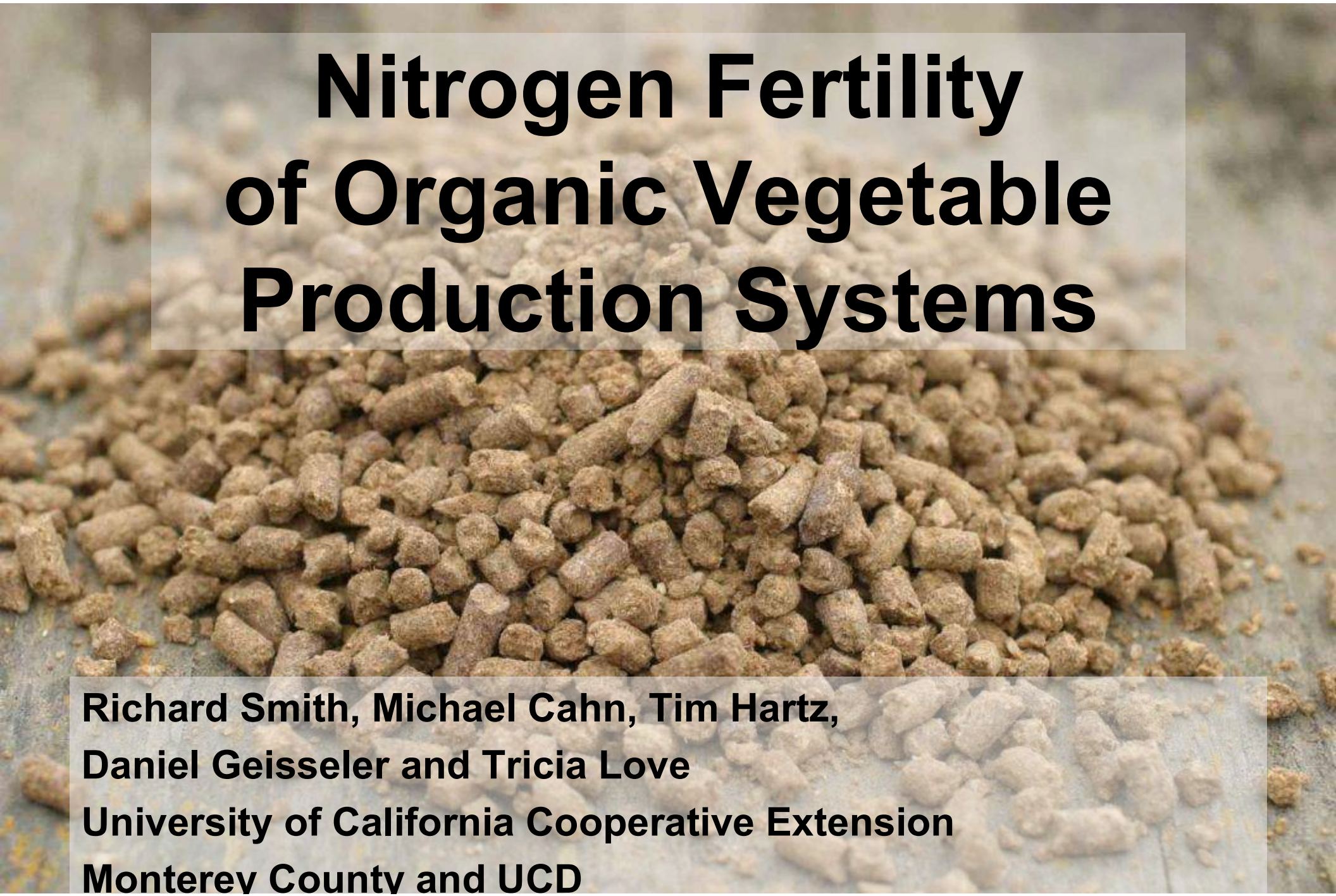


Nitrogen Fertility of Organic Vegetable Production Systems

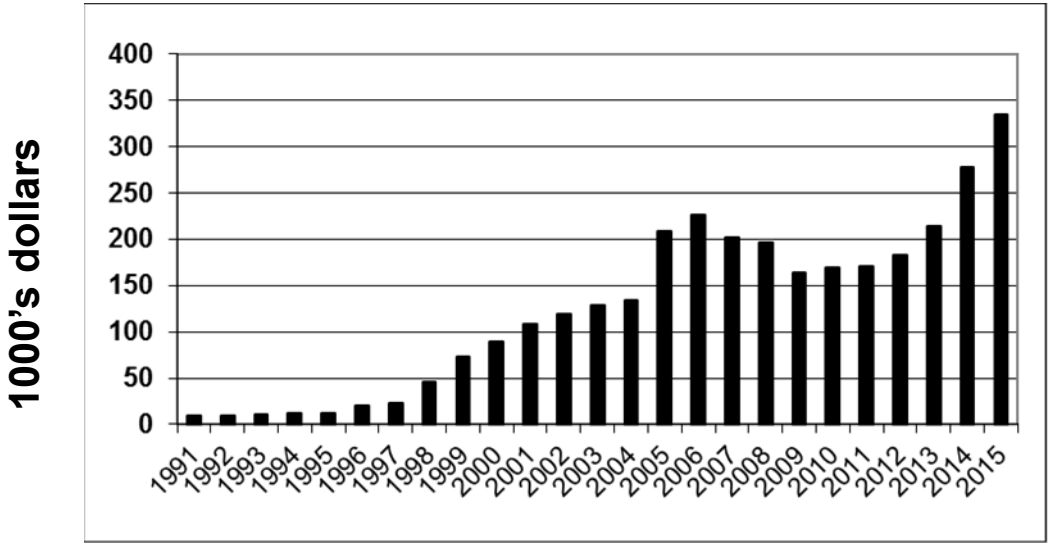
Richard Smith, Michael Cahn, Tim Hartz,
Daniel Geisseler and Tricia Love
University of California Cooperative Extension
Monterey County and UCD

Organic Fertilizer Evaluation

- Evaluation nitrogen and phosphorus management in organic leafy green vegetables production on the Central Coast
- Funded by the Fertilizer Research and Education Program (FREP) of the California Department of Food and Agriculture

Why this Project?

- **Organic vegetable production in Monterey County is growing rapidly**



Organic Agriculture: 6.9% of total ag value

- **Nitrogen management in organic production systems is more complicated than conventional systems and is in need of greater understanding**

Organic Fertilizer Evaluation
Primary Objectives

- **Determine the magnitude of mineralization by soil organic matter and its role in providing the N needs of leafy green vegetables**
- **Evaluate mineralization behavior of commonly used dry and liquid organic fertilizers**

In-field Soil Organic Matter Mineralization Evaluations

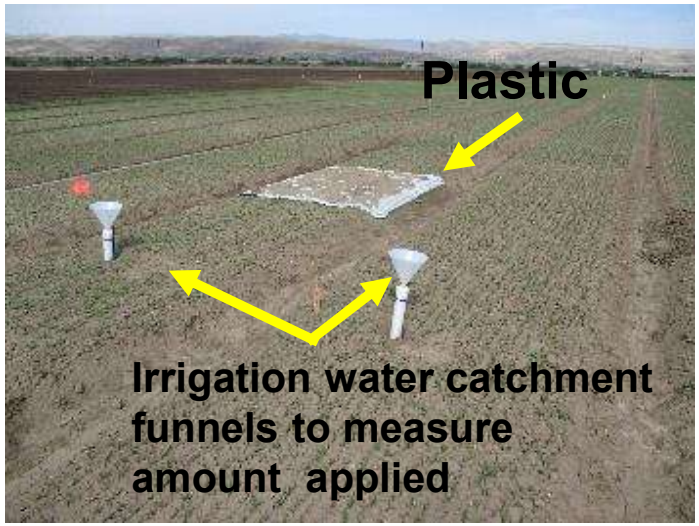
- A survey of 10 sites in the Salinas Valley was conducted with cooperating growers in commercial vegetable production fields
  - Crops included baby lettuce and spinach
  - Full term romaine and one broccoli field
- Replicated fertilized and non-fertilized plots were established in each field

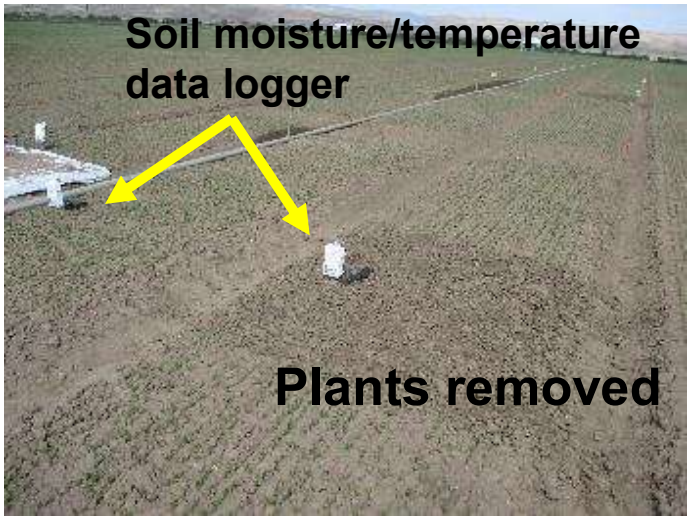
Range of Soil Characteristics of Survey Sites

pH	7.28 – 8.17
Total N	0.05 – 0.18*
Organic Matter	0.64 – 4.13
Olsen P	10.2 – 111.8
Clay percent	5.6 - 53.3

* a change of 0.01 = 380 lbs of N/A

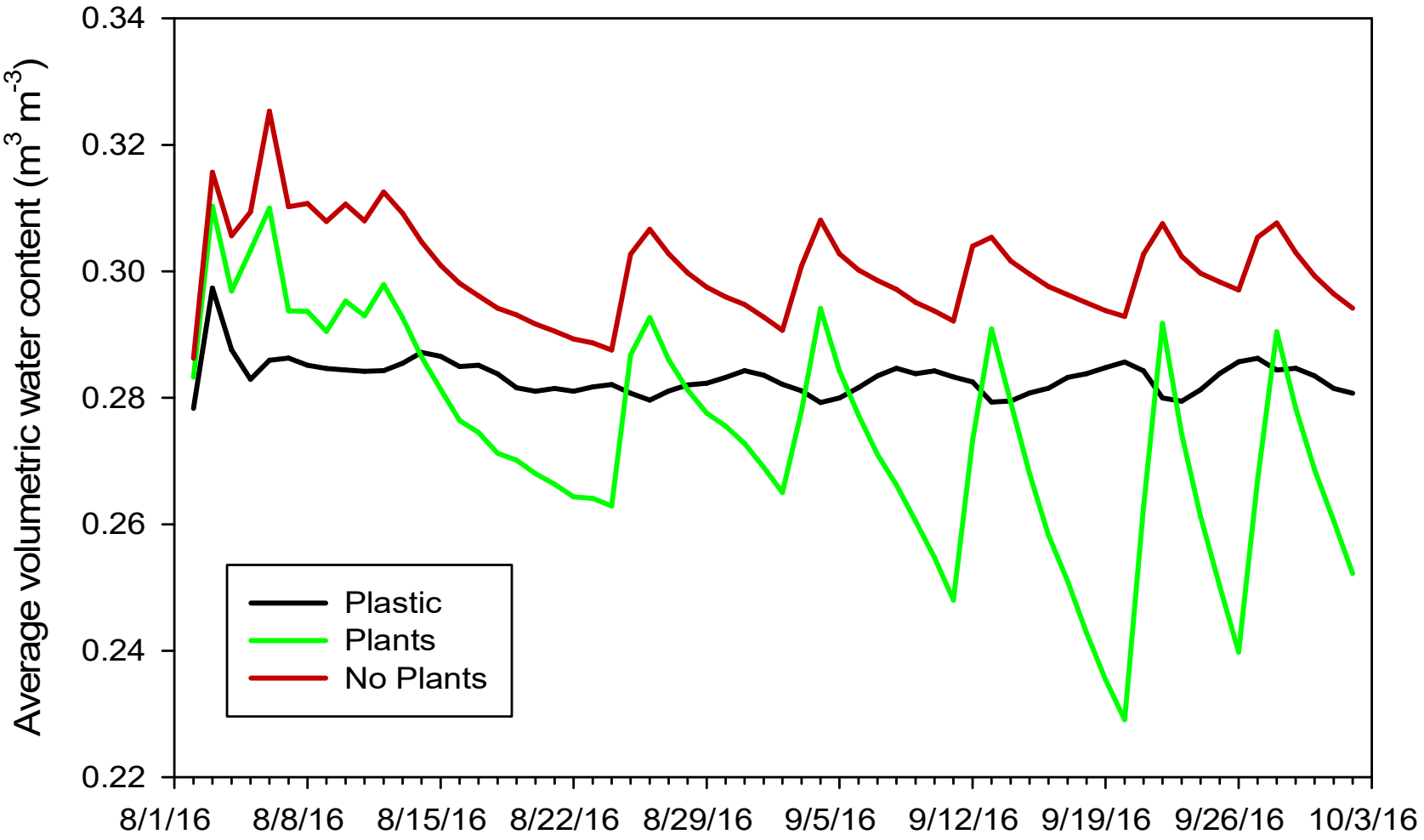
In-field Soil Organic Matter Mineralization Evaluations



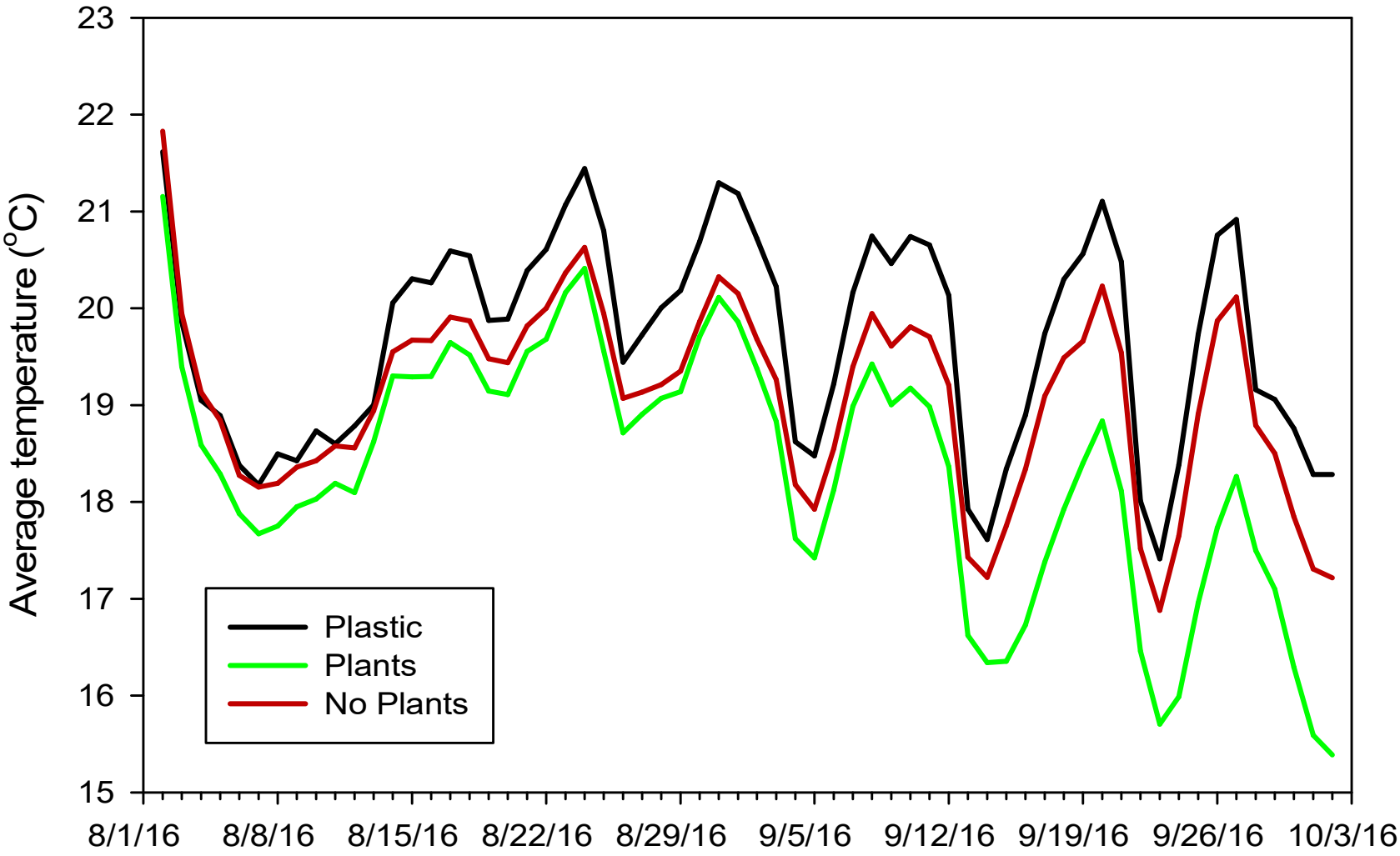


- **In each unfertilized plot subplots included:**
  1. **Plants present**
     - **Estimate of soil N mineralized, plant removal, leaching**
  2. **No plants**
     - **Estimate of soil N mineralized, no plant removal, leaching**
  3. **No plants, covered with plastic**
     - **Estimate of soil N mineralized, no plant removal, no leaching**

Soil Moisture Content



Soil Temperature



In-field Soil Organic Matter Mineralization Evaluations

Nitrogen Summary of the Sites

Values = lbs N/A

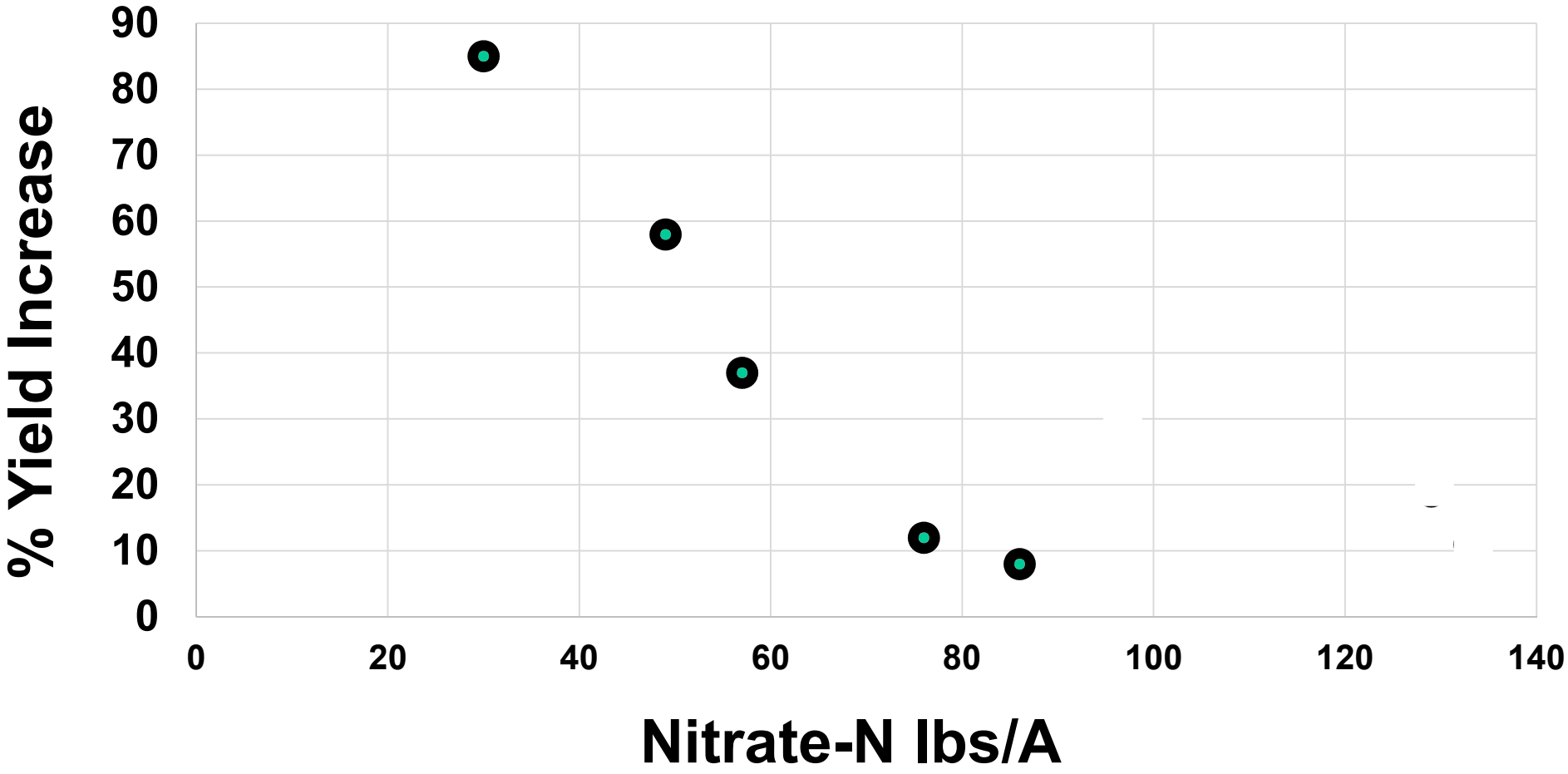
Crop	Initial mineral N (nitrate)	Fertilizer N applied	N mineralized from soil over crop cycle
Spinach	49	210	58
Spinach	129	120	---
Baby lettuce	30	90	16
Baby lettuce	57	120	33
Baby lettuce	86	160	73
Baby chard	97	160	82

Nitrogen Summary of the Sites

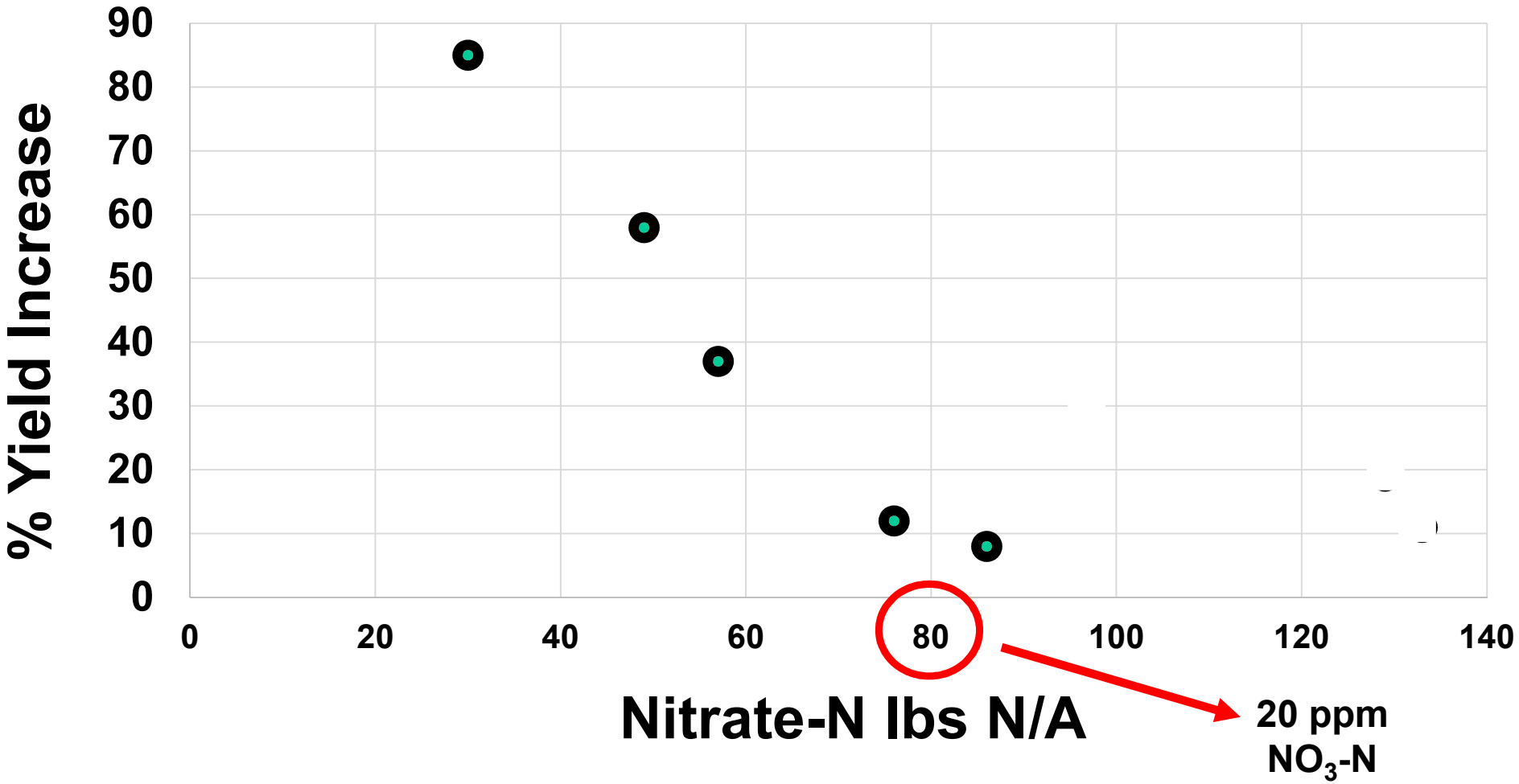
Values = lbs N/A

Crop	Initial mineral N (nitrate)	Fertilizer N applied	N mineralized from soil over crop cycle
Broccoli	67	437	---
Romaine	16	160	29
Romaine	76	360	59
Romaine	133	160	78

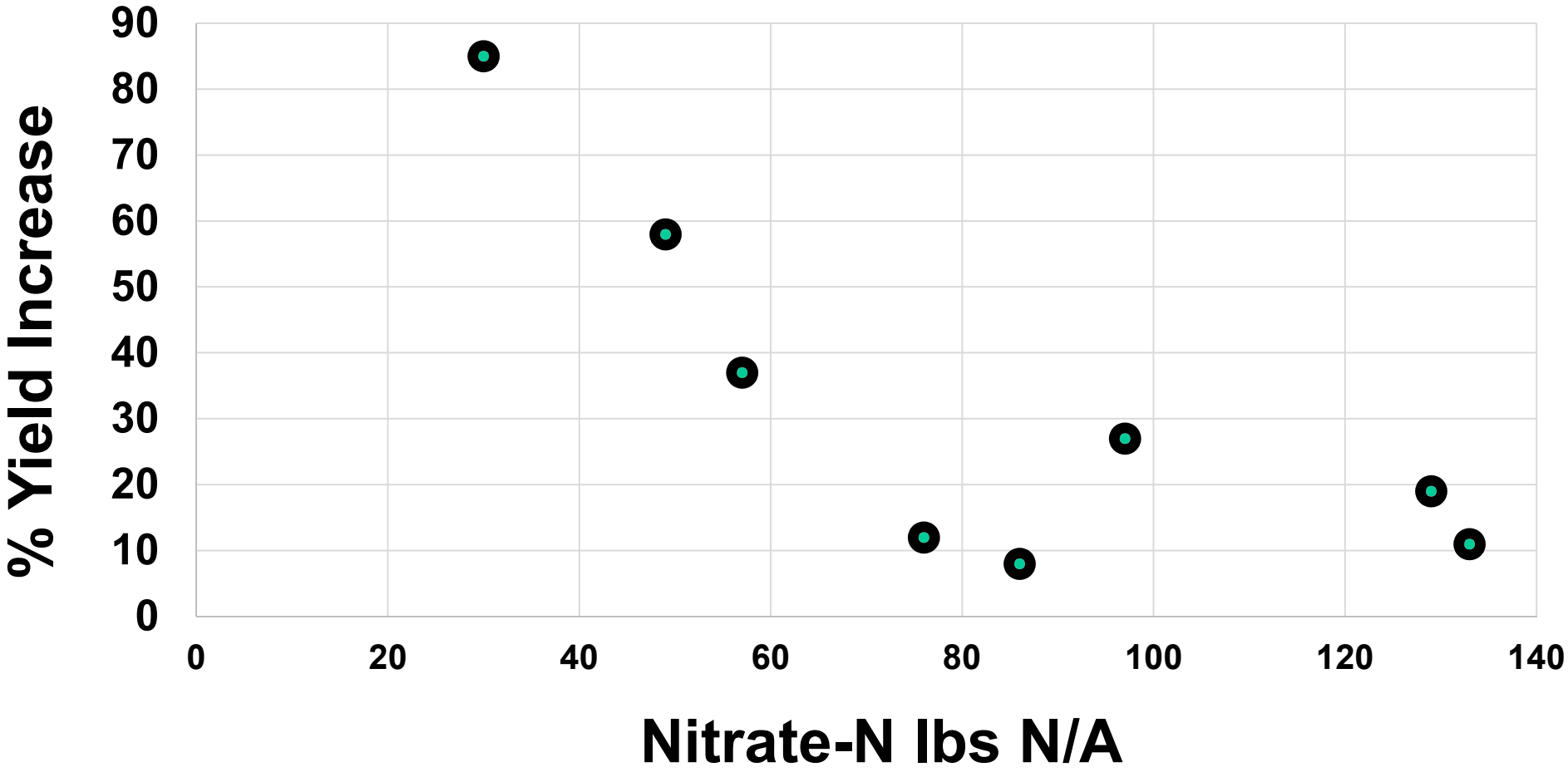
Initial Nitrate-N and Percent Yield Increase with Fertilization



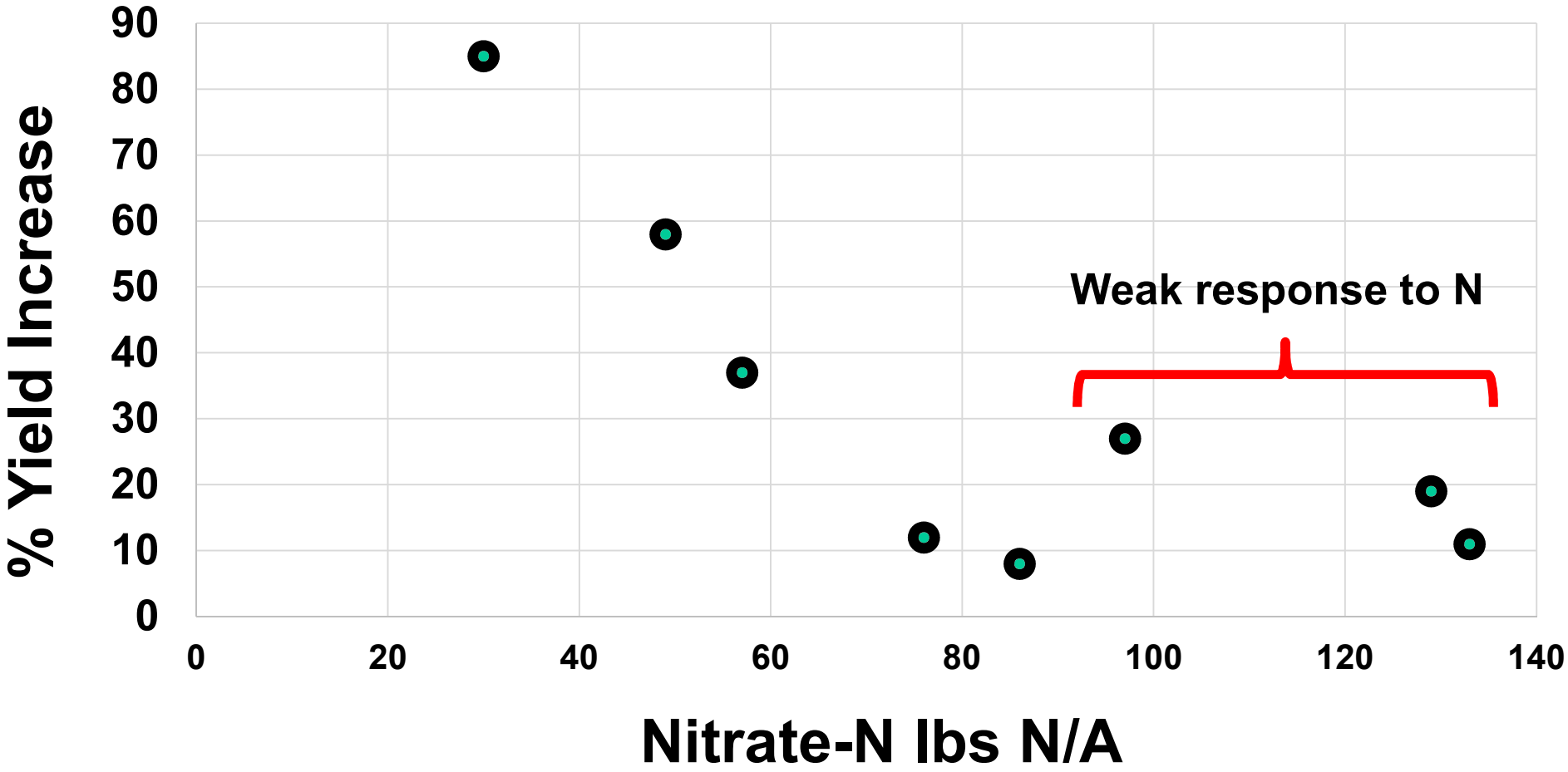
Initial Nitrate-N and Percent Yield Increase with Fertilization



Initial Nitrate-N and Percent Yield Increase with Fertilization



Initial Nitrate-N and Percent Yield Increase with Fertilization



In-field Fertilizer Mineralization Studies

Polypropylene Pouches with Fertilizer

- Pouches with fertilizer were placed into the soil at the beginning of the crop cycle
- Two studies conducted:
- 4-4-2 (blend of chicken manure, bone and meat meals) buried and on soil surface (direct seeded romaine)
- 4-4-2 and feather meal buried in soil (broccolini)

In-field Fertilizer Mineralization Studies

Buried in soil

Place on top of soil

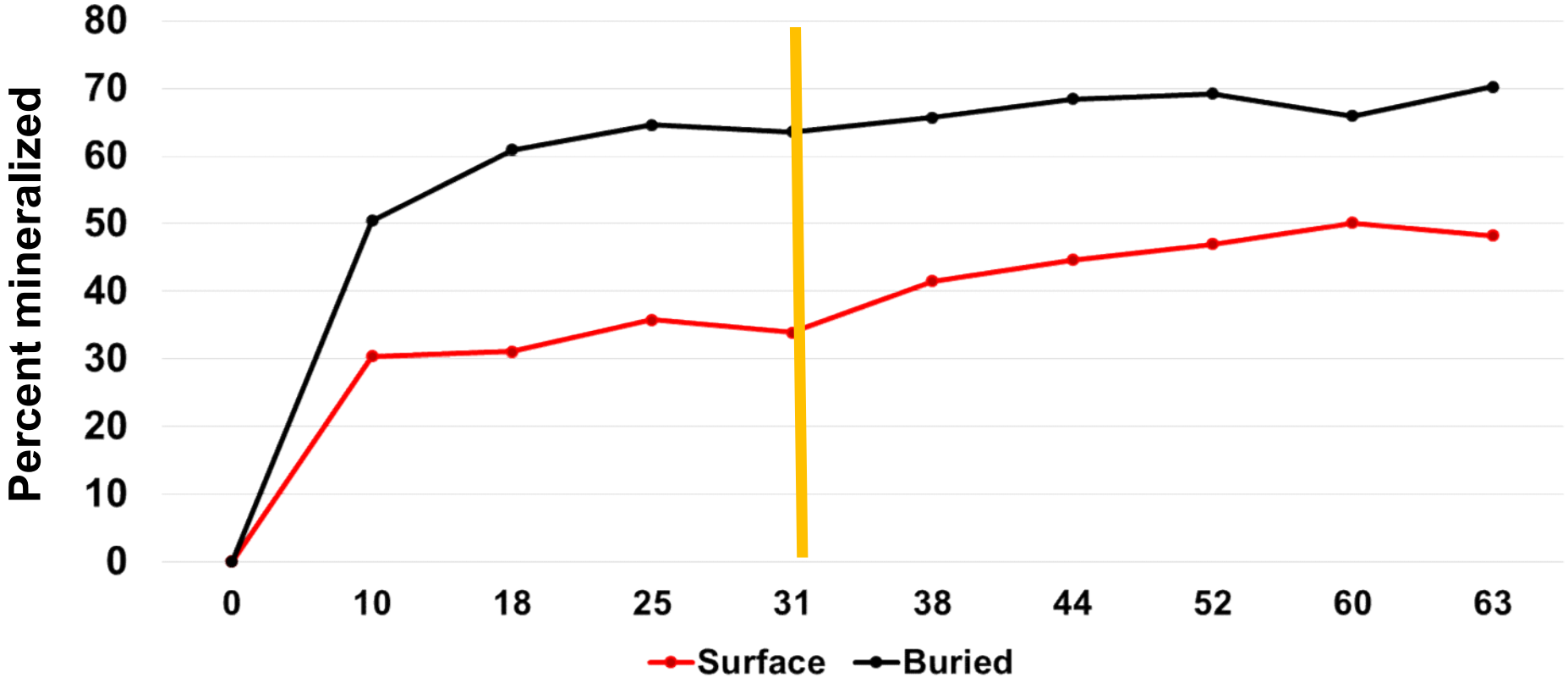
In-field Fertilizer Mineralization Studies

- 3-4 pouches were collected each week and the contents were collected, weighed and analyzed for N, P and K
- This technique has limitations (e.g. loss of particulate matter)

4-4-2

Percent N Mineralized from Pouches

Buried vs Surface

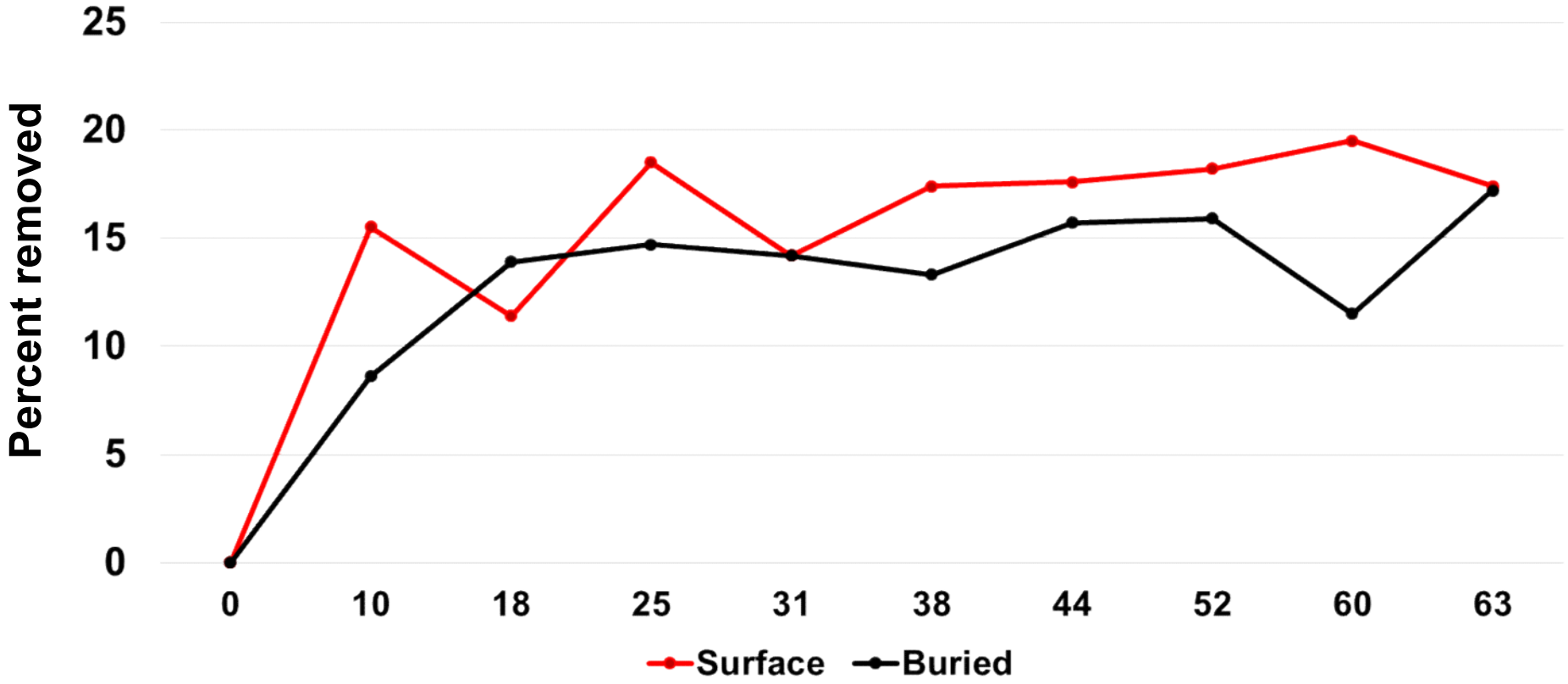


Days after Planting

4-4-2

Percent Phosphorus Removed from Pouches

Buried vs Surface

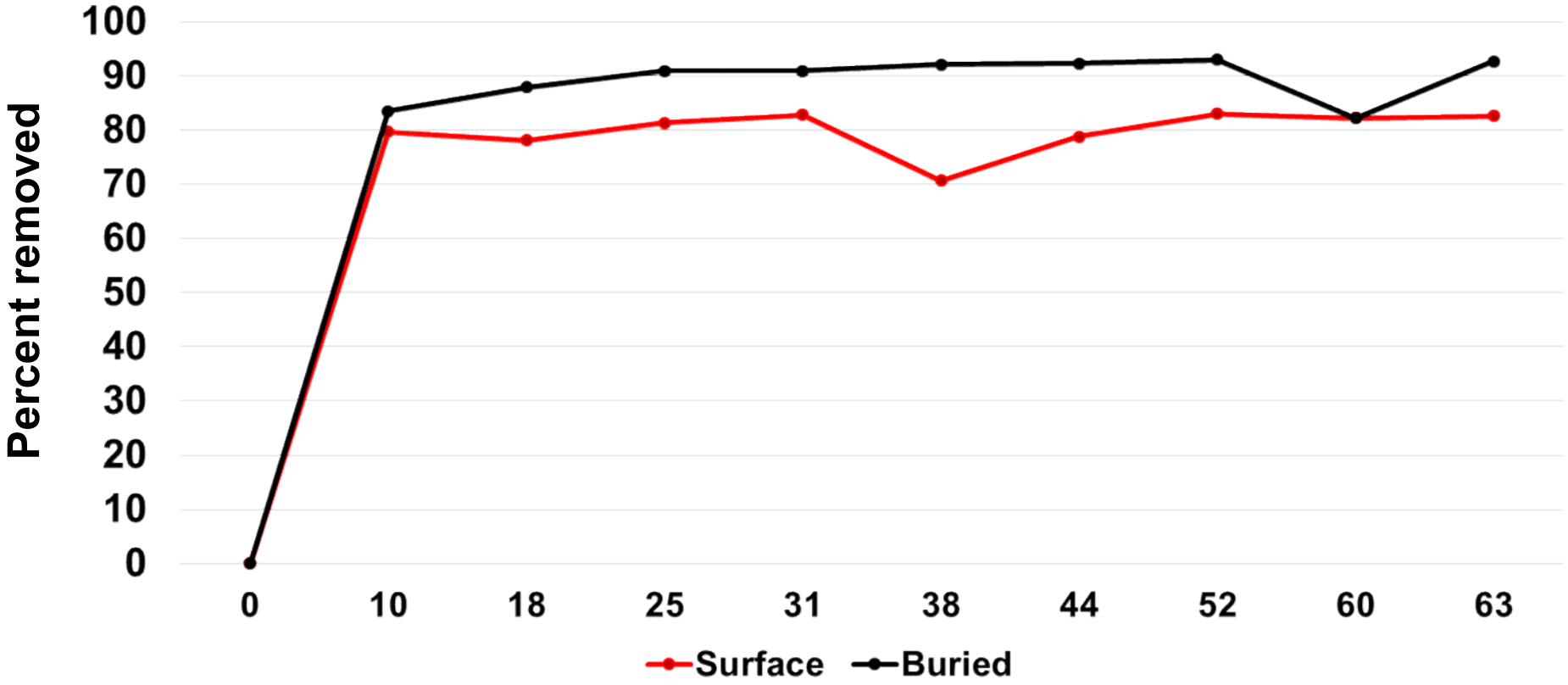


Days after Planting

4-4-2

Percent Potassium Removed from Pouches

Buried vs Surface

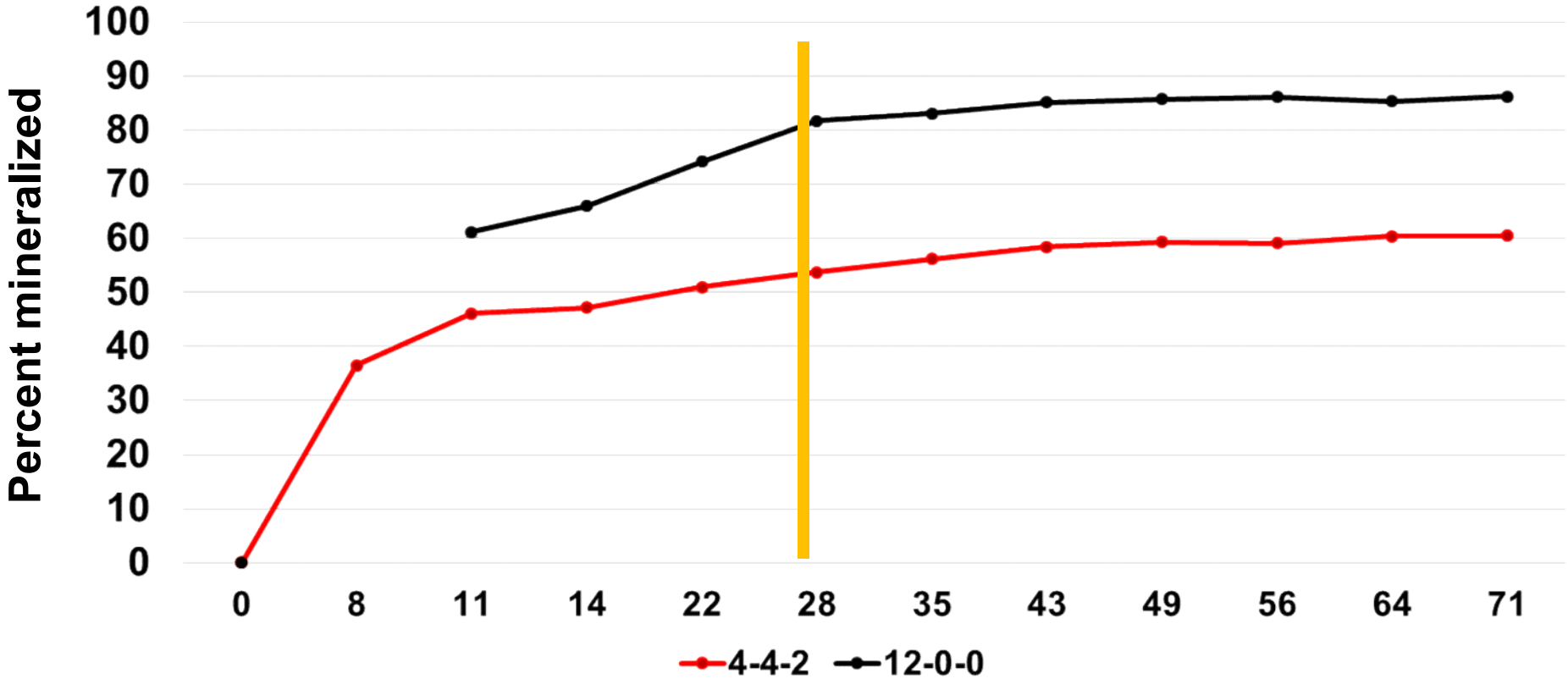


Days after Planting

Summary of Pouch Evaluations Buried vs Surface

- Placement of the material affects the speed of mineralization of N and may affect the rate of material needed for optimal growth
- Given the pH's of the soil, the phosphorus in 4-4-2 that comes from bone meal, is not available to the crop and remains in the soil as an insoluble mineral
- Potassium is rapidly released

Buried 4-4-2 vs 12-0-0
Percent N Mineralized from Pouches



Days after Planting

Summary of Pouch Evaluations 4-4-2 vs 12-0-0

- **Nitrogen from feather meal was nearly 50% more available than from 4-4-2 in 30 days**

Laboratory Incubations of Fertilizer Materials

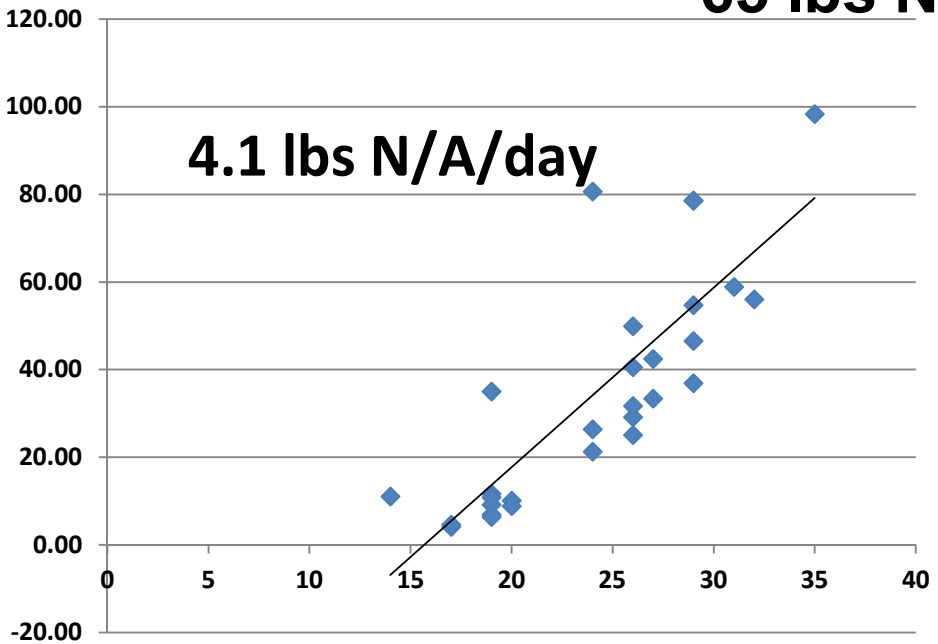
Percent N Mineralized

Material	2 weeks	4 weeks	8 weeks
2.5-2.0-2.5	4.0	5.8	13.6
4-4-2	28.8	30.5	37.5
8-5-1	47.2	43.5	58.5
10-5-2	43.8	49.3	58.8
12-0-0	48.7	56.5	59.3

Nitrogen Uptake

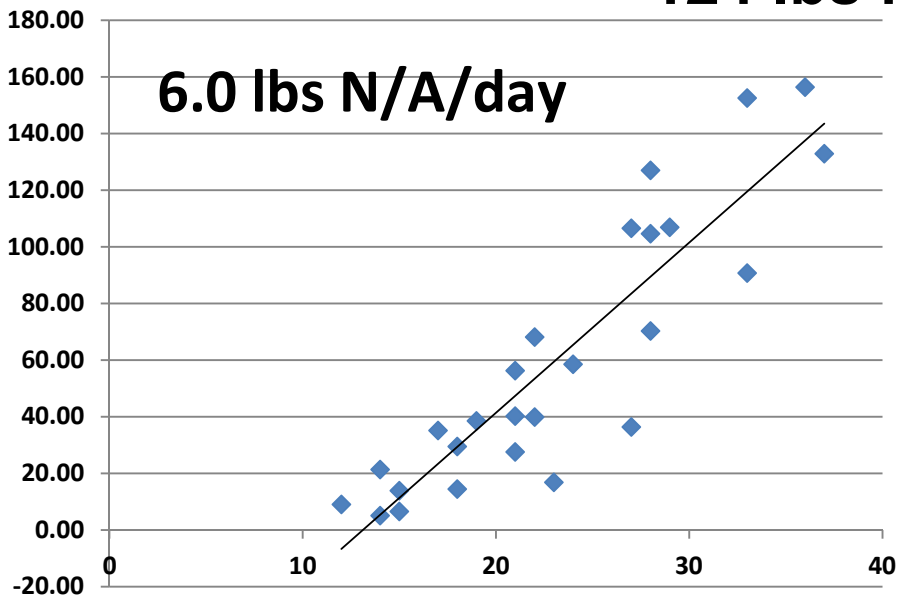
Conventional Production

65 lbs N



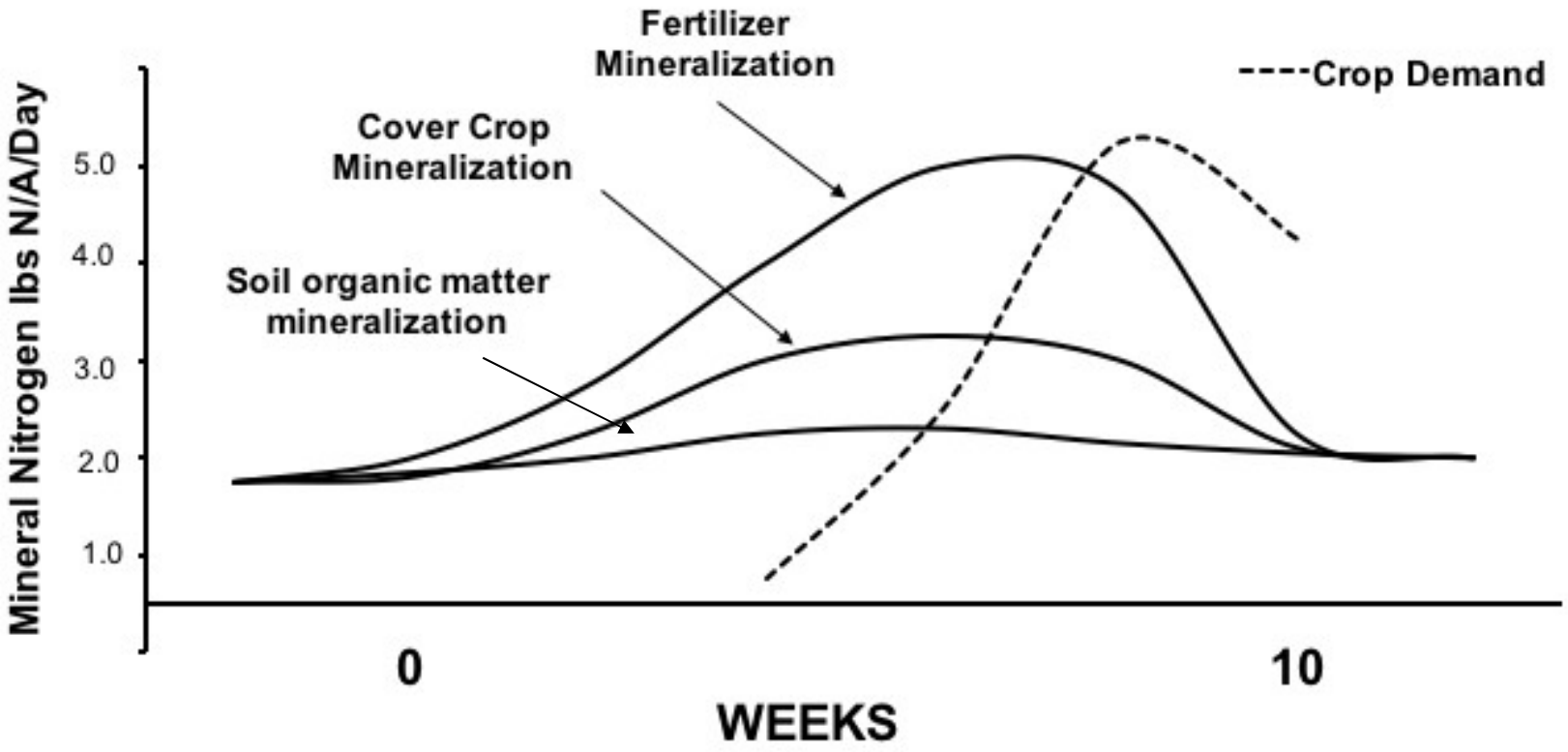
Baby Lettuce

124 lbs N



Spinach

Effective Synchrony Between Mineralization from the Various Sources and Crop Demand



Yield of the Survey Sites

Crop	Mean yield Survey lbs DW/A	Mean yield Conventional lbs DW/A
Spinach*	1,058	2,121
Romaine	2,669	5,500

* Affected by downy mildew?

Is N nutrition a factor in the lower yield? If so, is it due to placement or release rate of the material.

Fate of Unused Applied N

- Double or triple cropping may be leaving a significant amount of residual N from the fertilizer in the soil
- What is the fate of this N?
- Is it continuing to slowly mineralize or is it recalcitrant and building up total N in the soil?

Management Considerations

- **4-4-2 N released slower than the higher N materials**
- **The efficiency of soil surface applications is lower than incorporated applications**

Management Considerations

- **Ultimately, a reliable N soil test would be helpful to organic agriculture**
- **Organic soil fertility in fast-growing leafy vegetables is very challenging**
- **The need to apply the organic fertilizer N early in the crop cycle makes an early season evaluation of soil N necessary**
- **A nitrate quick test following the germ water may be the best tool for getting an understanding of N available for the crop**

Management Considerations

- **We observed that later season crops, just like in conventional production, had more initial residual mineral N that can be measured with a nitrate quick test and taken into account in planning for fertilizer applications**

Acknowledgements

- Cooperating growers
- Crop consultants
- Karina Mendez, Kacie Wynn, Tom Lockhart and Ivy Lurz
- Funding provided by FREP