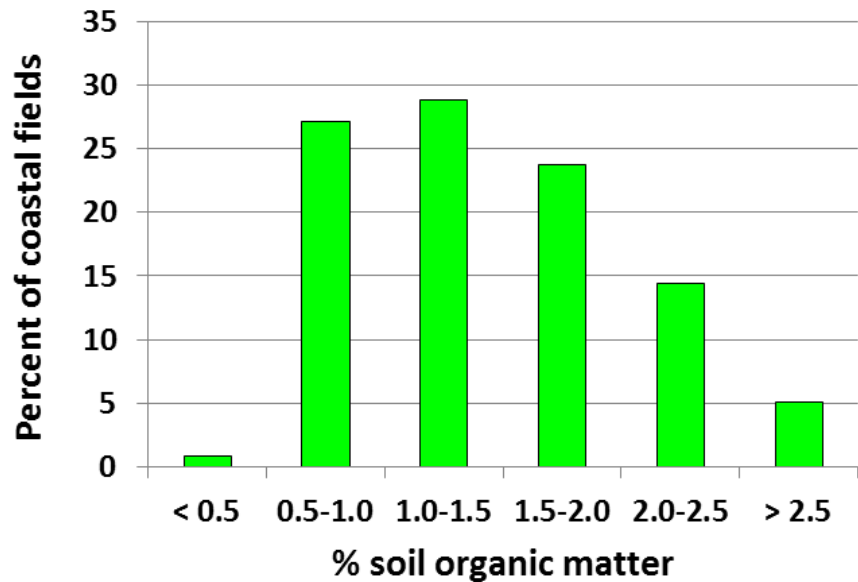


# Nitrogen mineralization and its role in crop fertility

## **N mineralization:**

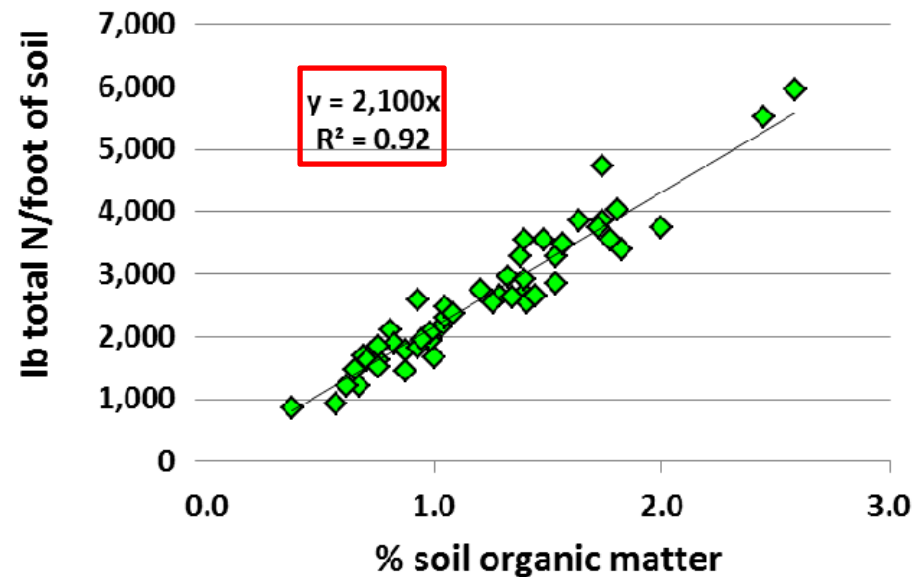
- Soil organic matter
- Prior crop residues
- Organic amendments

## Organic matter in coastal soils:



Soil organic matter in a survey  
of coastal fields

Each % organic matter represents  
about 2,100 lb total N/acre ft

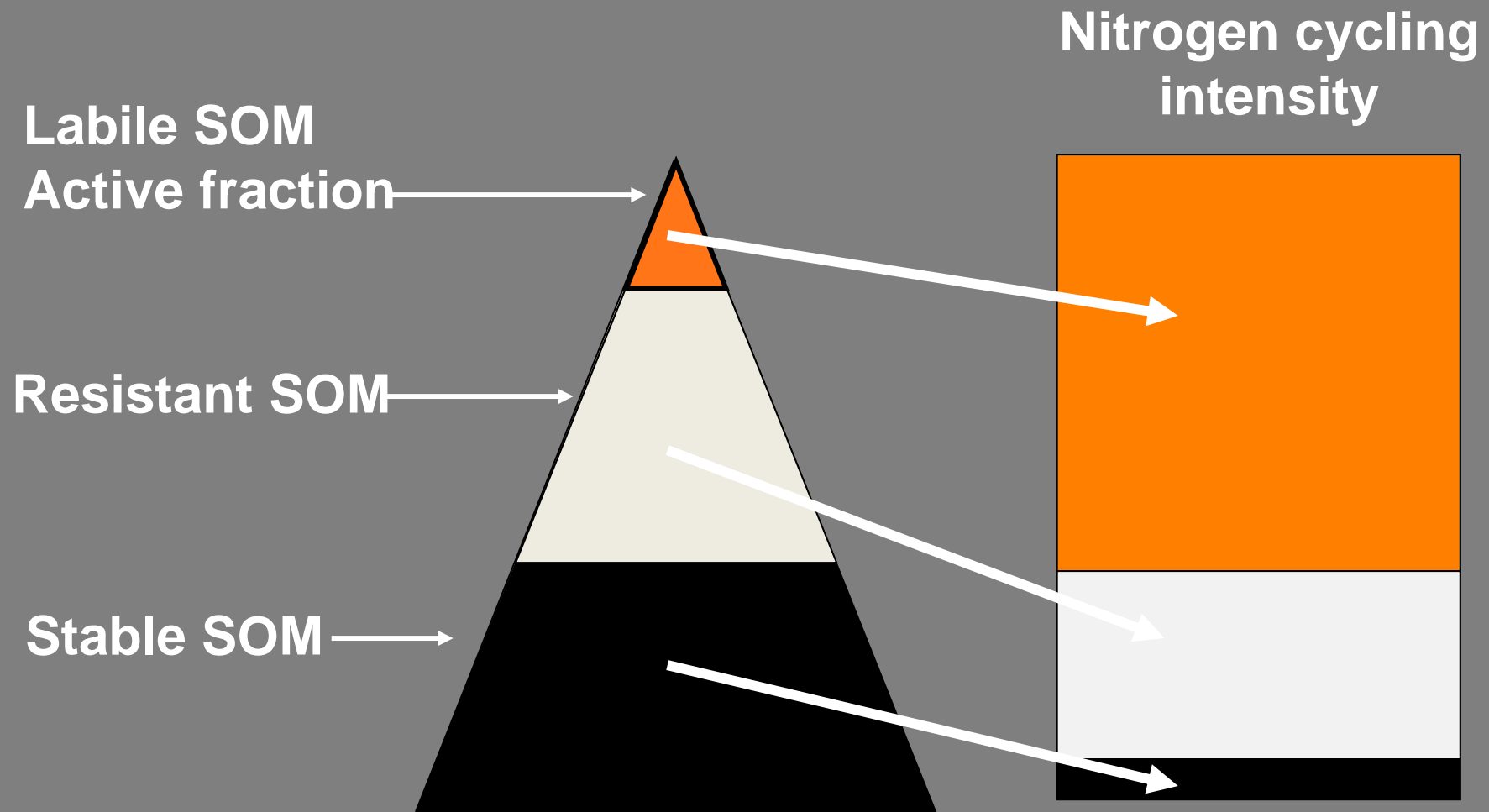


## To what depth does N mineralization occur?

- > 50% in the top foot



# Contribution of soil organic matter fractions to available soil nitrogen

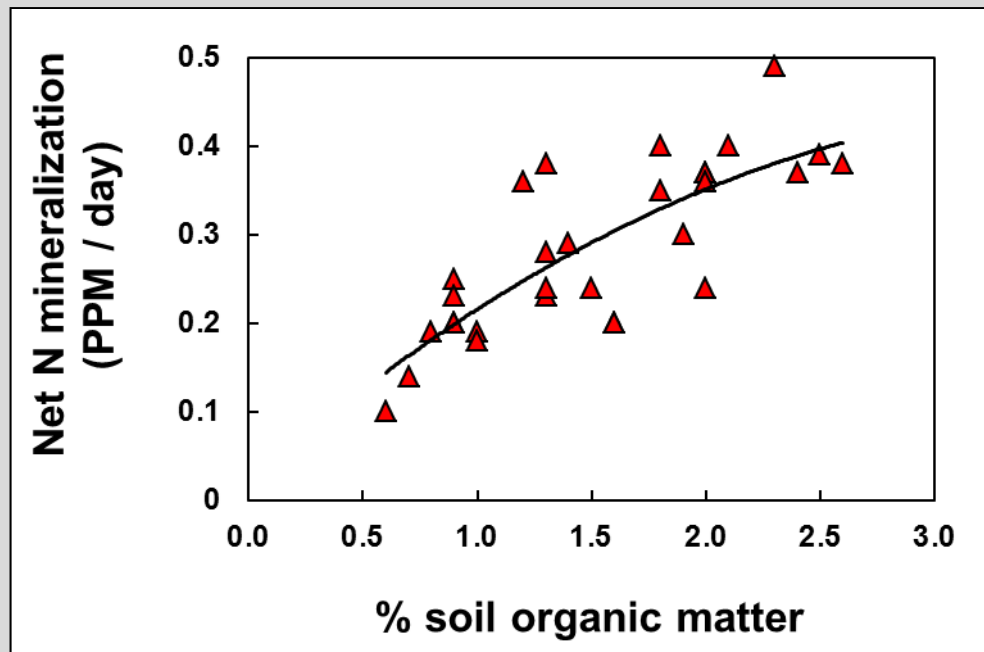




## Estimating net soil N mineralization potential:

- Long-term controlled incubation

30 coastal soils incubated for 8 weeks



- On average between 1-2% of soil organic N in the top foot of soil was mineralized
- $1-2\% \text{ organic N}_{\min} \times 2,000 \text{ lb soil N/acre} \approx 20-40 \text{ lb N} / \% \text{ soil organic matter}$

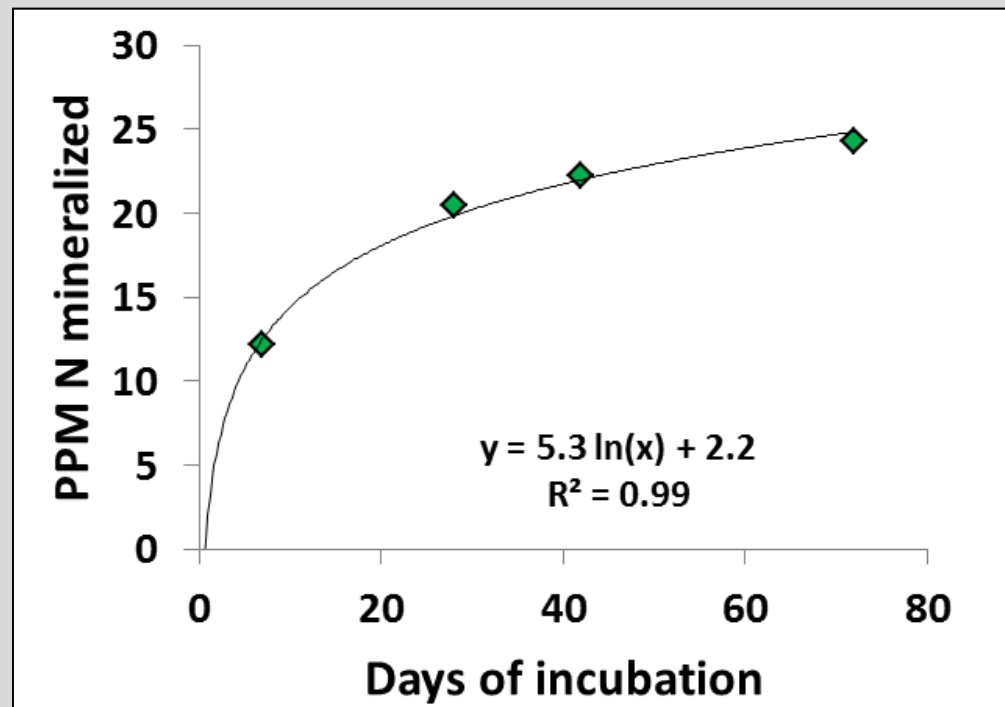
## Estimating net soil N mineralization potential:

- N mineralization dynamics over time



- Drying and screening soil disrupts aggregates, and soil microbes
- Rewetting causes a burst of microbial activity, indicative of longer-term  $N_{\min}$

Mean of 15 soils incubated for 70 days:



# Soil Testing for Soil Health

Rick Haney PhD, USDA-ARS, Temple, TX



## ‘Soil health index’

- Integrated measure of soil biology, and nutrient supplying power
- Requires measurement of soil C mineralization, water extractable organic C and N (WEOC, WEON)

the Solvita® soil respiration test

## Estimating net soil N mineralization potential:

- Laboratory surrogate measurements

### 'Solvita' CO<sub>2</sub>-C mineralization protocol



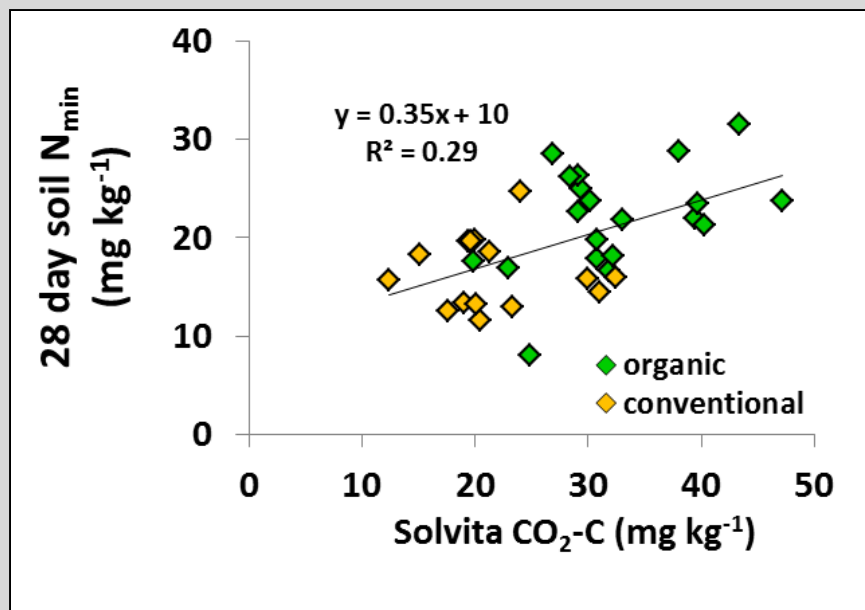
**Evaluated 35 soils from annual crop rotations**

- 20 organically managed soils from Sacramento Valley
- 15 conventionally managed soils from Sacramento and Salinas Valleys



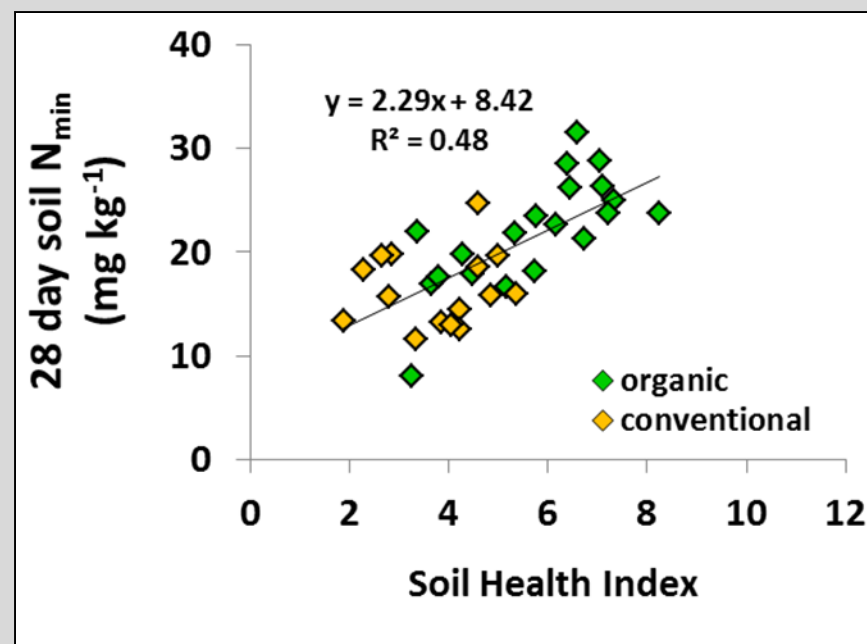
## Estimating net soil N mineralization potential:

- Laboratory surrogate measurements



Combining Solvita CO<sub>2</sub>, WEOC and WEON into the NRCS Soil Health Index improved  $N_{min}$  prediction

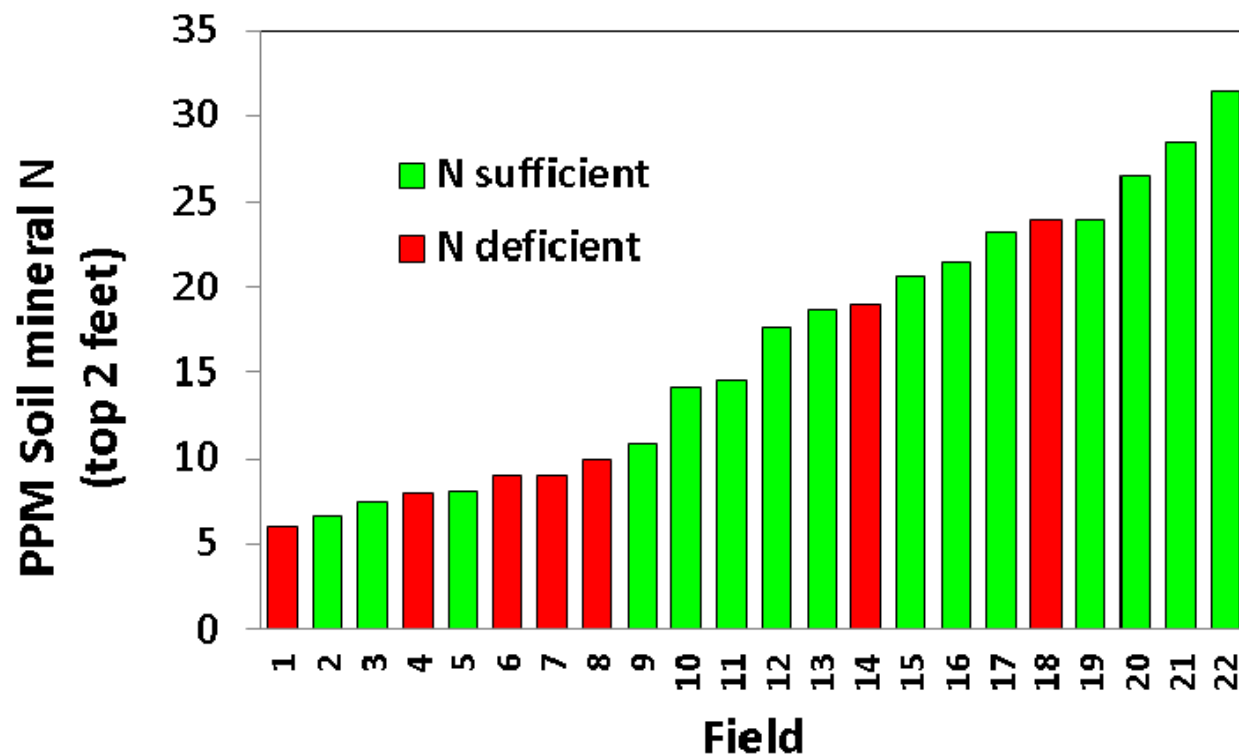
Solvita CO<sub>2</sub> moderately correlated with soil  $N_{min}$



## In-season soil $N_{\min}$ plays a relatively small role in crop N supply

2012-13 organic processing tomato N sufficiency project:

- assessed post-transplant soil residual  $NO_3$ -N in 22 fields
- determined late-season crop N sufficiency





## N mineralization from crop residue





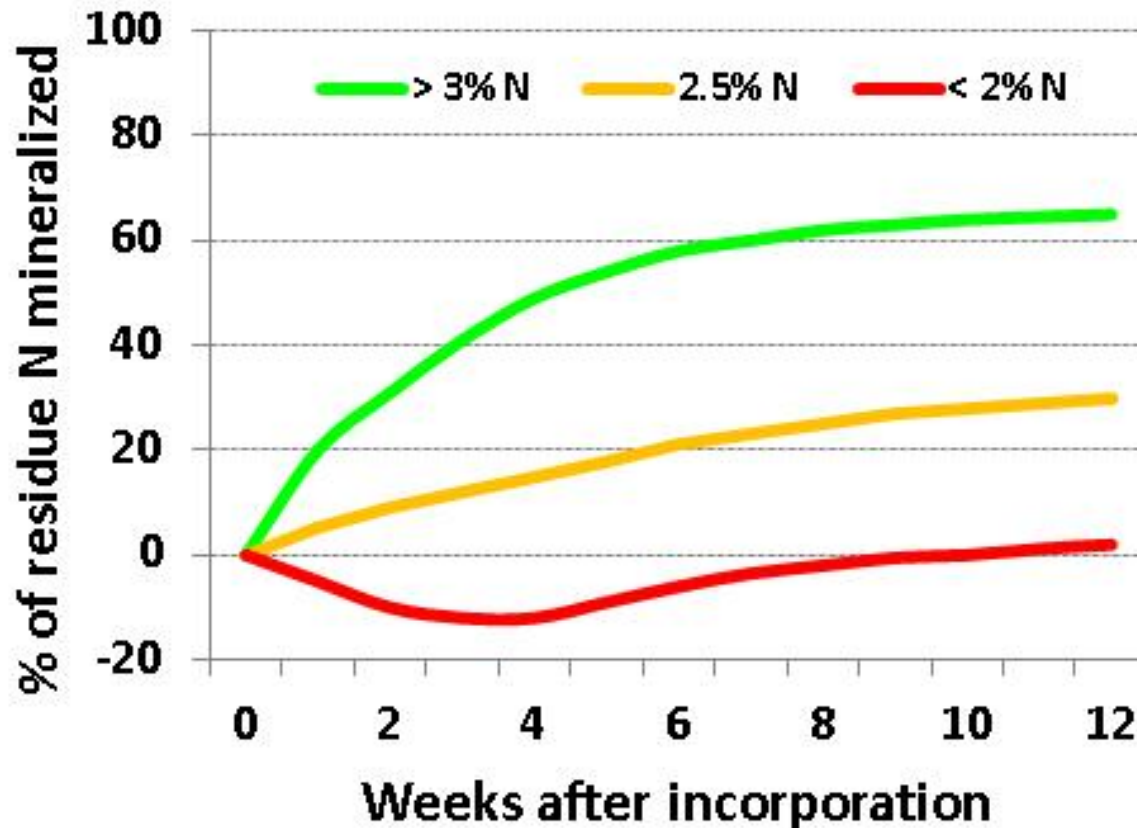
## N mineralization from crop residue

Residue N content predicts N mineralization behavior:

	wheat	tomato	broccoli
Typical residue N content (lb/acre)	50	70	200
Residue %N	1.5	2.5	3.5



## N mineralization from crop residue



- Greatest activity occurs in the initial 6-8 weeks after incorporation



## N mineralization from crop residue

### Coastal crops:

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



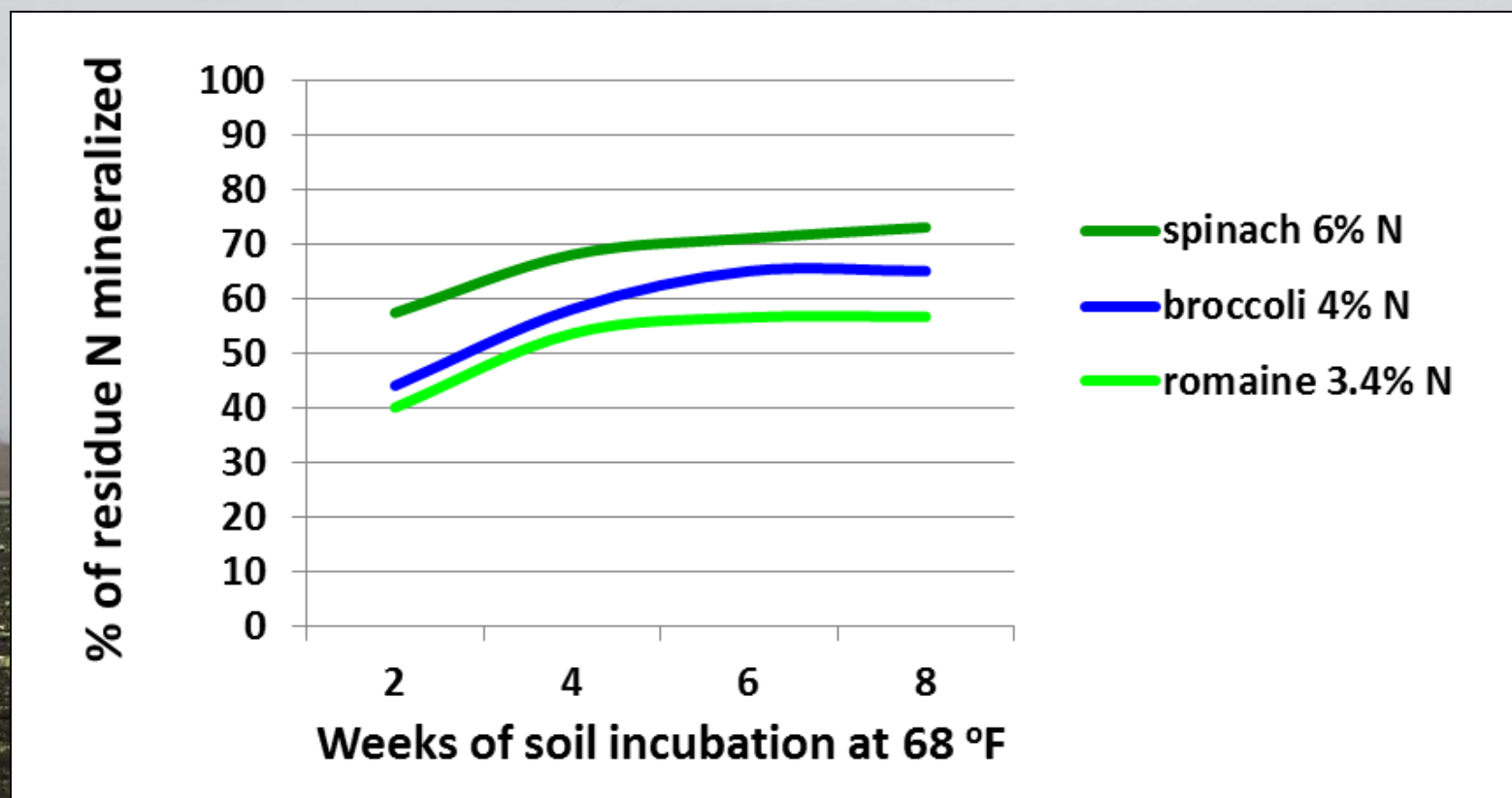


# N mineralization from crop residue

Laboratory incubation:



## N mineralization from crop residue

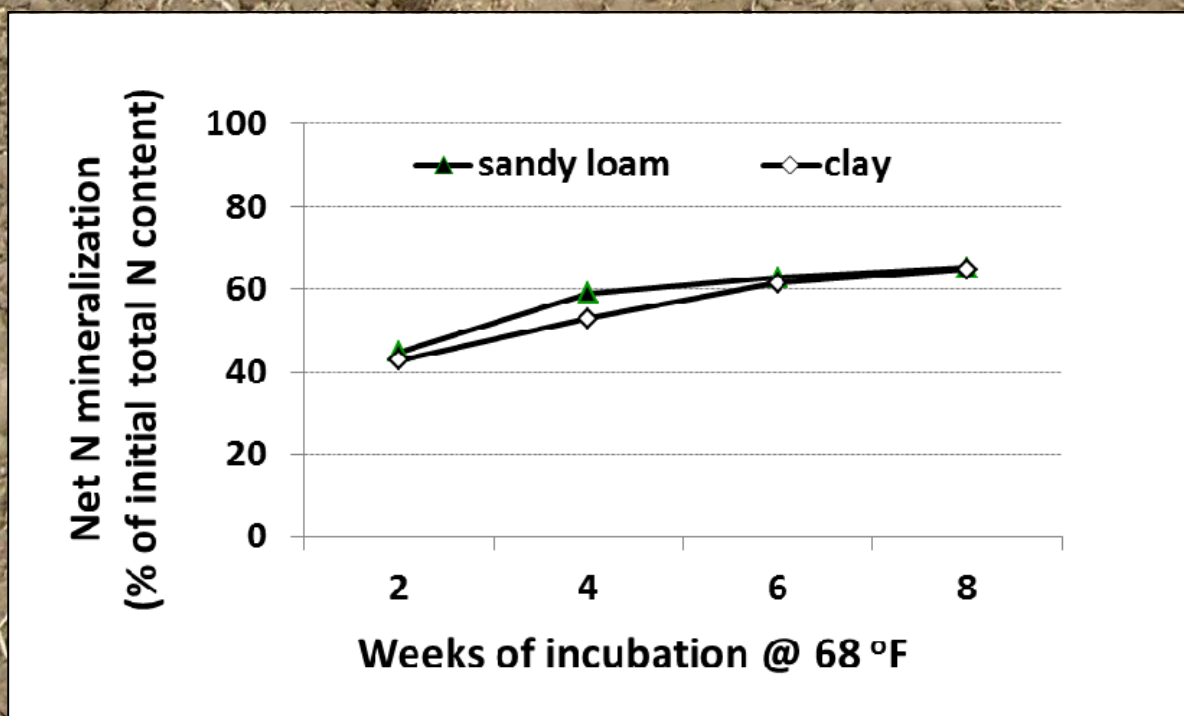


- a high percentage of residue N is mineralized within weeks of incorporation
- within 4-6 weeks after incorporation, the rate of additional  $N_{\min}$  slows
- the majority of residue effects on soil N availability can be directly measured by soil nitrate testing before fertilizing the subsequent crop



# Does soil type affect residue breakdown?

Net N<sub>min</sub> average of 7 vegetable crop residues:

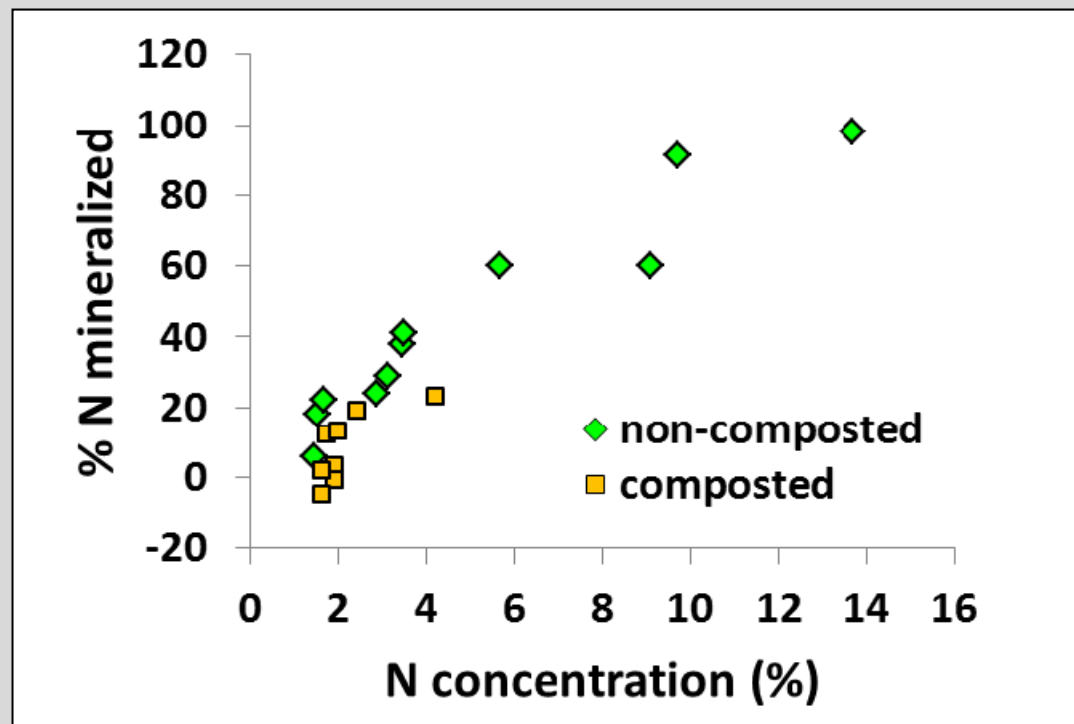


## N mineralization from organic fertilizers and amendments

N mineralization dynamics depend on:

- Percent N
- C:N ratio
- 'Fresh' or composted

% N mineralized in full field season, Oregon:

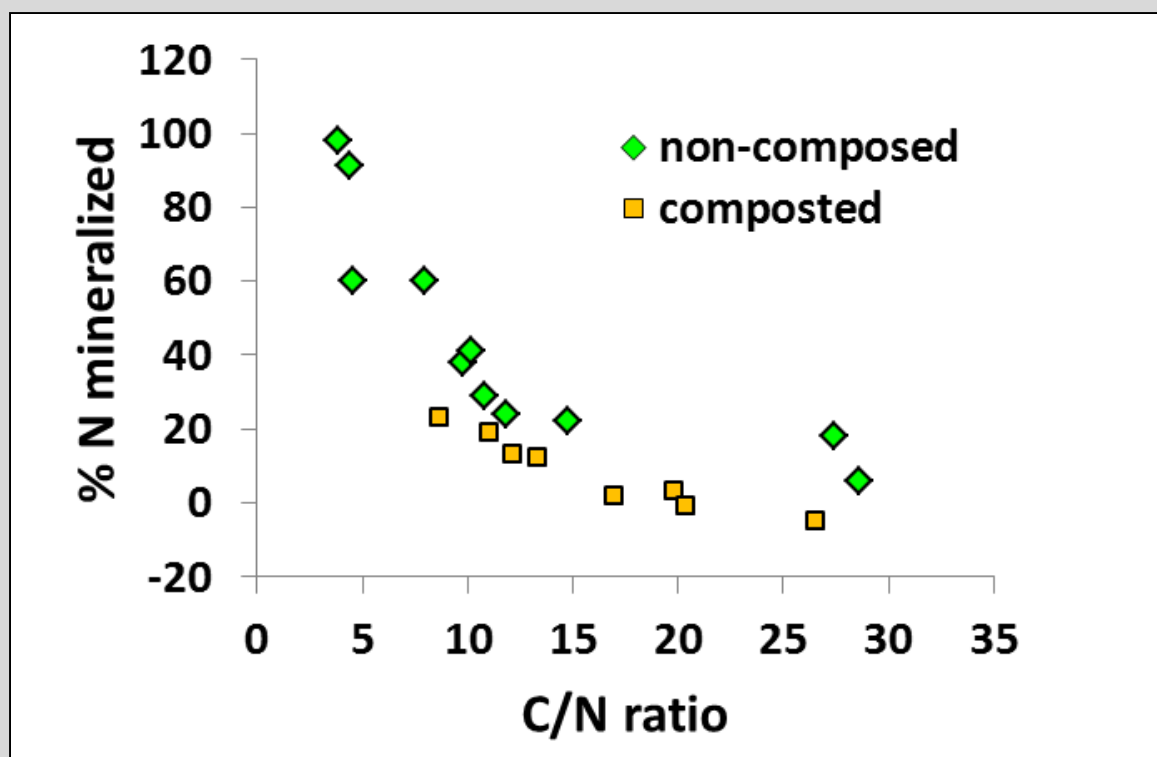


(Gale et al., JEQ 35:2321-2332, 2006)



## Relationship between %N and C:N ratio

	% C	% N	C:N ratio
Blood meal	49	15	3
Fish powder	45	12	4
Dewatered poultry manure	30	3.5	9
Poultry manure compost	20	2.5	8
Dairy manure compost	25	2.0	13

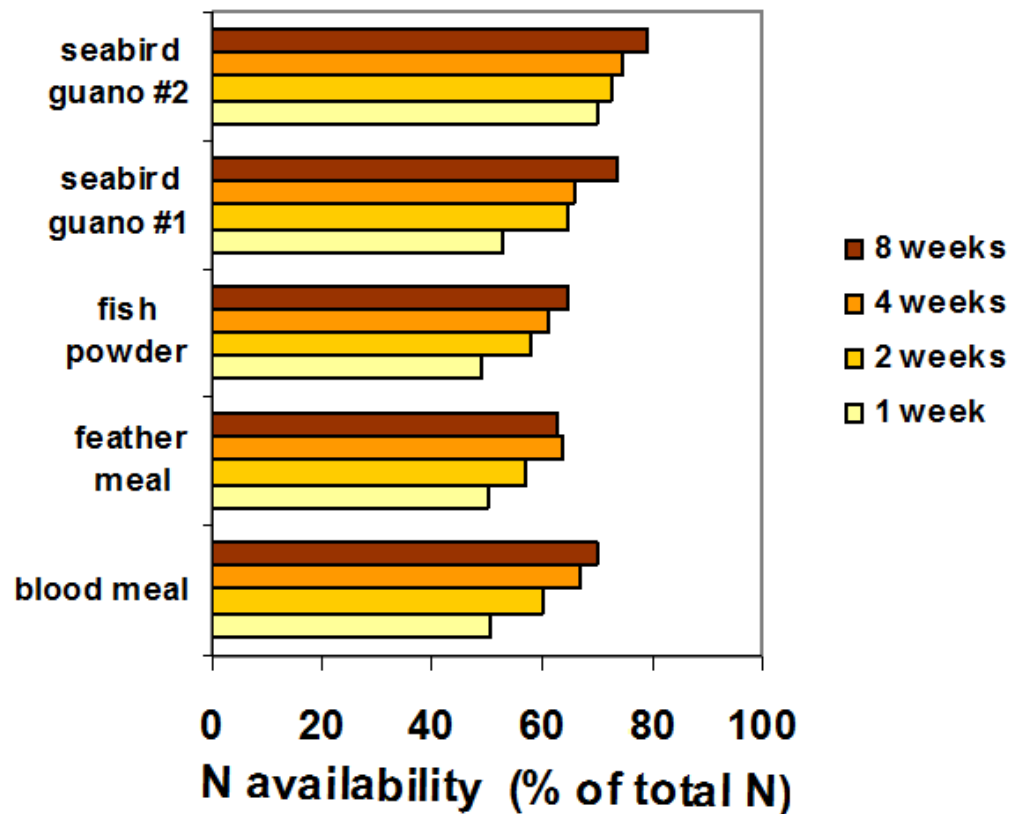


# N availability of high-N organic fertilizers:

## ❖ Five high-N materials (> 10% N)

- blood meal
- feather meal
- fish powder
- two types of seabird guano

## ❖ Incubated in moist soil at 77 °F for 8 weeks



## How about liquid organic fertilizers ?



Tradename	Feedstock	% N	
		total	organic
Agrolizer*	fish	5.1	1.0
Marizyme*	fish	4.2	0.5
Phytamin 522	fish	5.4	4.1
Phytamin 434	guano, fish	3.5	1.0
Phytamin 421	soy meal & plant extracts	4.0	3.0
Biolyzer	grain fermentation	2.6	2.3

\*removed from OMRI list

## How about liquid organic fertilizers ?



Tradename	% N	% N available
		in 4 weeks
Agrolizer*	5.1	85
Marizyme*	4.2	89
Phytamin 522	5.4	88
Phytamin 434	3.5	80
Phytamin 421	4.0	80
Biolyzer	2.6	58

\*removed from OMRI list





### **In summary:**

- in-season soil  $N_{\min}$  can be estimated (imperfectly); soil  $N_{\min}$  is likely to be a reasonably small component of crop fertility
- vegetable crop residue  $N_{\min}$  dynamics relatively quick; most of the prior crop influence can be picked up by PSNT sampling
- organic management increases  $N_{\min}$  potential, but without significant residual  $\text{NO}_3\text{-N}$  in-season fertilization likely to be needed
- in-season organic fertilizers tend to be quite fast-acting

