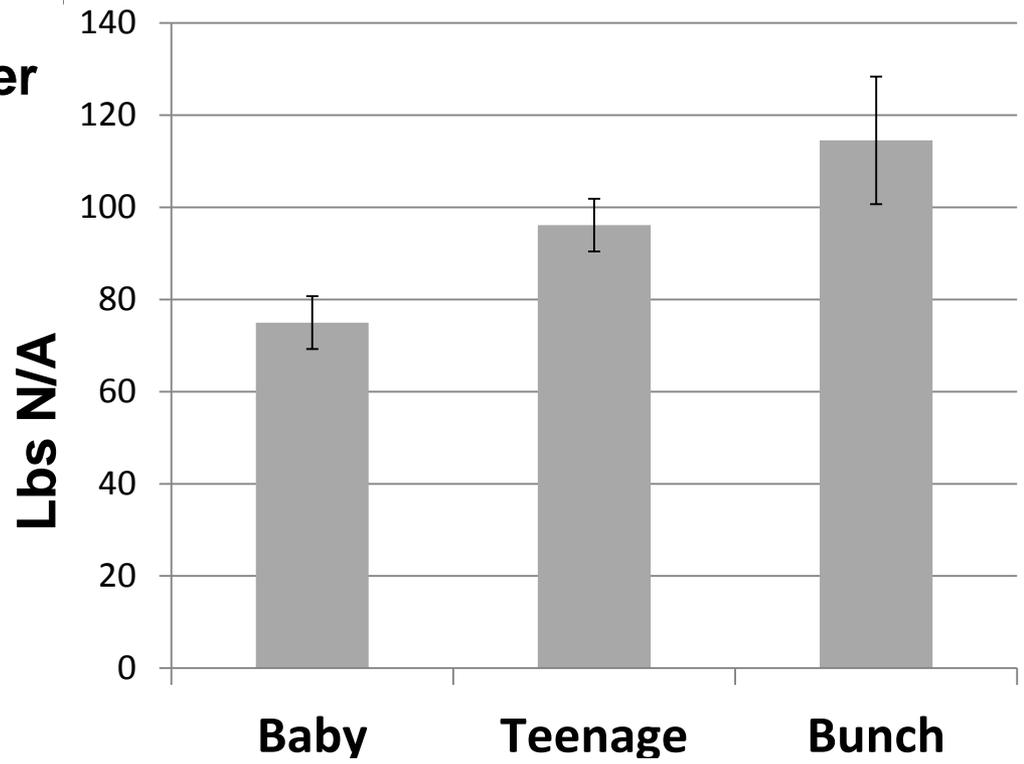
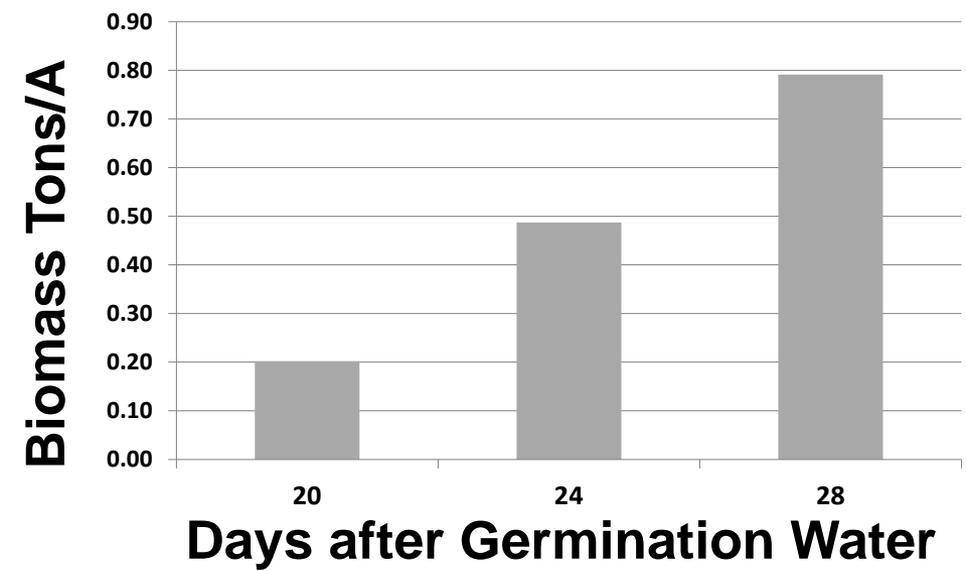
## Characteristic Growth: Vegetables

- All vegetables initially have a slow growth rate, when there is little biomass accumulation or N uptake
- About 30 days after seeding/transplanting, growth becomes rapid and the rate is linear
- Spinach may grow rapidly until the day of harvest
- Broccoli & lettuce growth rates may slow prior to harvest

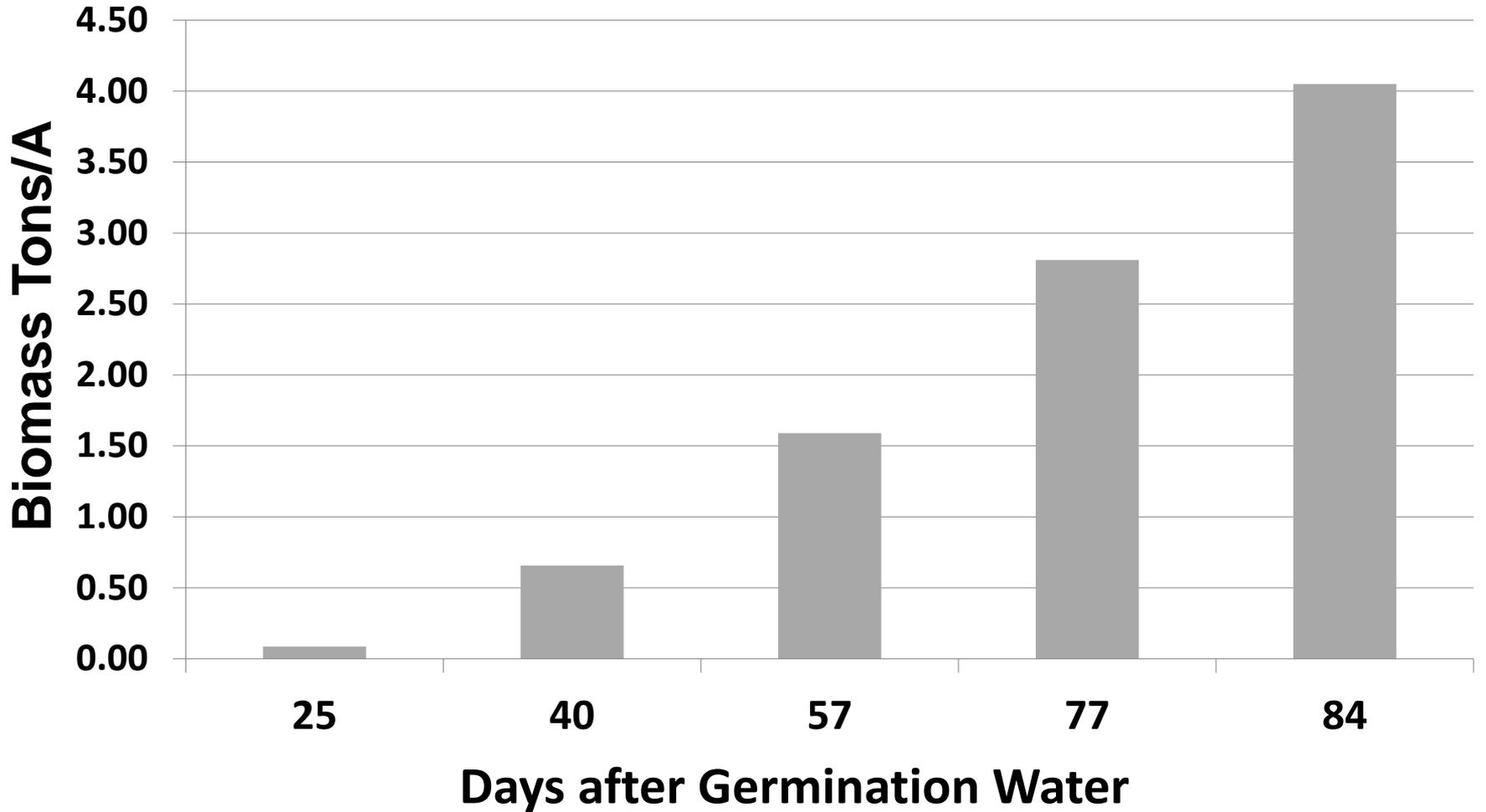
## N Accumulation: Vegetables

- N accumulation closely follows the rate of biomass accumulation
- Although N concentration in crop tissue may decline a bit, total N accumulation in the crop biomass increases dramatically as crops mature

# Growth and N Accumulation: Spinach

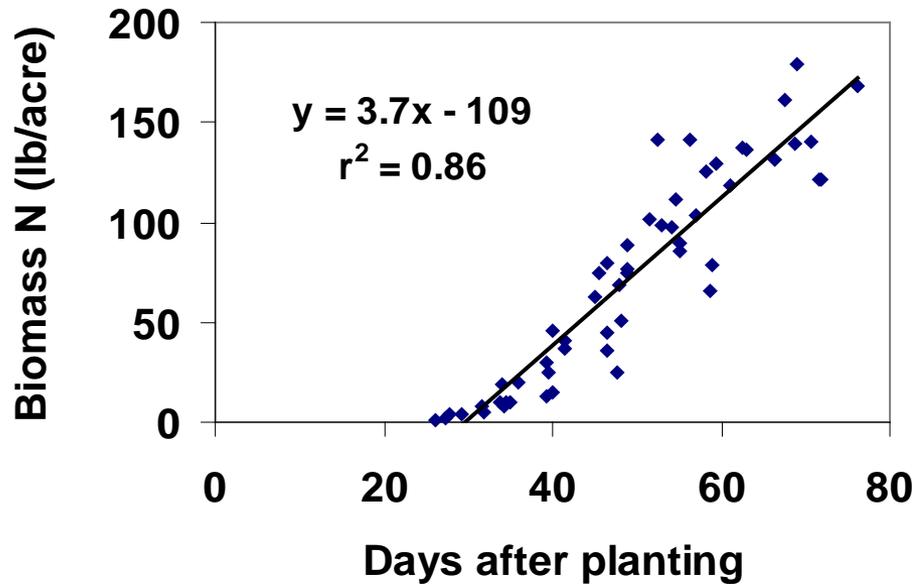


# Characteristic Growth: Broccoli

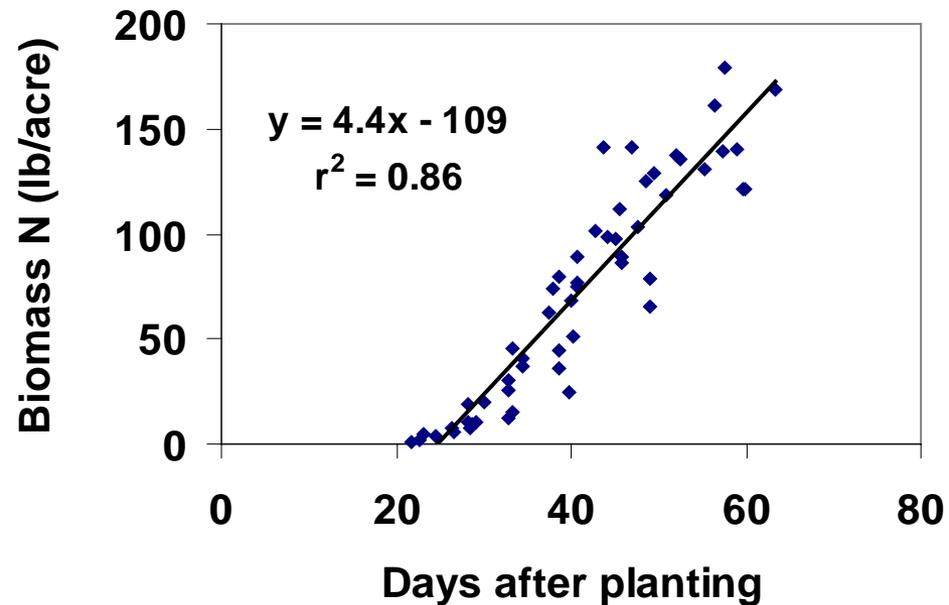


# Growth and N Accumulation: Lettuce

Salinas, Summer:



King City, Summer:

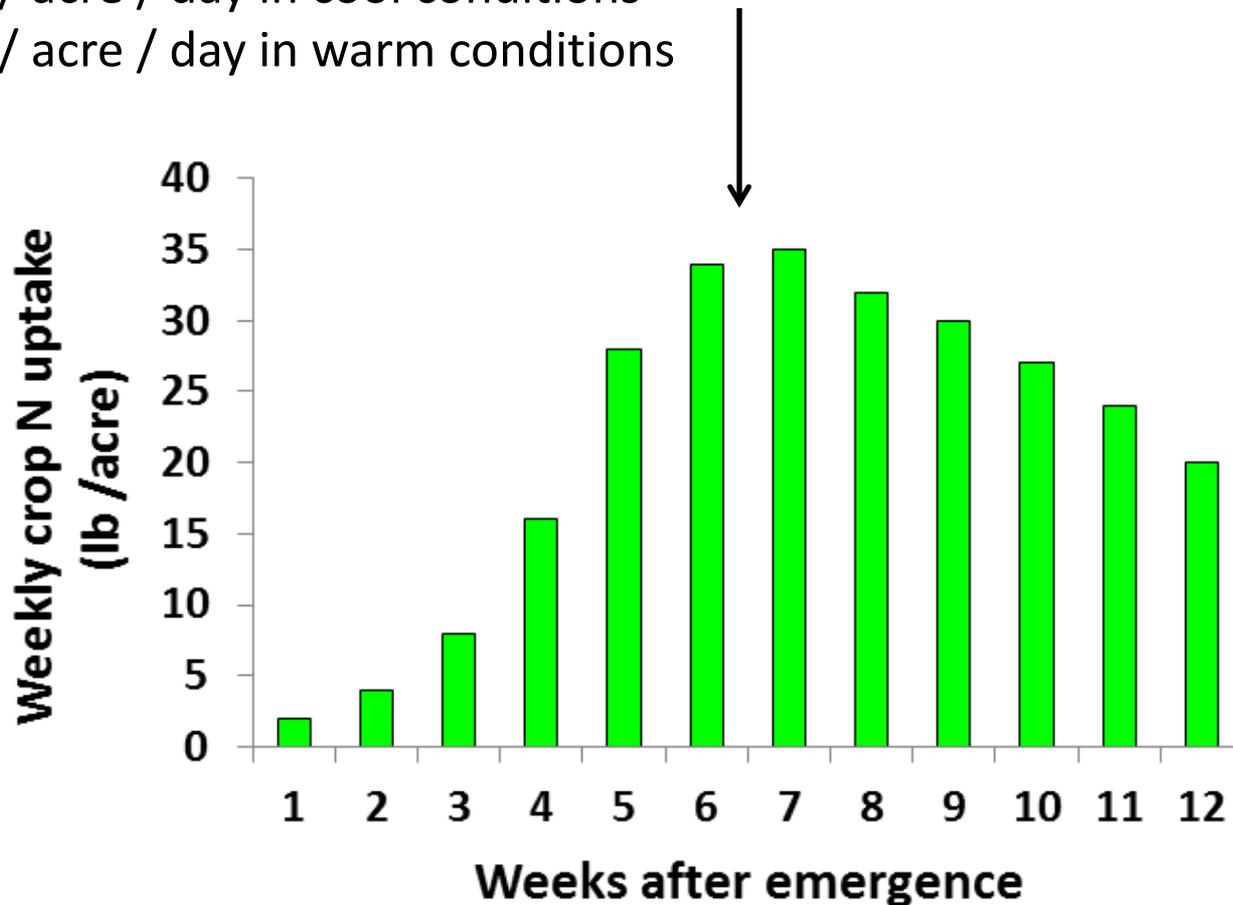


# **N Uptake in Cole Crops and Leafy Greens**

# N Uptake: Vegetables

Typical peak N uptake rates for vegetable crops:

- 3-4 lb / acre / day in cool conditions
- 4-6 lb / acre / day in warm conditions



## N Uptake Rates: Vegetables

Crop type		lb N / ton of fresh weight
Fruiting	Cantaloupe	3.0
	Honeydew	2.1
	Pepper	3.2
	Tomato	3.1
	Watermelon	2.0
Vegetative	Broccoli	11.6
	Lettuce	4.0

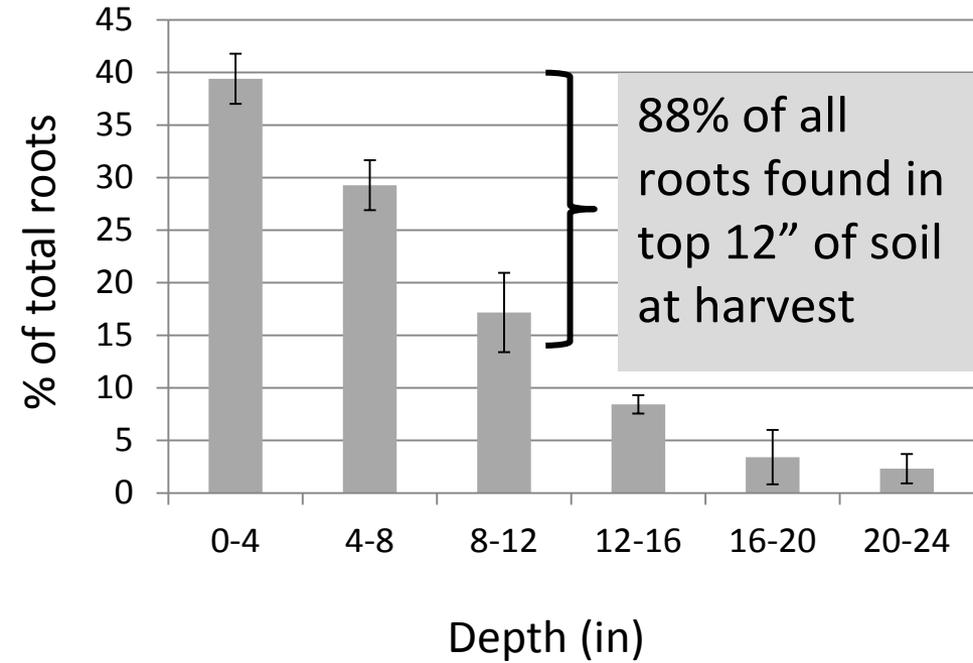


## N Uptake Rates: Vegetables

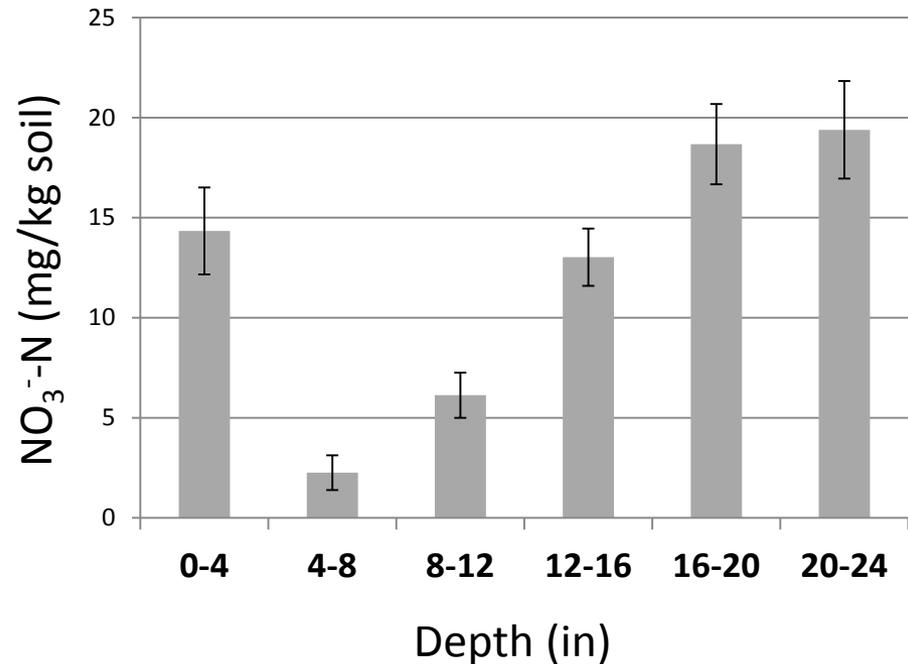
<b>Crop</b>	<b>Nitrogen Uptake Lbs N/A/Day</b>	<b># of days of rapid nitrogen uptake</b>
Lettuce (north valley)	3.7	30-35
Lettuce (south valley)	4.4	30-35
Spinach	5.1	15
Broccoli (summer)	5.7	60
Broccoli (winter)	2.6	90

# N Uptake: Effects of Rooting Depth in Spinach

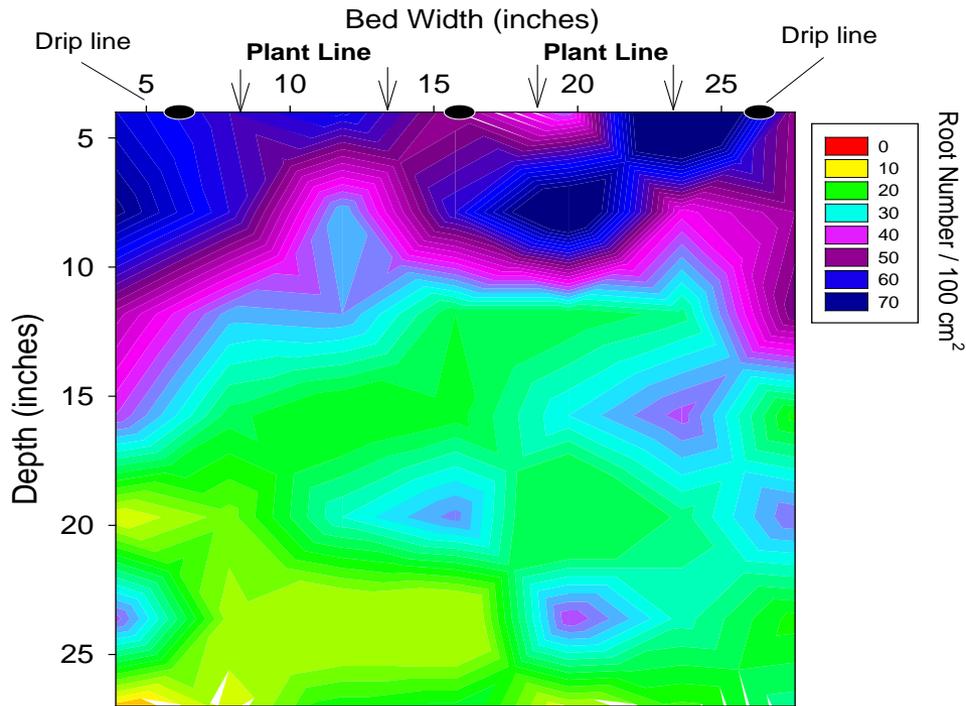
## Rooting Depth:



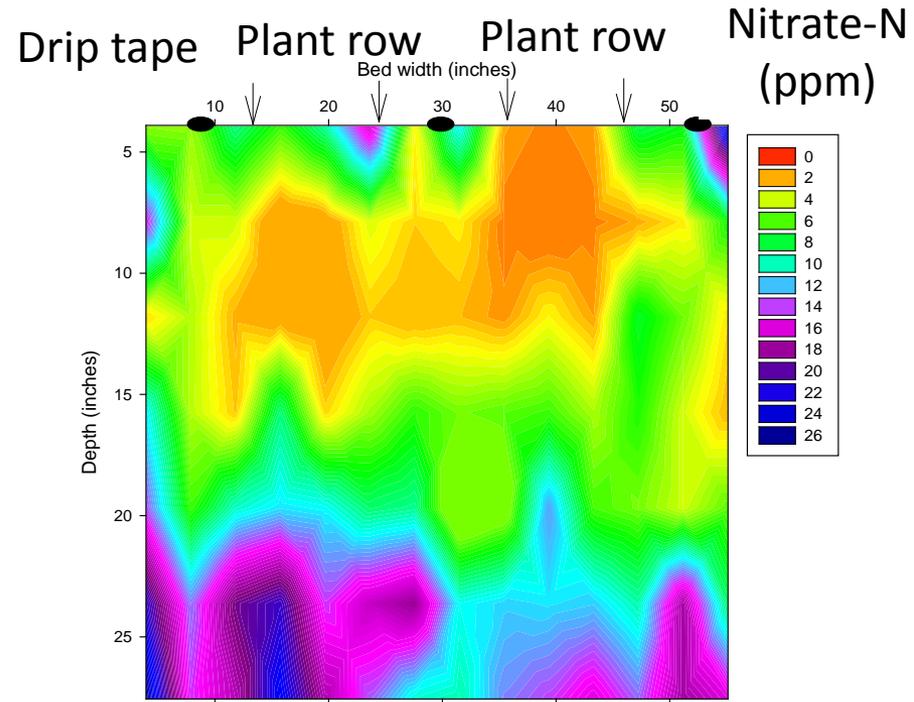
## Nitrate Distribution Post-harvest:



# N Uptake: Effects of Rooting Depth in Lettuce

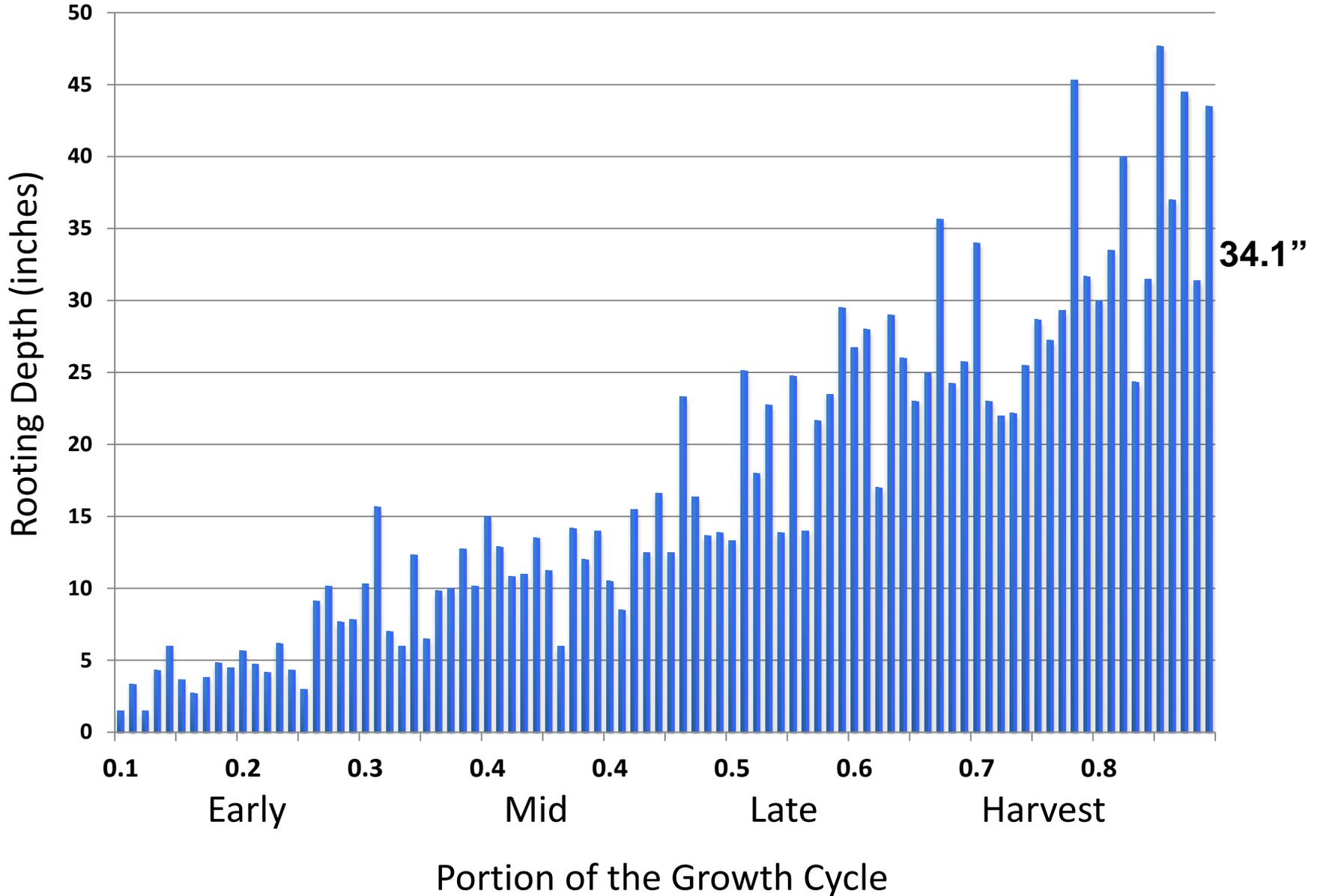


Rooting Density at Various Depths

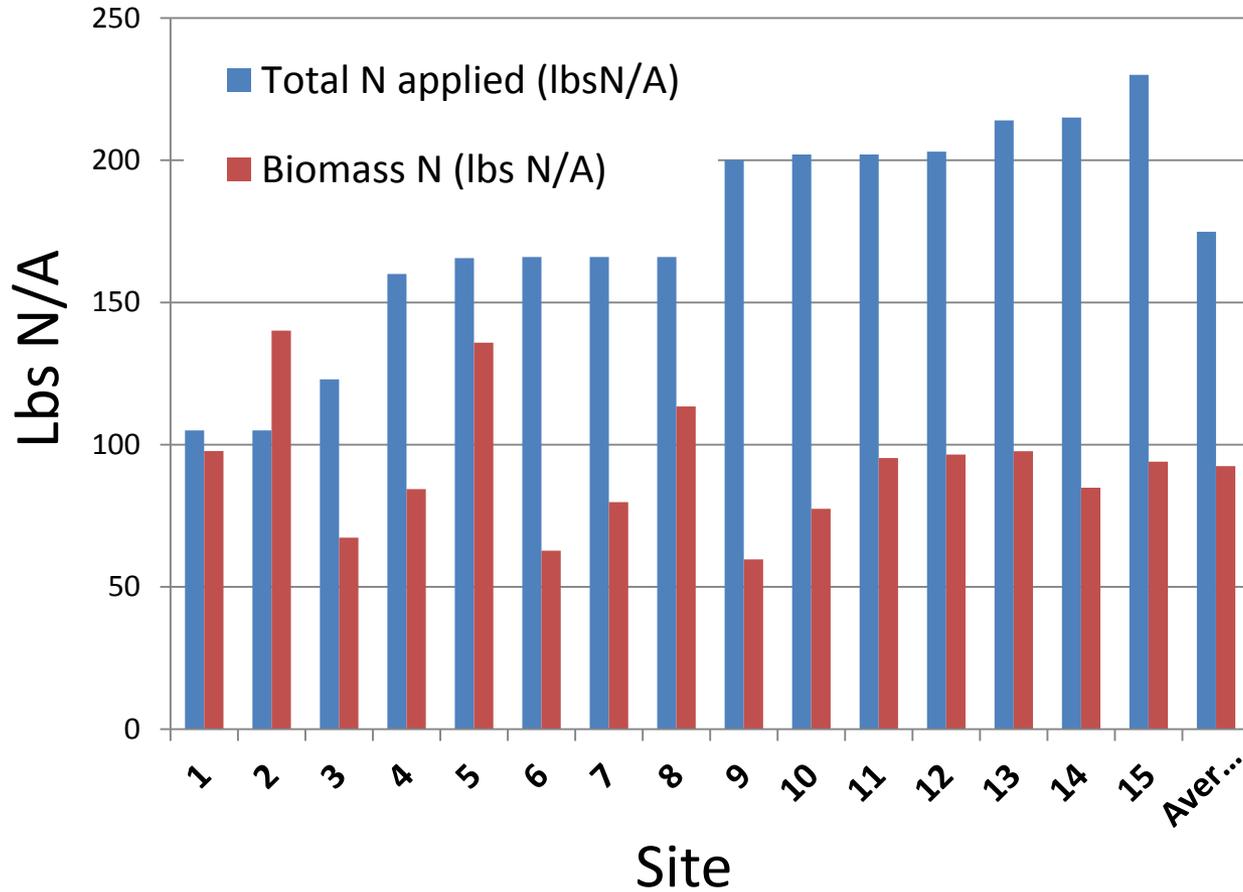


Soil Nitrate Distribution

# N Uptake: Effects of Rooting Depth in Broccoli



# N Uptake: Rates in Spinach



175 lbs N/A  
applied  
(66 at planting  
+109 midseason)

93 lbs N/A  
uptake



## N Uptake: Rates in Lettuce

Lettuce nitrogen uptake varies from 120 to 140 lbs N/A depending on planting configuration and type:

Nitrogen application to lettuce lbs N/A		
	Spring	Summer
Highest field	392	306
Lowest field	70	27
Overall Average	215	152
Average of highest 50% of fields	281	198
Average of lowest 50% of fields	149	106



## N Uptake: Rates in Cole Crops

Crop	Dry Biomass Lbs/A	Percent Nitrogen	Harvest Product N/A	Residue N/A	Scavenged from soil
Broccoli	8,585	4.0	99	238	155
Cauliflower	6,930	4.1	61	224	21
Cabbage	11,564	3.0	188	163	97

# **Field-Specific N Management In Cole Crops and Leafy Greens**

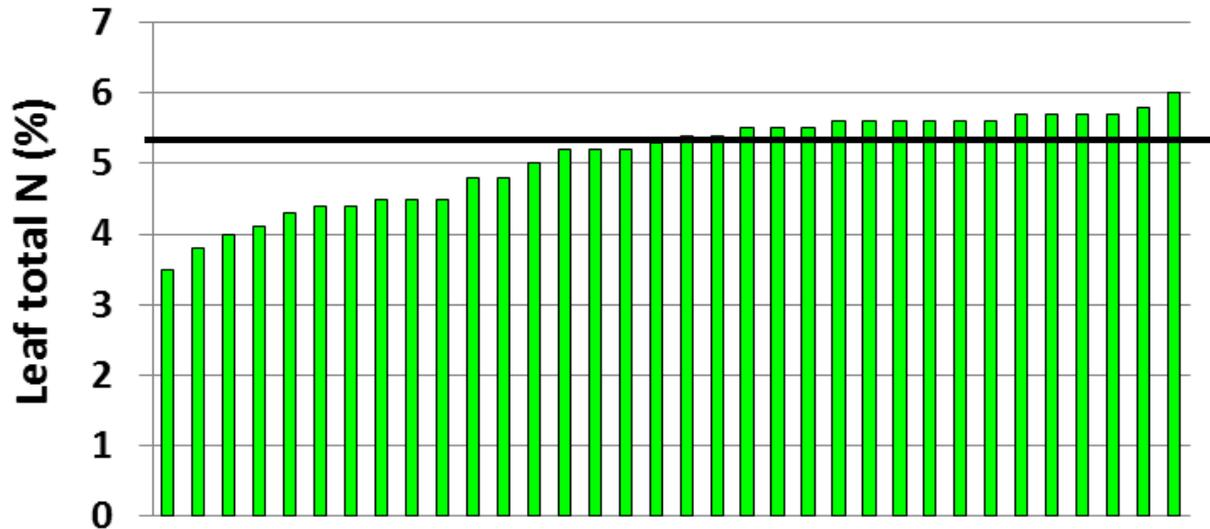
- Tissue and Soil Testing
  - Other N Credits
    - Reporting



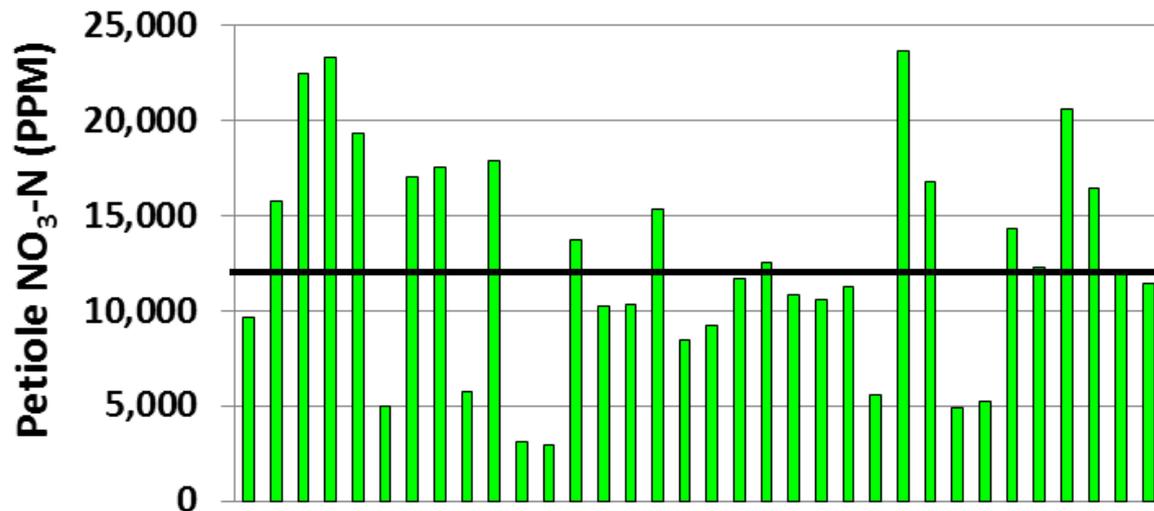
# Petiole N Monitoring: Limitations in Lettuce

- Much more variable than leaf total N

2009 Lettuce N trials, cupping stage:



C.V. = 13%

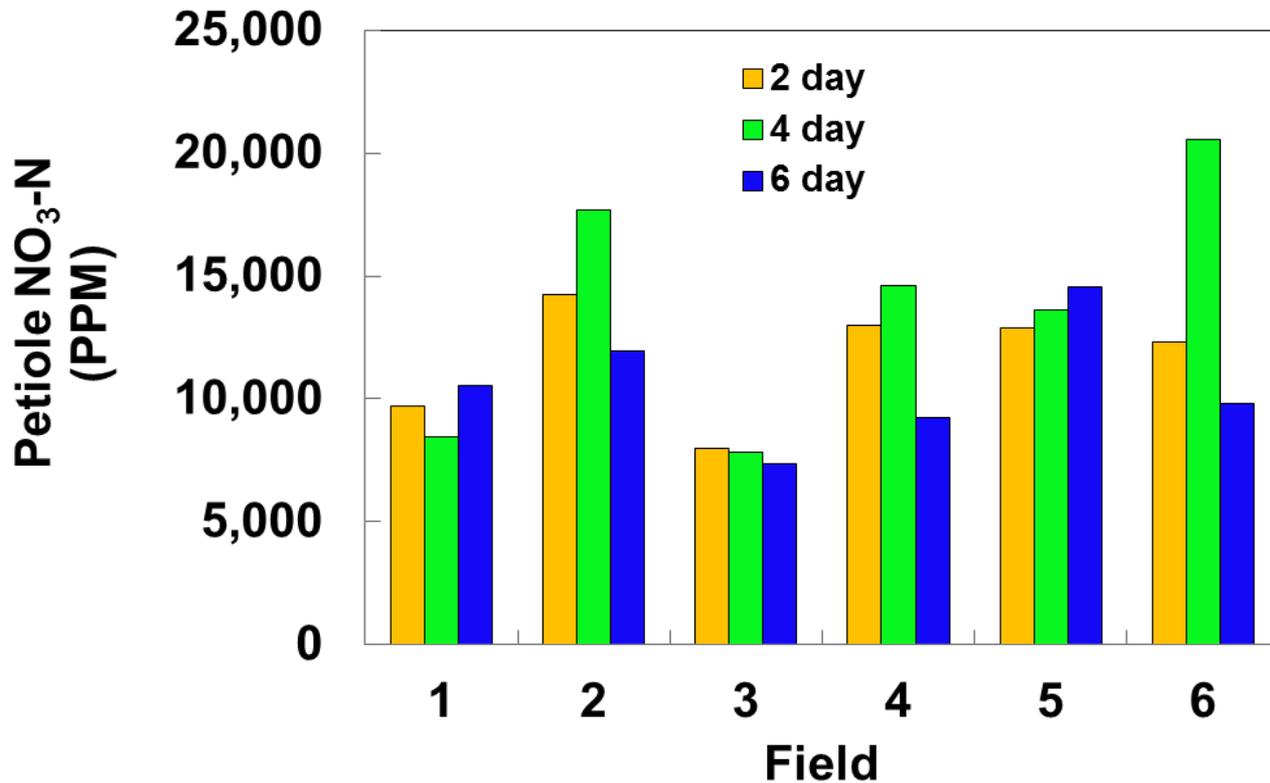


C.V. = 46%



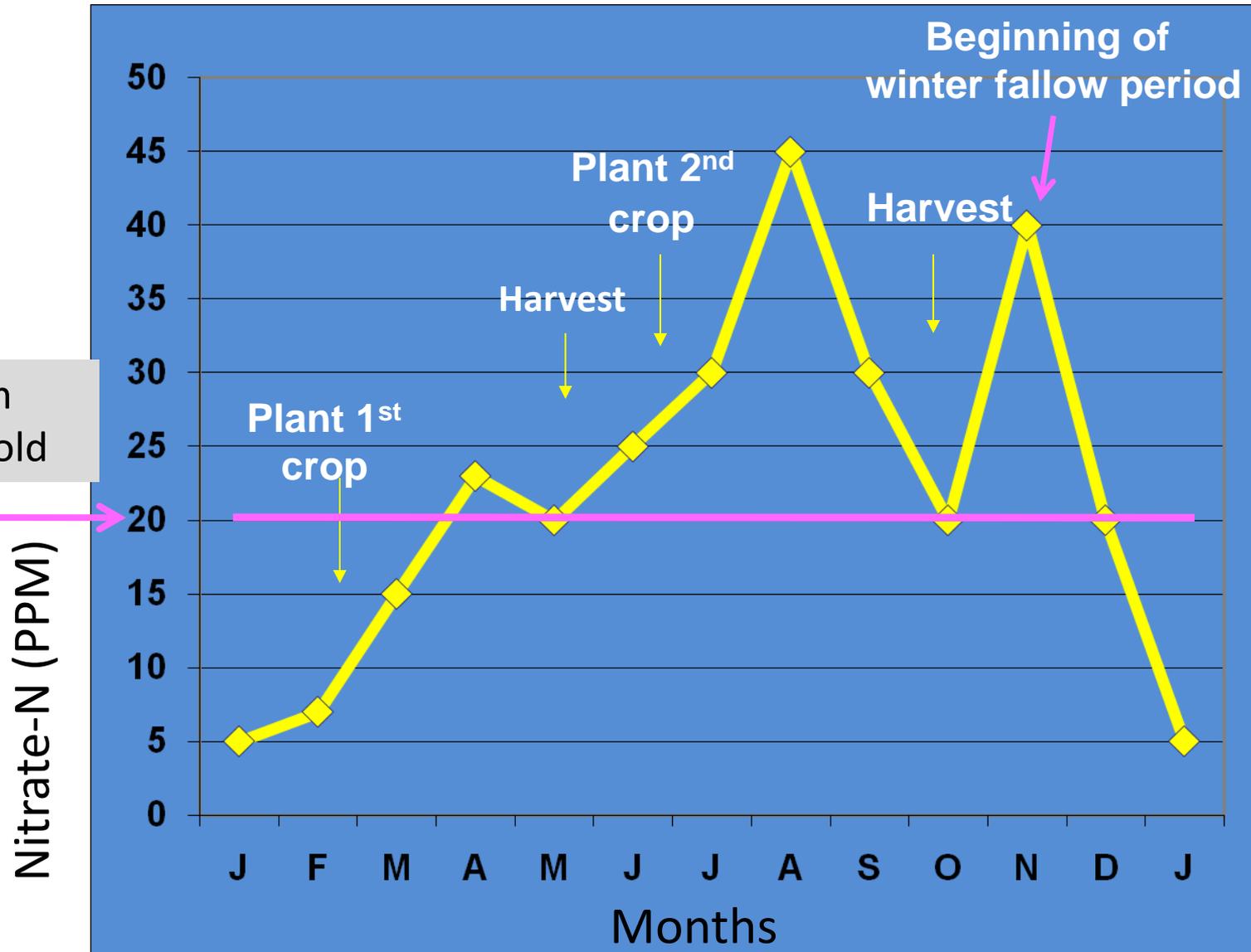
# Petiole N Monitoring: Limitations in Cole Crops

- How much can environmental factors influence petiole  $\text{NO}_3^-$ -N?
- Six sprinkler-irrigated coastal broccoli and cauliflower fields, sampled every 2 days over a sprinkler irrigation cycle :



# Soil Residual Nitrate Testing:

20 ppm  
threshold



# Other N Credits:

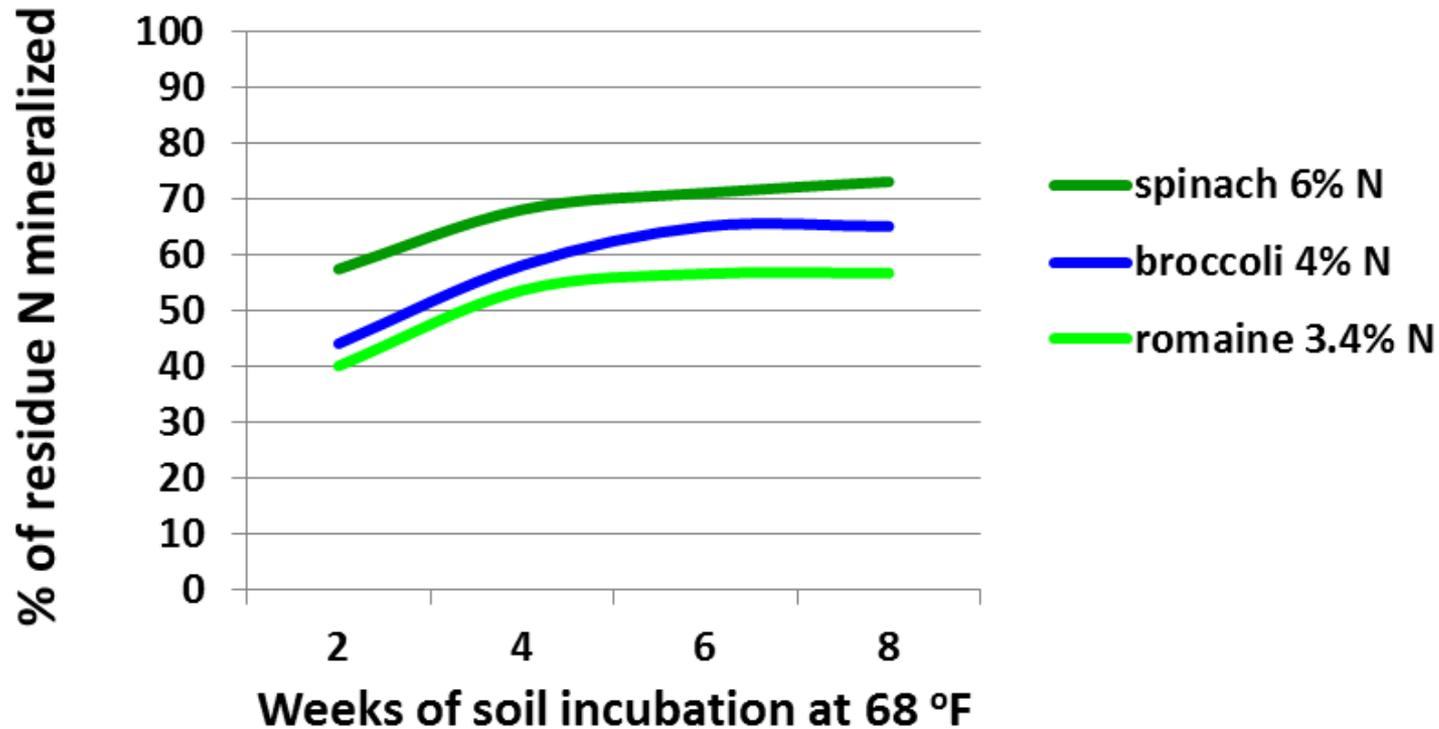
## Contribution of Prior Crop Residue

	<b>spinach spring mix</b>	<b>lettuce celery</b>	<b>broccoli cauliflower</b>
<b>Typical residue N content (lbs/acre)</b>	<b>20-40</b>	<b>60-80</b>	<b>160-240</b>
<b>Typical residue %N</b>	<b>5-6</b>	<b>2.5-3.5</b>	<b>3-4.5</b>



# Other N Credits:

## Contribution of Prior Crop Residue



- A high percentage of residue N is mineralized within weeks of incorporation
- Within 4-6 weeks after incorporation, the rate of residue N mineralization slows
- The majority of residue effects on soil N availability can be directly measured by soil nitrate testing before fertilizing the subsequent crop



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