In-Season Fertilization in Organic Systems

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Cooperative Extension

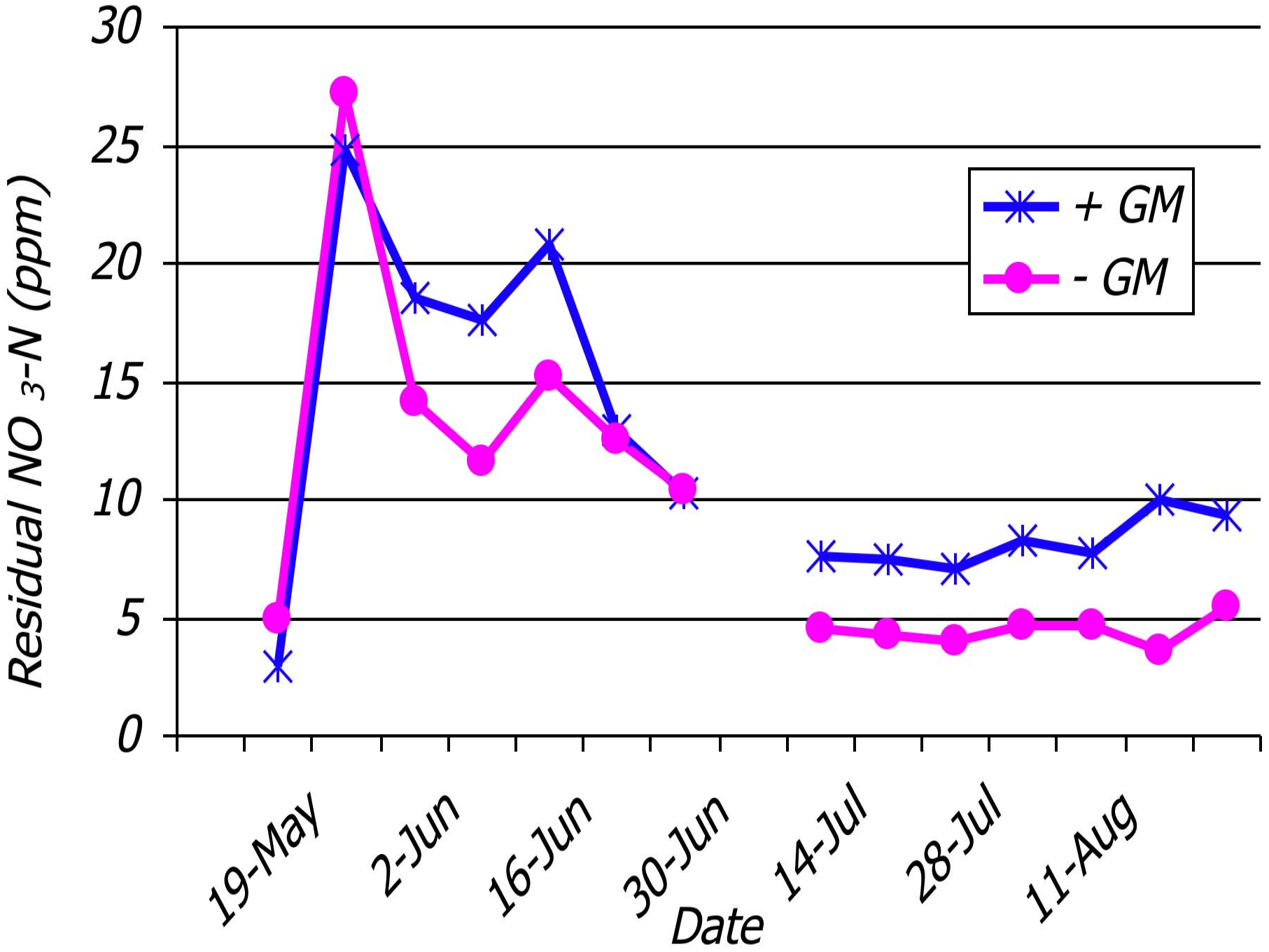
Concentrate on Nitrogen

- *Nitrogen often most critical limiting factor*
- *Nitrogen forms constantly shifting*
- *Phosphorus, potassium less problematic*
  - *composts, powdered, granular, liquid, etc*
  - *tend to accumulate*
  - *can apply preplant / incorporated – use economical material - manage for long term*

Overview of in-season organic fertilization

- ***Preplant fertilization limited for many crops***
- ***Need mineralization for plant uptake***
  - biological process, variability
- ***Commercial organic N fertilizers***
  - dry bulk, + pelleted
  - liquid

Material determines ease of use, uniformity, bioavailability

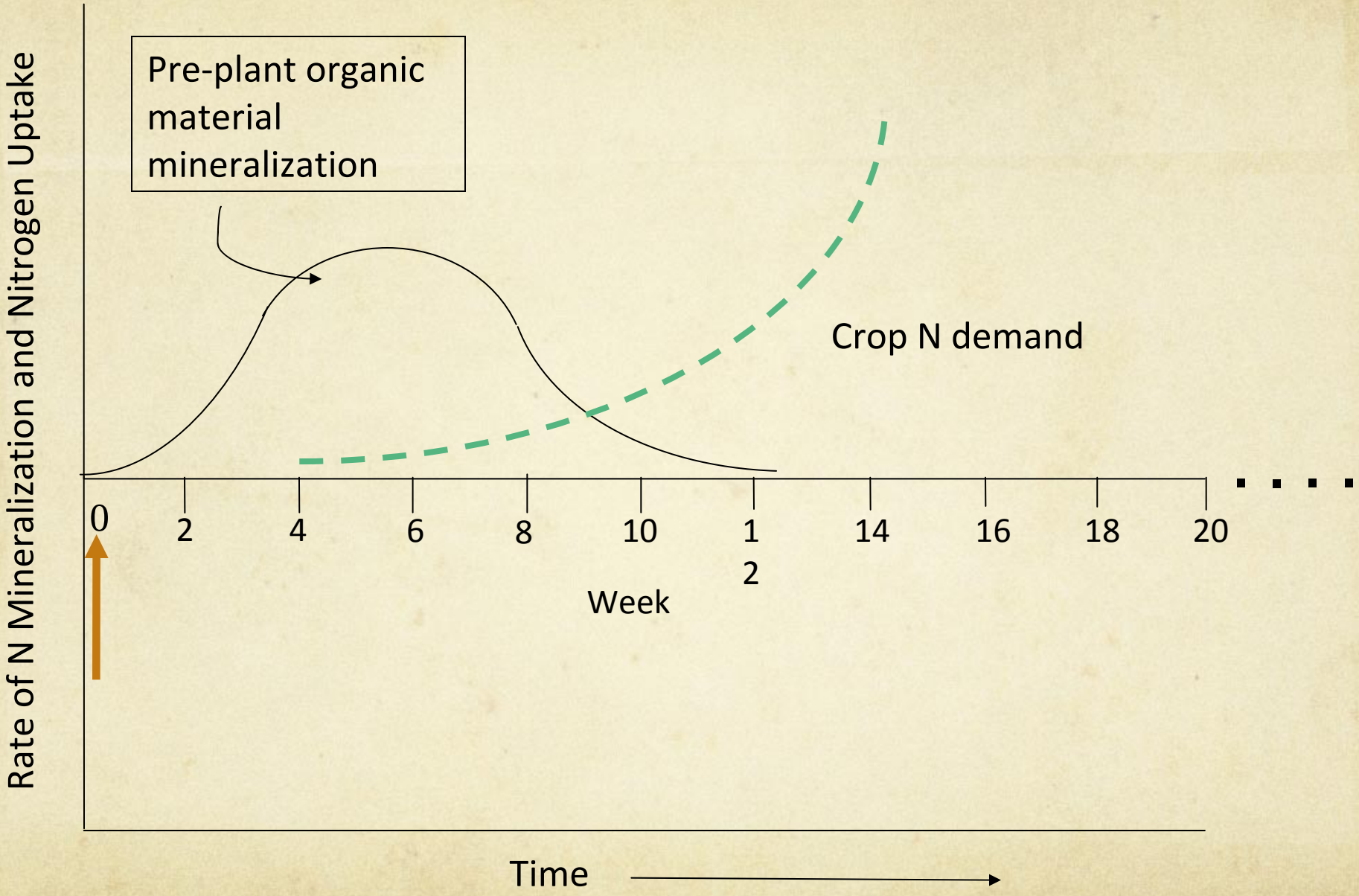

30
25
20
15
10
5
0
Residual NO 3-N (ppm)
+ GM
- GM
19-May
2-Jun
16-Jun
30-Jun
14-Jul
28-Jul
11-Aug
Date

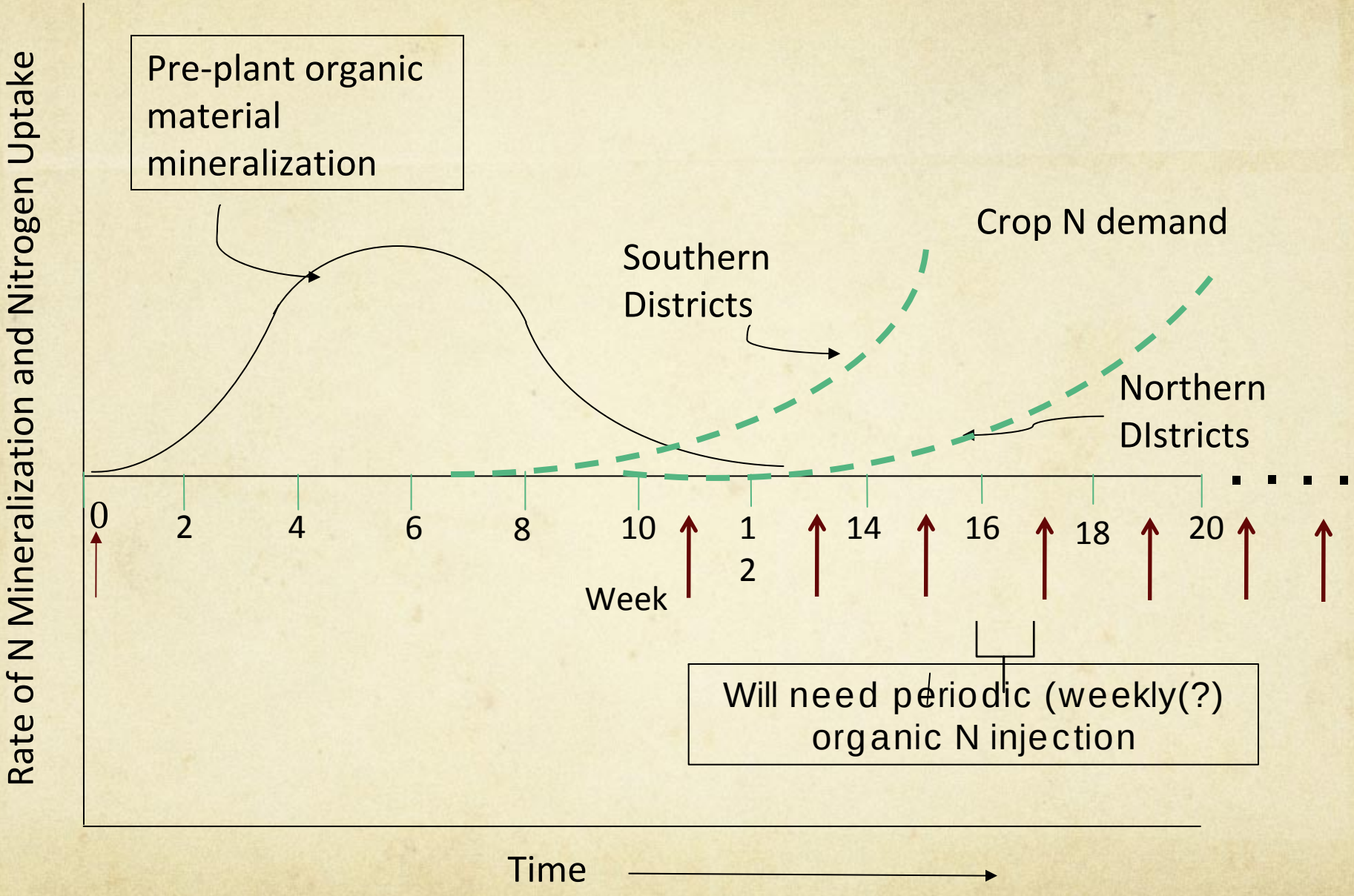
Key questions

- ***Which crops are most likely to need in-season fertilization?***
- ***How to determine in-season N needs?***
- ***Which soils most likely to need in-season fertilization?***
- ***Sources of in-season organic nutrients***

  - types of fertilizer materials?
  - special management requirements

- ***Management of liquid organic N sources.***


Rate of N Mineralization and Nitrogen Uptake
Pre-plant organic material mineralization
Crop N demand
0
2
4
6
8
10
12
14
16
18
20
Week
Time


Rate of N Mineralization and Nitrogen Uptake
Pre-plant organic material mineralization
Crop N demand
Southern Districts
Northern DIstricts
0
2
4
6
8
10
12
14
16
18
20
Week
Will need periodic (weekly(?) organic N injection
Time

Crops most likely to require in-season N?

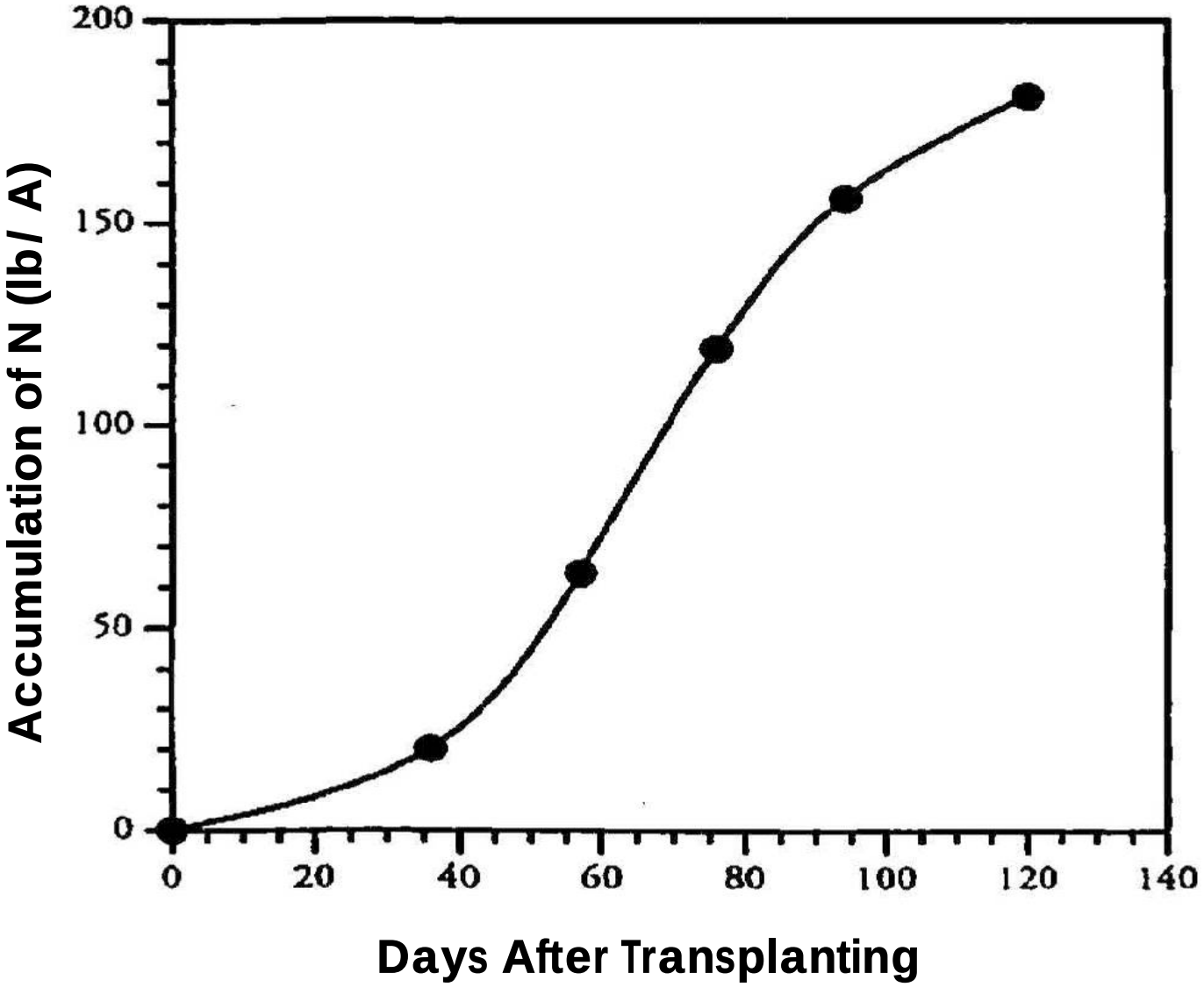
- ***Longer season crops > 12-14 weeks***
- ***Shallow rooted***
- ***Fruiting annuals, perennials***
- ***Warm season***
- ***Uptake patterns?***

  celery vs. strawberry

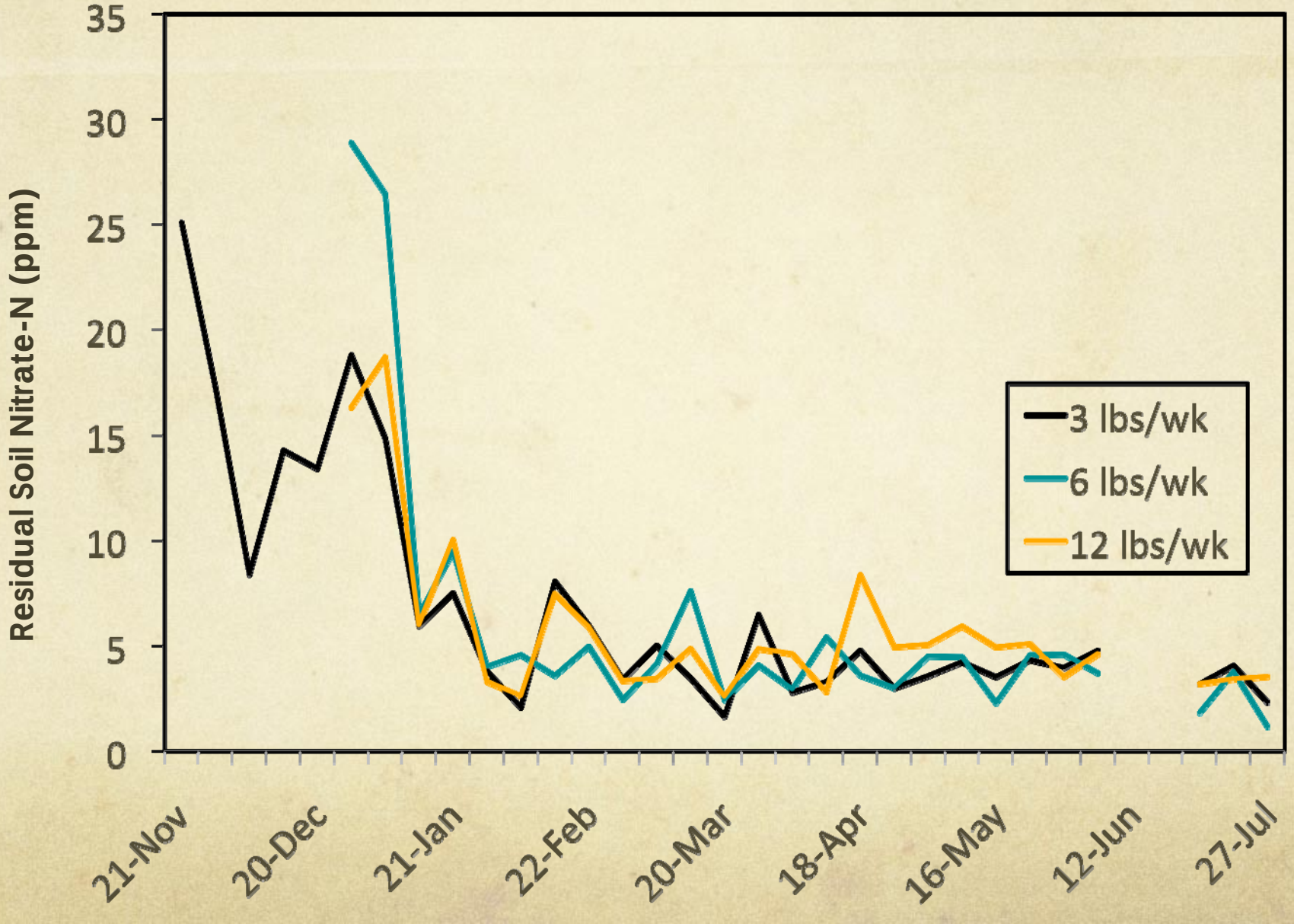
How to determine in-season needs?

- ***Plant uptake patterns***
  - amount and timing
- ***Crop response trials***
- ***Budgeting based on N sources***
  - amounts and timing

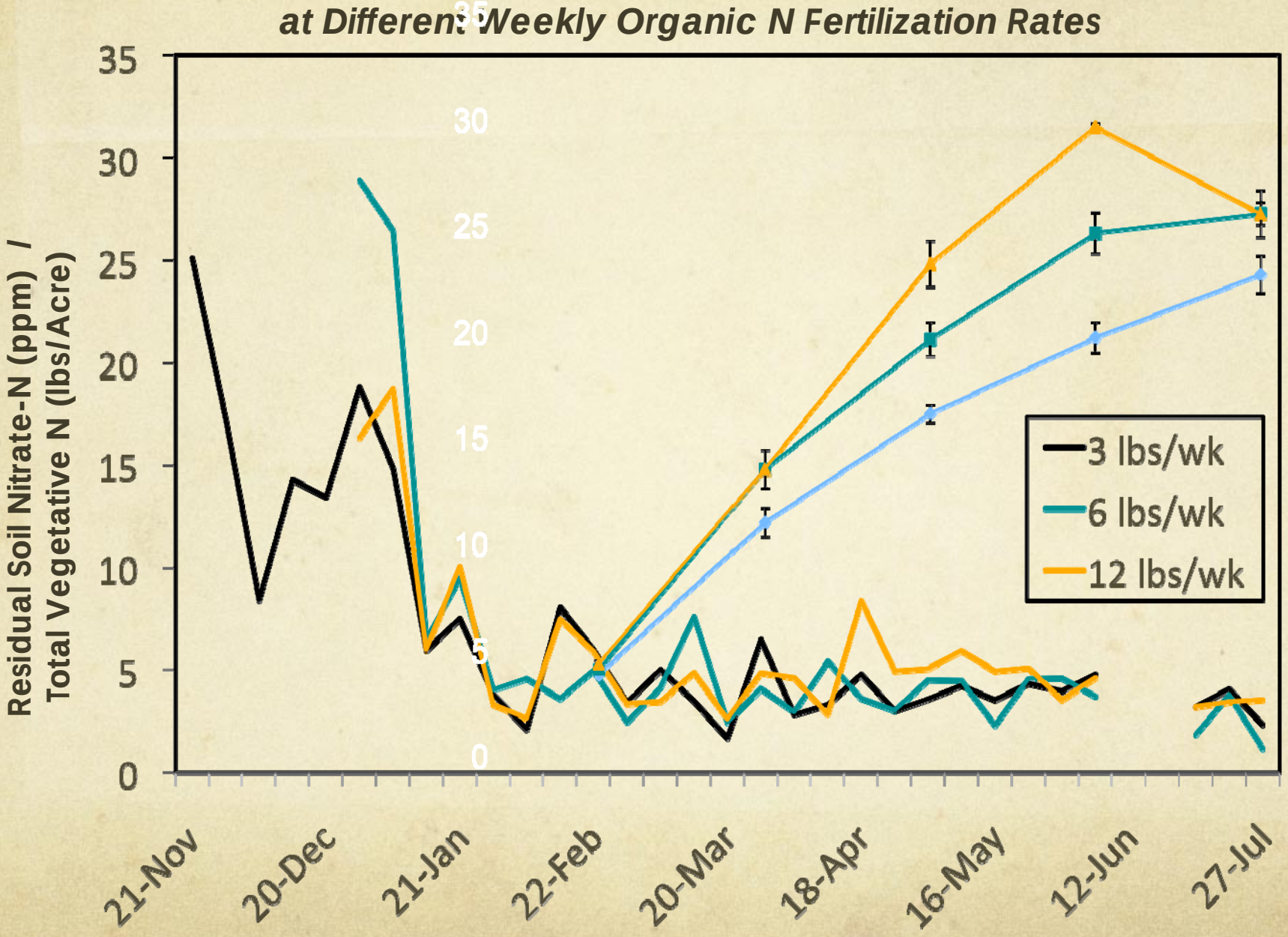
Seasonal Nitrogen Accumulation for Celery



Peck Organic Strawberry Trial 2007-2008
Residual Soil Nitrate Nitrogen
at Different Weekly N Fertilization Rates



Peck Organic Strawberry Trial 2007-2008
Total Vegetative N & Residual Soil Nitrate Nitrogen at Different Weekly Organic N Fertilization Rates



Crop	Yield	Max. dry matter accumulation (ton / A)	Maximum N accumulation lb N / acre	Phase II Growth Period	Max. N Uptake lb N / A / day
Broccoli	6 ton fresh	3	190	40 - 90 days	4 - 7
Cauliflower	10 ton fresh	4	200	50 - 90 days	2 - 4
Onions	630 cwt	10	120	40 - 85 days	1 - 2
Corn (grain)	190 bu	12	275	45 – 65 days	4 - 7
Celery	30 ton fresh	5	240	50 – 90 days	5
Strawberry	5500 trays	3	150	170 days	< 1

adapted from Sullivan et. al.,1999; Hartz; Maynard & Hochmuth, others

Match N availability to crop need - celery

- ***Transplanted celery accumulates about 20 lb N/acre - first 35-40 days***
- ***40-90 days 60-70% of total N taken up (~200 lb N/acre)***
- ***N uptake slows at 90-100 days***
- ***Maximum accumulation of approximately 240 lb N/acre is reached by physiological maturity for high-yielding celery.***

Match N availability to crop need- strawberry

- *Transplanted strawberry N uptake about 4 lb N/acre*
  - first 90 days.
- *During the next 20 weeks of growth, N uptake approaches 70 to 90 percent of total ~ 130-150 lb N/acre*
- *N uptake is steady and continuous for the entire period.*
- *Current strawberry fertigation reccs for FL*
  = 0.3 lb – 0.75 lb/acre/day

Crop	Yield	Max. dry matter accumulation (ton / A)	Maximum N accumulation lb N / acre	Phase II Growth Period	Max. N Uptake lb N / A / day
Broccoli	8 ton fresh	3.5	190	40 - 90 days	5 - 7
Cauliflower	10 ton fresh	4	200	50 - 90 days	2 - 4
Onions	630 cwt	10	120	40 - 85 days	1 - 2
Corn (grain)	190 bu	12	275	45 – 65 days	4 - 7
Celery	30 ton fresh	5	240	50 – 90 days	5
Strawberry	5500 trays	3	150	170 days	< 1

- **not 100% efficient**

- **leaching losses and EC mgmt**

Soils most likely to require in-season N?

- ***Low organic matter***
  - mineralization of high OM can provide adequate N
- ***Sandy, well drained, - leaching potential,***
  nitrate-N moves readily - spoon feeding
- ***EC problems?***
  - irrigation management can be a factor
- ***Water use, sprinklers etc. can increase N needs***
  compared to drip

Sources of in– season N?

- ***Soil organic matter turnover***

  generally, 1% O.M. ~ 30-50 lb N per acre in 100 days or 0.3-0.5 lb per acre per day (per foot of depth)

  - related also to temperature

- ***May be some N movement upward by capillarity***
- ***Preplant nutrient incorporation***
- ***Nitrate-N in irrigation water***
- ***In-season fertilization***

Types of organic fertilizer materials?

- ***Uniformity always important***
  - ***material? – new materials continually better***
    pelletizing, micronizing, enzyme hydrolysis
  - ***cultural practices for application?***

- ***Band applied, cultivated in and contact with moist soil***
  - ***dry or liquid***

- ***Injected in irrigation system - drip and micro-sprinklers***
  - ***importance of solubility and particle size***
  - ***management / maintenance of system? Mixing?***

Compliance via NOP or OMRI third party certification

N availability from organic fertilizers related to composition and characteristics that affect mineralization

- *Proportion of material as ammonium or amino acid fragments - rapidly transformed to ammonium*
  - *rapid mineralization, N availability*
  - *almost as ammonium sulfate*
  - *temperature?*

- *Chilean nitrate is special case*

- *Particulates collect in system even when finely ground and pre- sieved*
  - *growers bypass filtration*
  - *efficiency clearly affected*
  - *losses of material?*
  - *losses in irrigation distribution uniformity*

- *Hidden losses likely throughout the system*
  - *current trials attempting to quantify*
  - *additive effects?*

	Total N availability			
Organic fertilizer	% of initial N	lb / ton	$ / ton	$ / lb available N
Pelleted poultry manure	46	26	70	2.70
Sea bird guano	79	175	400	2.30
Pelleted sea bird guano	74	173	700	4.00
Fish powder	65	178	4,000	22.50
Feather meal	63	179	600	3.60
Blood meal	70	221	1,000	4.50

Real costs of N can be high

(Hartz and Johnstone)

Name	description	label N %	actual % total N	% Mineral N by lab analysis of original material	% N in solution or particulate matter small enough to pass through a media filter	%N possibly lost in filtration in drip system
Agrolizer	fish	6	5.1	70.0	4.5	0.6
Biolyzer	grain ferment	2.5	2.6	12.4	2.0	0.6
Phytamin 801	guano, fish	6	6.0	5.5	5.5	0.5
Phytamin 522	fish	5	5.4	26.0	4.8	0.6
Phytamin 434	guano, fish	4	3.5	62.5	3.1	0.4
Marizyme	fish	4	4.2	94.3	4.0	0.3
Mega Green	catfish	2	1.8	3.5	1.5	0.3
Phytamin 421	soy meal / plant extracts	4	4.0	24.3	3.2	0.7

Source- Tim Hartz, UC-Davis

Santa Maria Sand	Total N availability at:					
	15 ° C.			25 ° C		
Name	week 1	week 2	week 4	week 1	week 2	week 4
Agrolizer	71	85	87	85	85	87
Biolyzer	42	46	49	50	55	66
Phytamin 801	83	89	93	93	95	99
Phytamin 522	81	87	87	89	90	91
Phytamin 434	77	80	83	84	89	85
Marizyme	78	91	91	93	93	91
Mega Green	62	73	79	75	76	84
Phytamin 421	70	71	79	75	80	92
MEAN	70.5	77.7	80.9	80.5	83.0	86.9

Averaged across soils Name	$ / gal (9.5 lb)	$/lb N	15 ° C.		25 ° C	
			$/lb available N 1 week	$/lb available N 4 weeks	$/lb available N 1 week	$/lb available N 4 weeks
Agrolizer	3.25	5.70	8.15	6.88	6.87	6.87
Biolyzer	2.00	8.42	22.41	17.33	20.12	14.79
Phytamin 801	3.39	5.95	7.35	6.78	6.70	6.53
Phytamin 522	3.60	7.58	9.66	8.93	8.82	8.80
Phytamin 434	3.45	9.08	12.03	11.34	11.30	11.24
Marizyme	3.10	8.16	10.27	9.33	8.82	9.53
Mega Green	6.00	31.58	54.71	43.30	44.98	41.35
Phytamin 421	2.94	7.74	11.77	10.15	11.11	9.61

Averaged across soils Name	$ / gal (9.5 lb)	$	1 week	4 weeks	25 ° C $/lb available N 1 week	25 ° C $/lb available N 4 weeks
Agrolizer	3.25	5.70	8.15	6.88	6.87	6.87
Biolyzer	2.00	8.42	22.41	17.33	20.12	14.79
Phytamin 801	3.39	5.95	7.35	6.78	6.70	6.53
Phytamin 522	3.60	7.58	9.66	8.93	8.82	8.80
Phytamin 434	3.45	9.08	12.03	11.34	11.30	11.24
Marizyme	3.10	8.16	10.27	9.33	8.82	9.53
Mega Green	6.00	31.58	54.71	43.30	44.98	41.35
Phytamin 421	2.94	7.74	11.77	10.15	11.11	9.61

Does not include losses behind filter, drip tape or irrigation DU

Conclusions – incubation study:

1) *high mineral N content with some products – act similar to ammonium fertilizer*

2) *plant-based fertilizer materials mineralize more slowly than animal waste-based*

3) *animal waste fertilizers have similar behavior*

4) *soil temp has surprisingly little effect on mineralization rate, may have larger effect on nitrification - NH_4-N >> NO_3-N.*

5) *soils have some effect; the Santa Maria soil was about 10% faster across all fertilizers – texture?*

Greater variability likely in field situations

Summary – In season organic fertilization

- ***Challenge to match N availability with crop demand***
- ***Diverse organic amendments as N nutrient sources but bulk, uniformity, stability, problems slow development of reliable crop response data.***
- ***Green manure or pre-plant compost are the most economical sources of pre-plant N but many crops need supplemental in-season N.***
- ***Dry organic N sources - feather meal, guano, among others are more efficient than compost for later season N side dressing.***
- ***Liquid organic fertilizers are also variable but quality and reliability are improving. Smaller particle sizes and protein hydrolysis necessary for microirrigation aids N availability.***

Key questions

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- ***Which soils … ?***
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- ***Management of liquid organic N sources***

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