Nutrient (N) Management in Organic Production Systems

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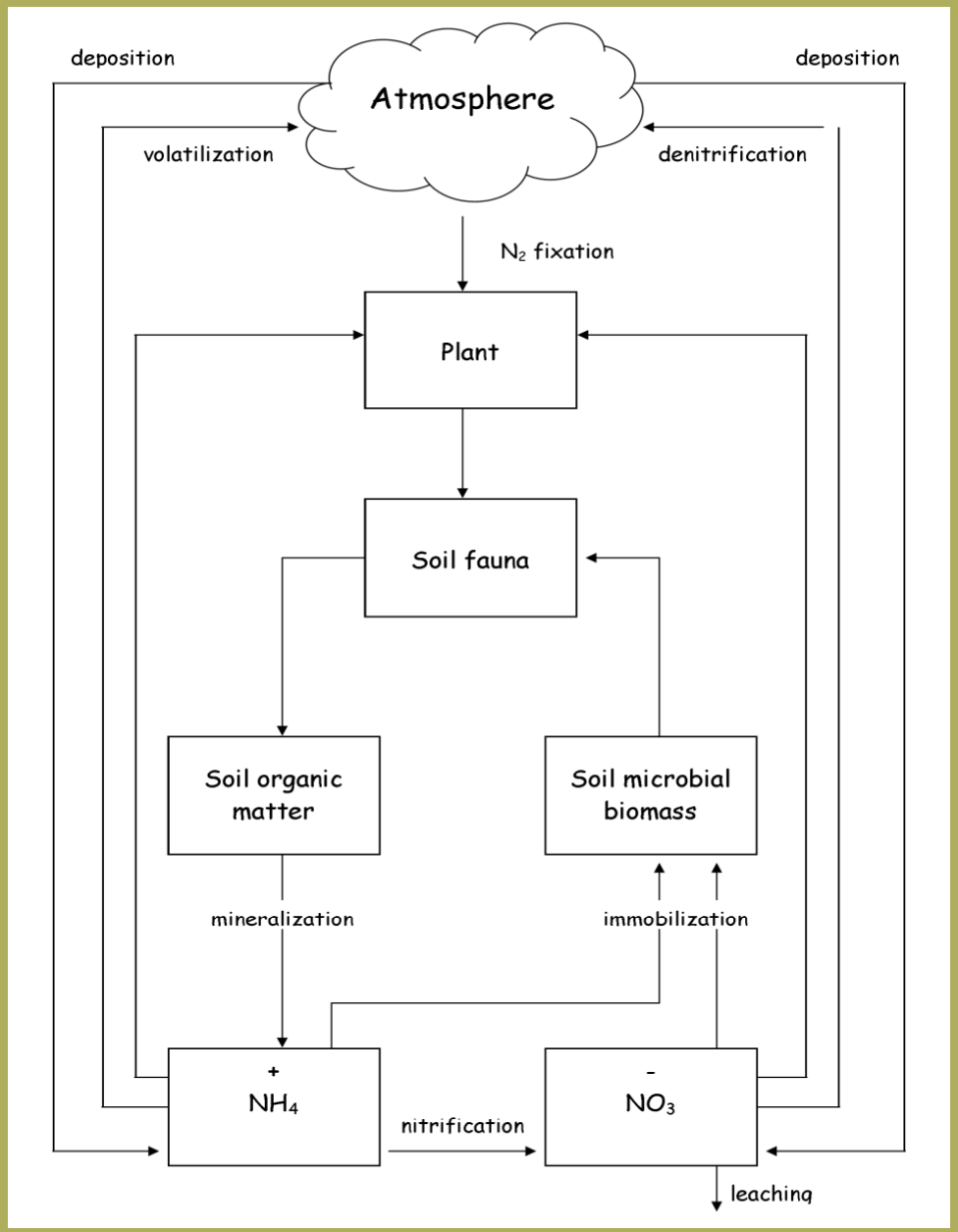
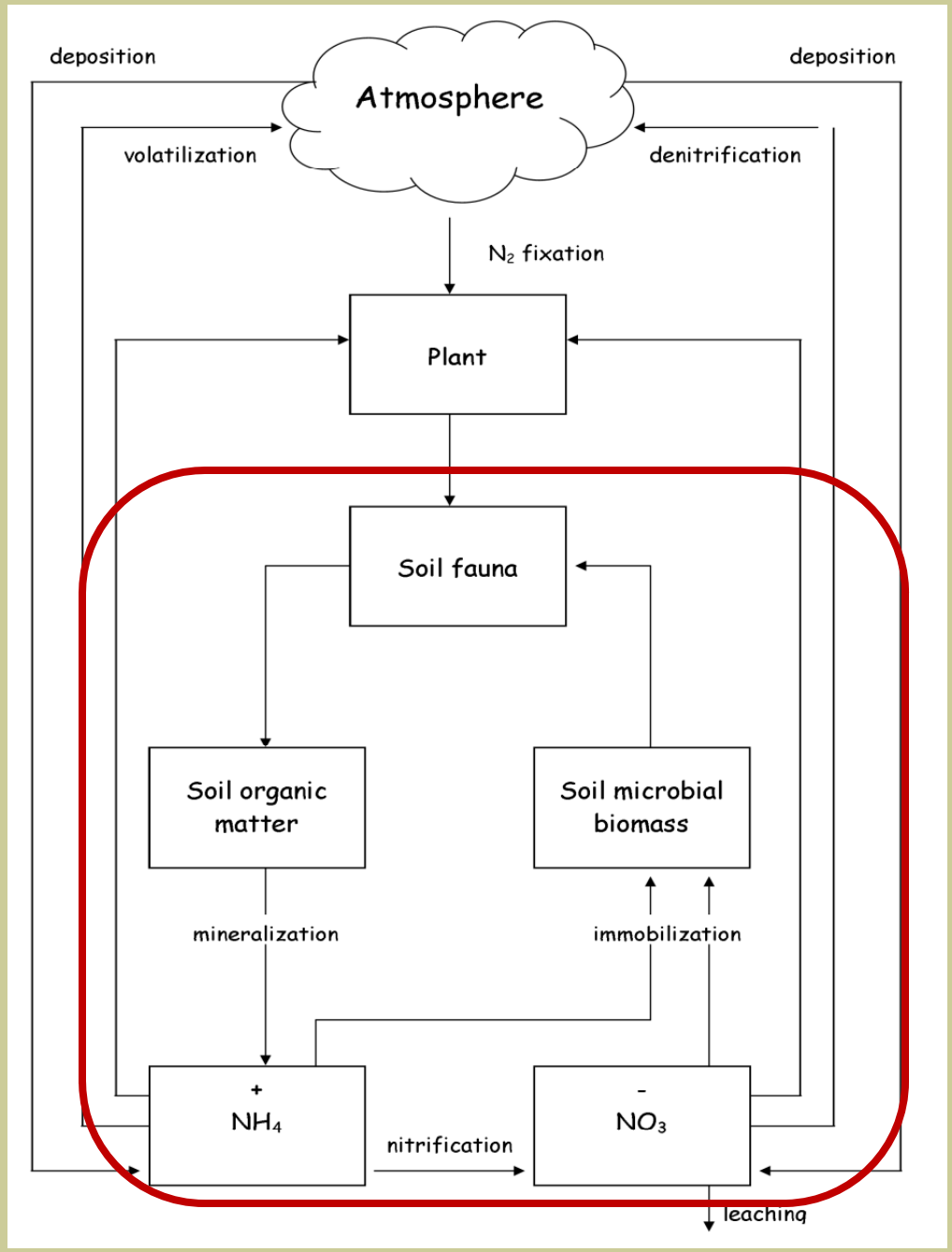
Background and overview

- *Fertilization – especially N - is the most expensive cultural practice of organic vegetable growers in California.*
- *Compost and green manure cover crops have long been the basic program.*
- *Mineralization of N from compost and cover crops is variable – material? season? cultural practices?*
- *New dry and liquid organic materials replacing compost and green manure*


deposition
Atmosphere
deposition
volatilization
denitrification
N_2 fixation
Plant
Soil fauna
Soil organic matter
Soil microbial biomass
mineralization
immobilization
+
NH_4
nitrification
-
NO_3
leaching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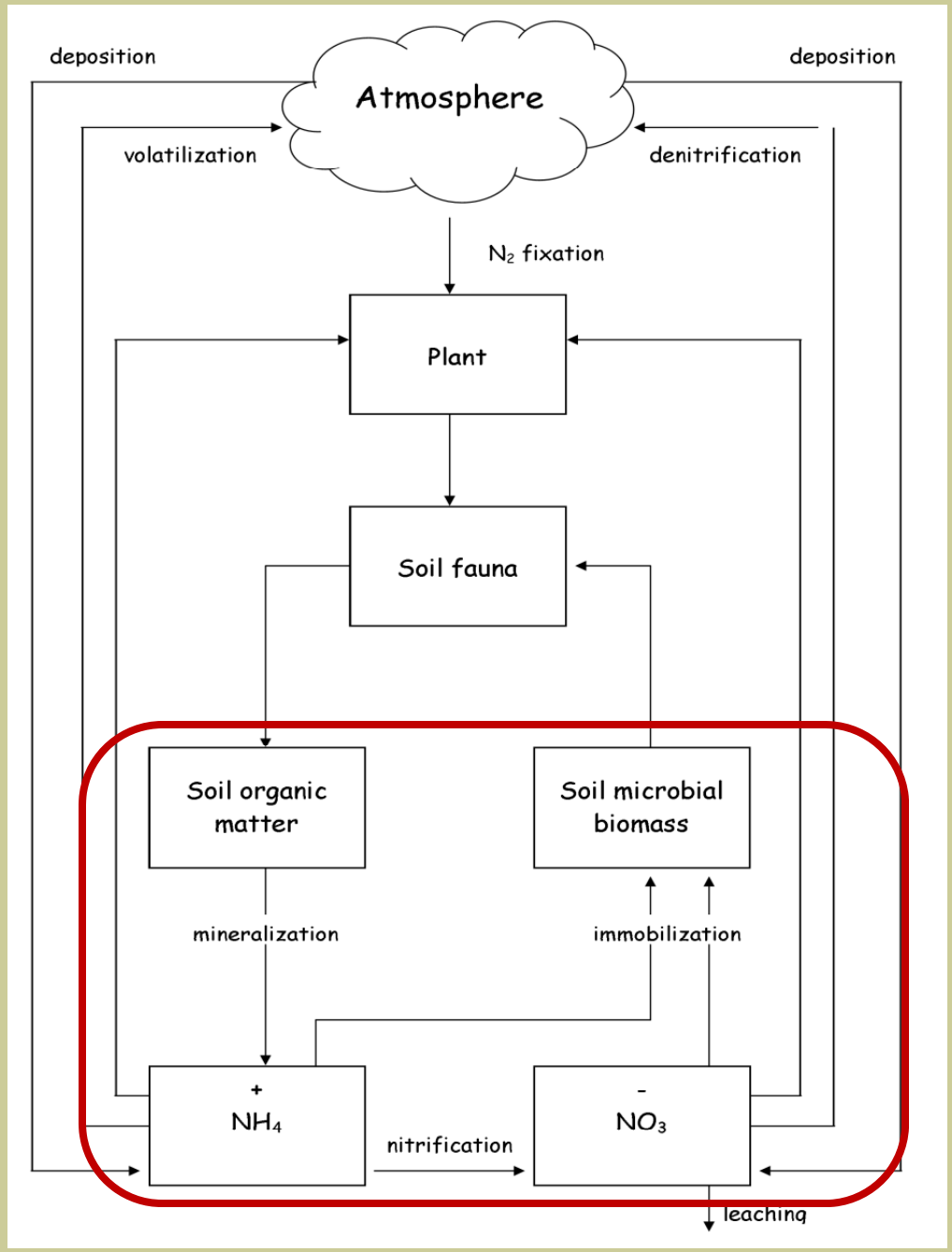
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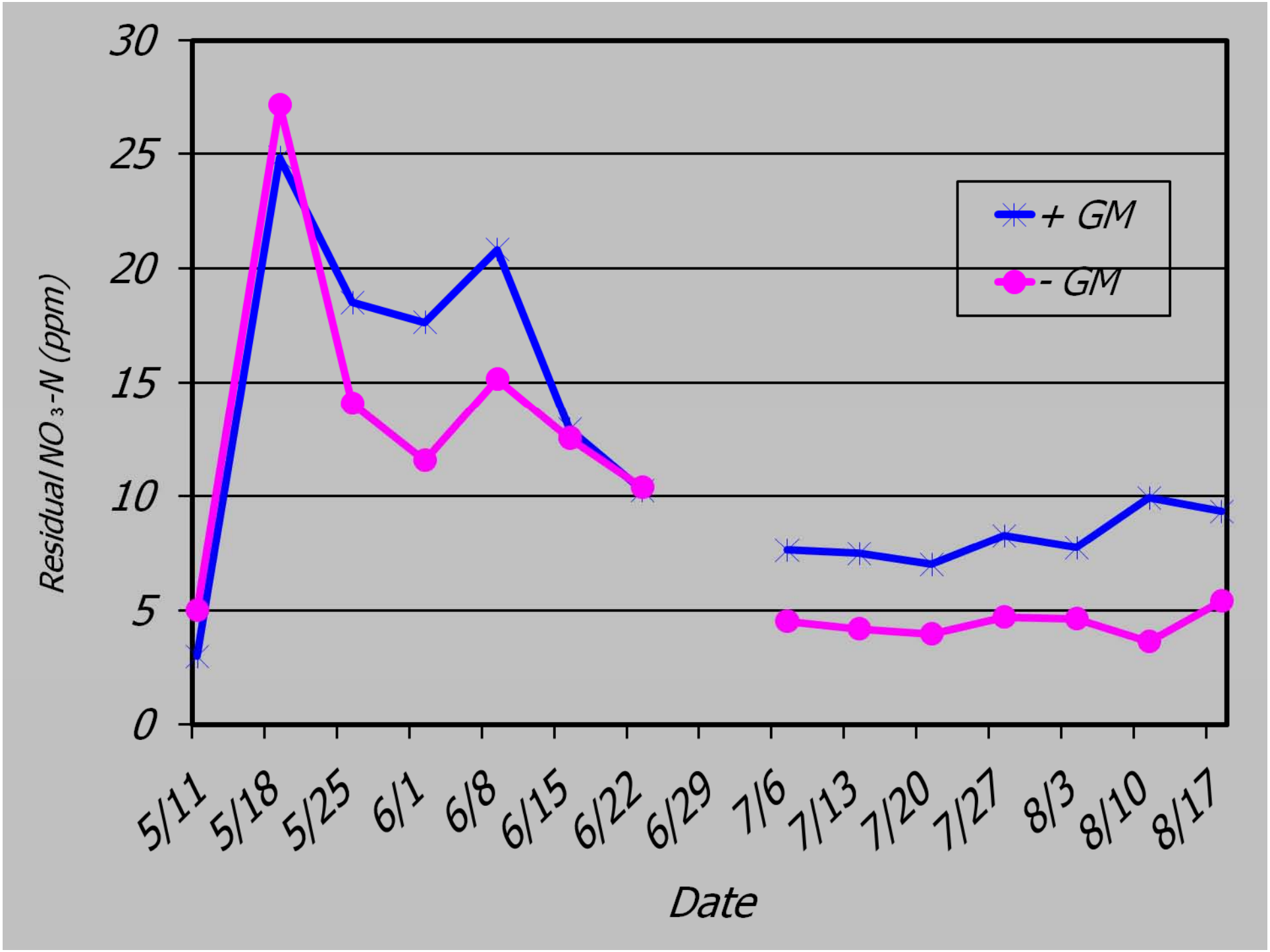
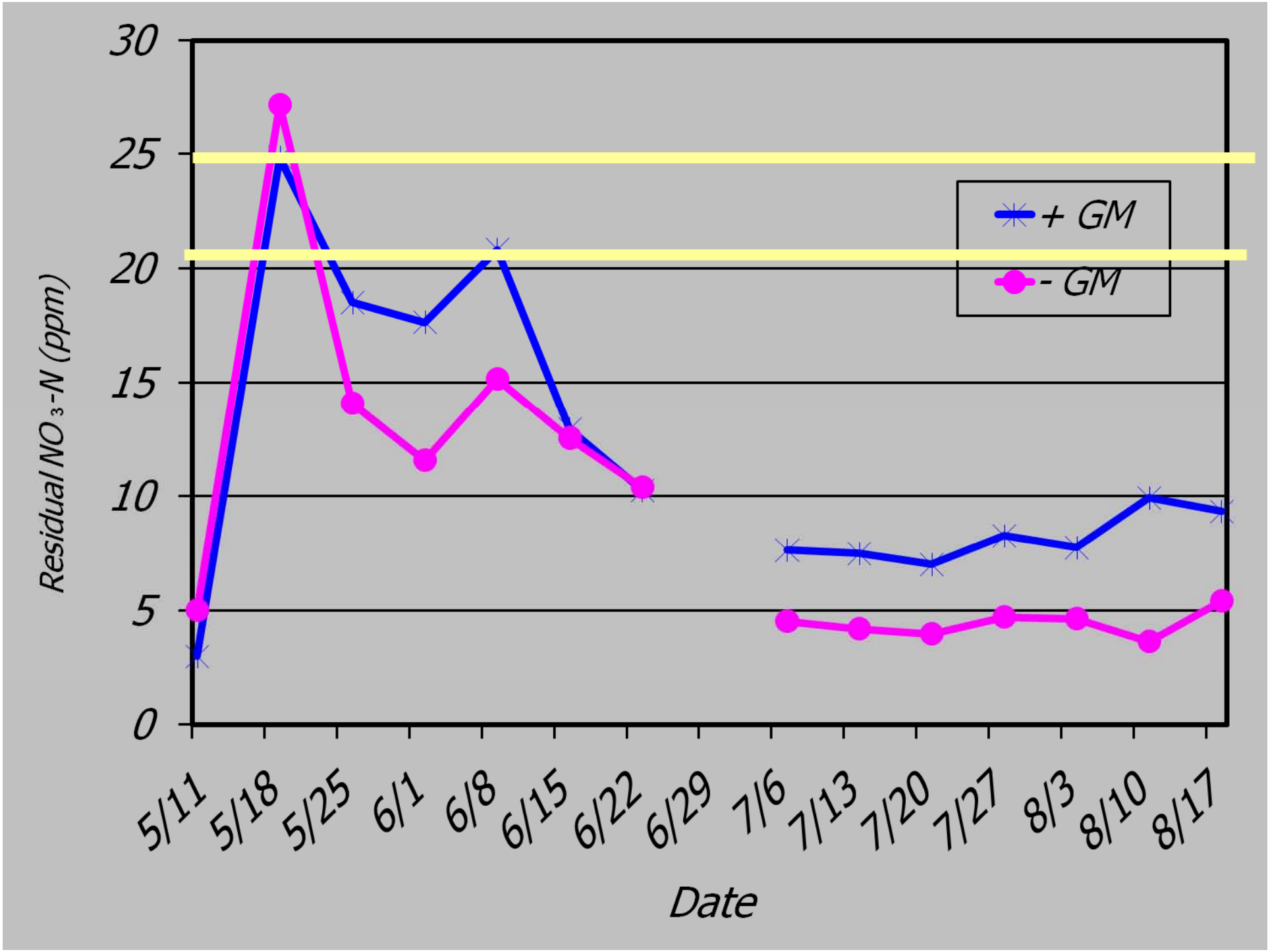
Compost and cover crops

- *More economical forms of N despite limitations*
- *Often sighted as slow release N sources*
  - later N release not useful for the succeeding crop
- *Synchrony of N release is critical limitation*
- *Legumes release N more quickly than grasses*


30
25
20
15
10
5
0
Residual NO3-N (ppm)
+ GM
- GM
5/11
5/18
5/25
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
8/17
Date


30
25
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0
Residual NO3-N (ppm)
+ GM
- GM
5/11
5/18
5/25
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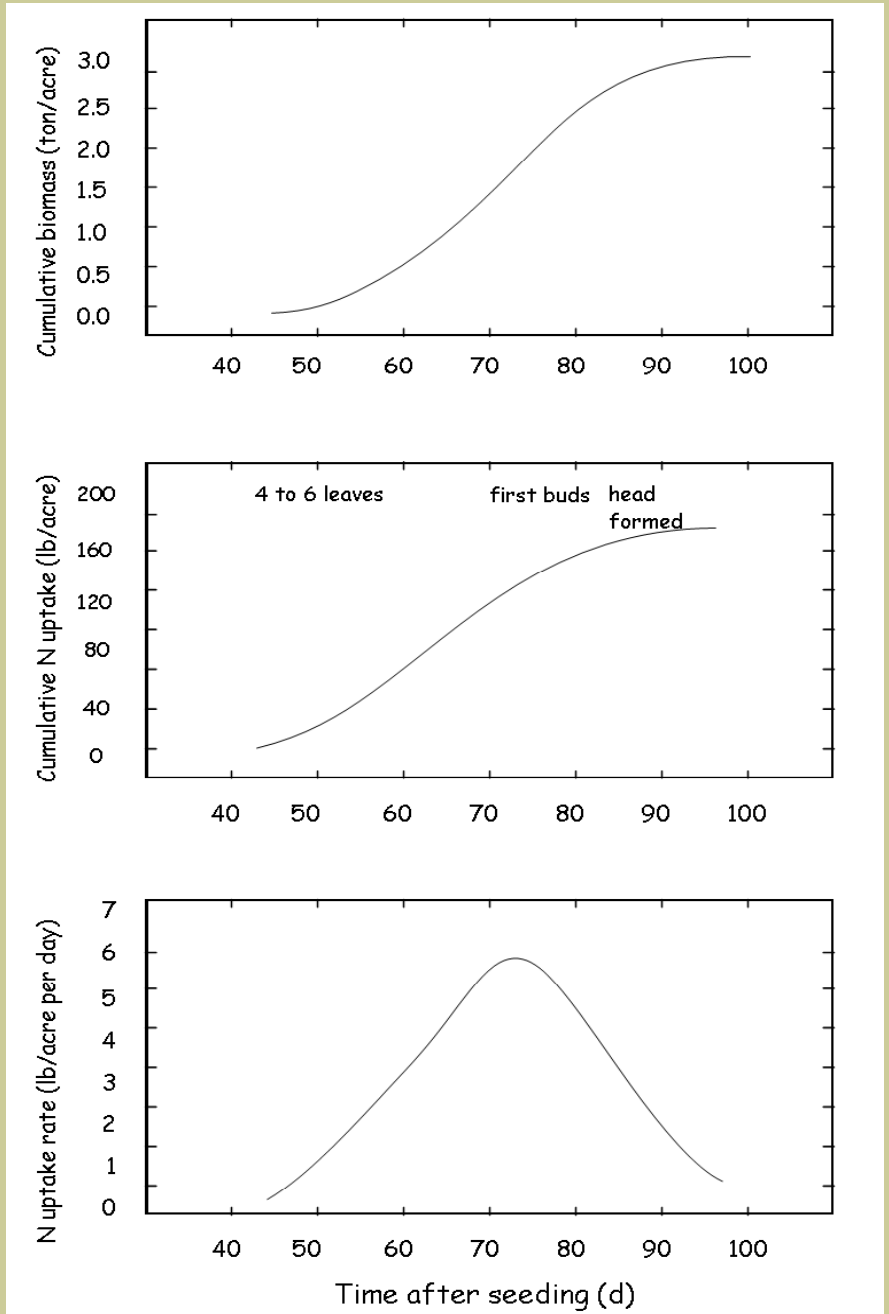
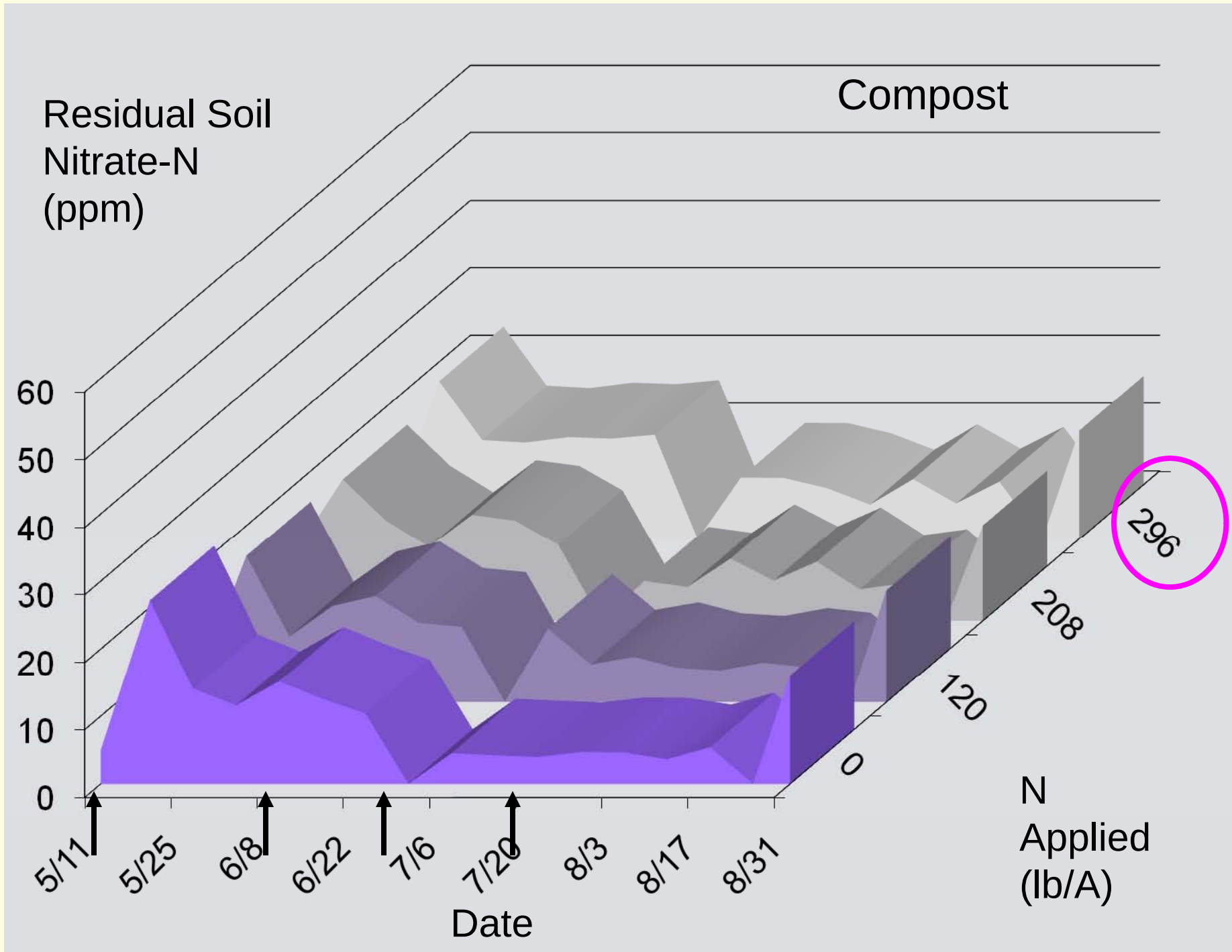
7/6
7/13
7/20
7/27
8/3
8/10
8/17
Date

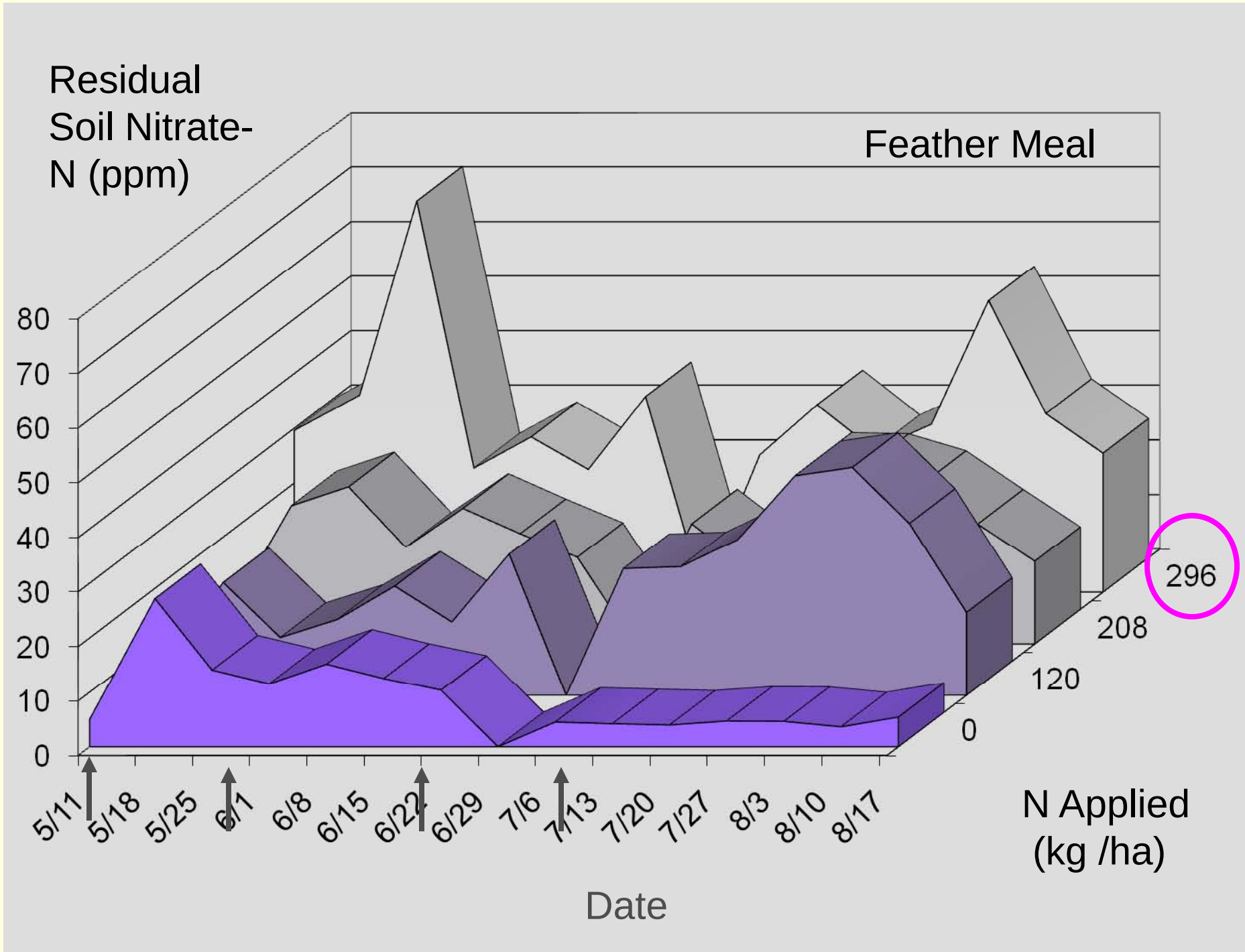


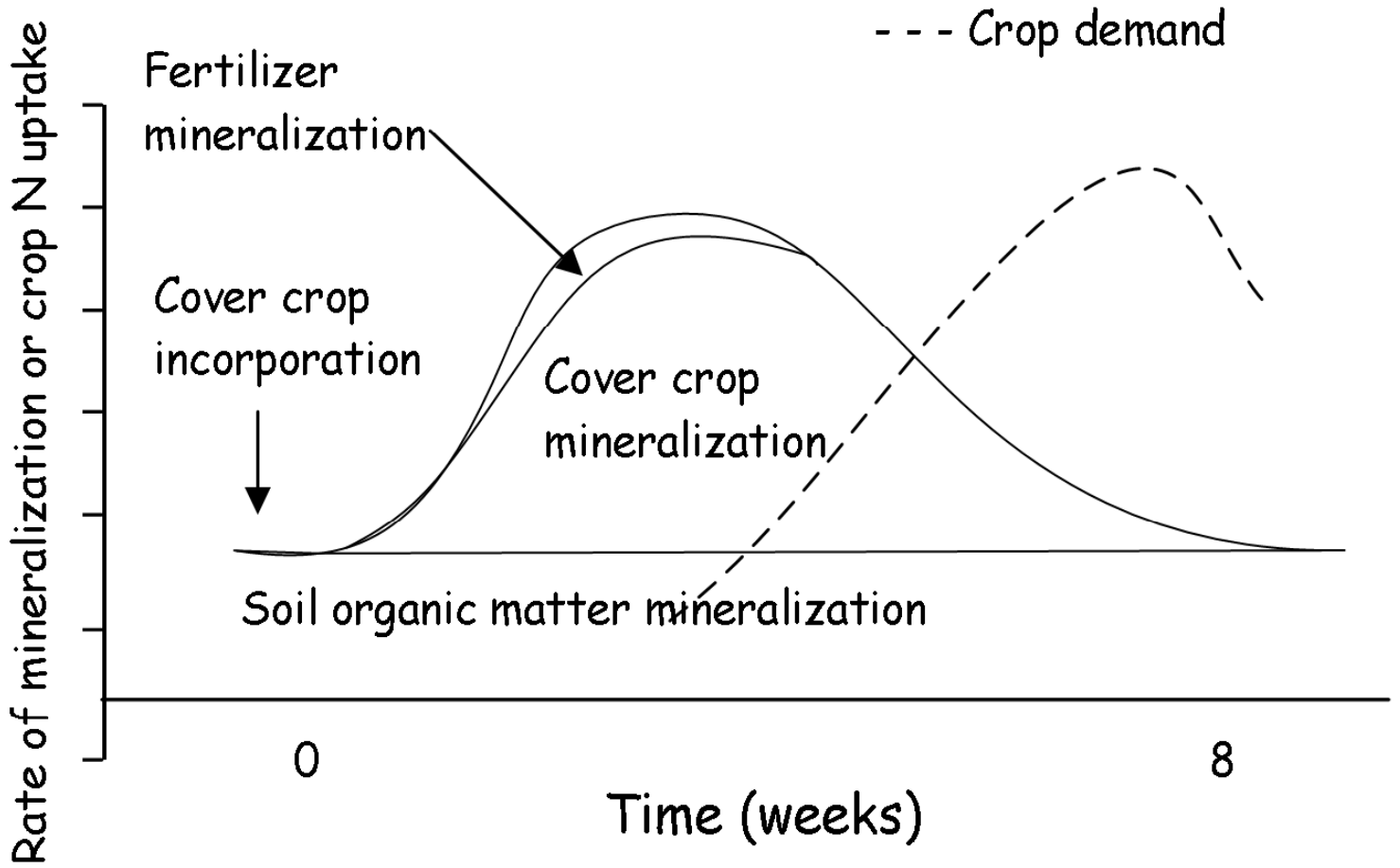
(Sullivan et al., 1999);.

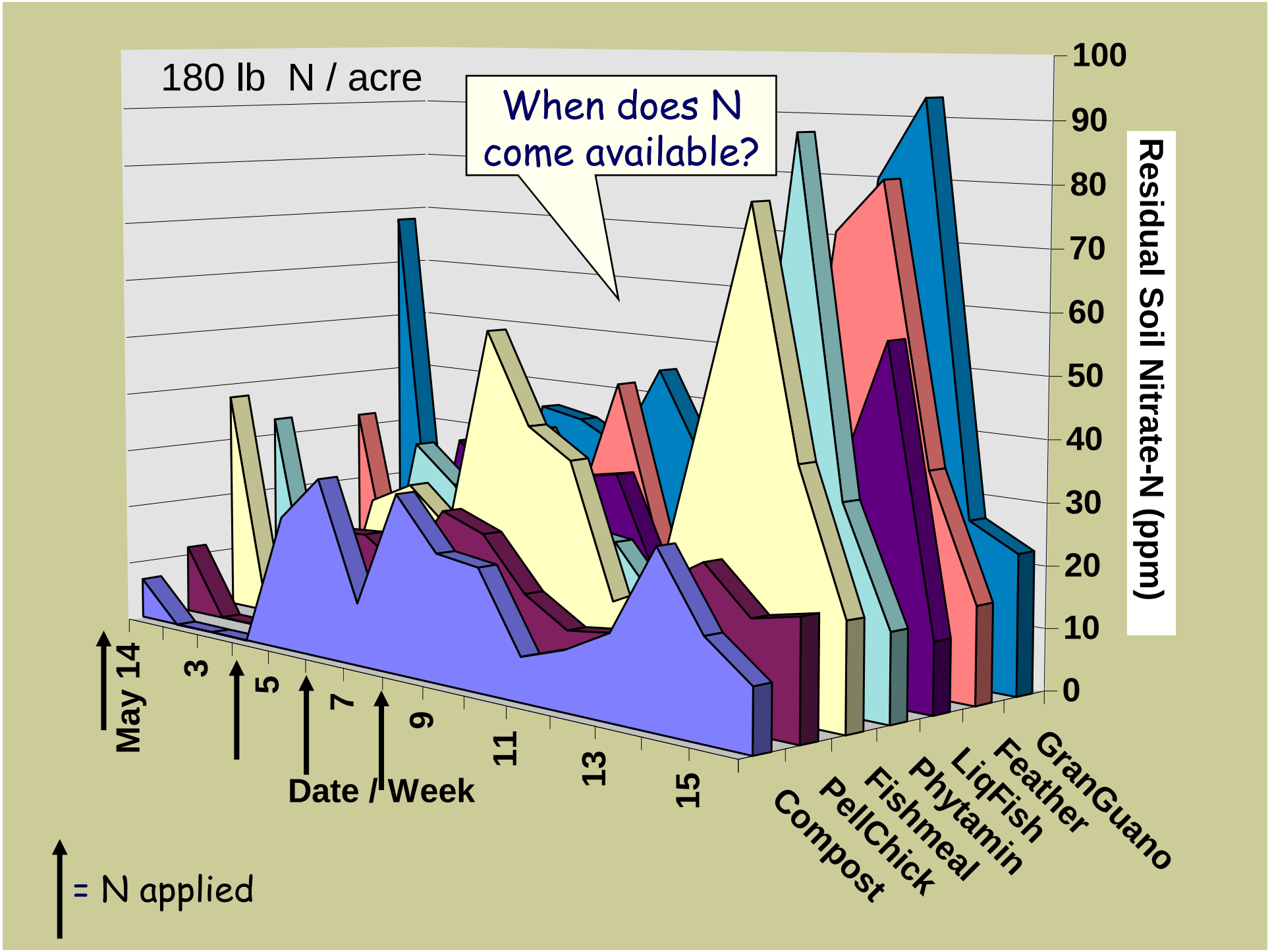
Pattern of release from pre-plant N may not match crop N need

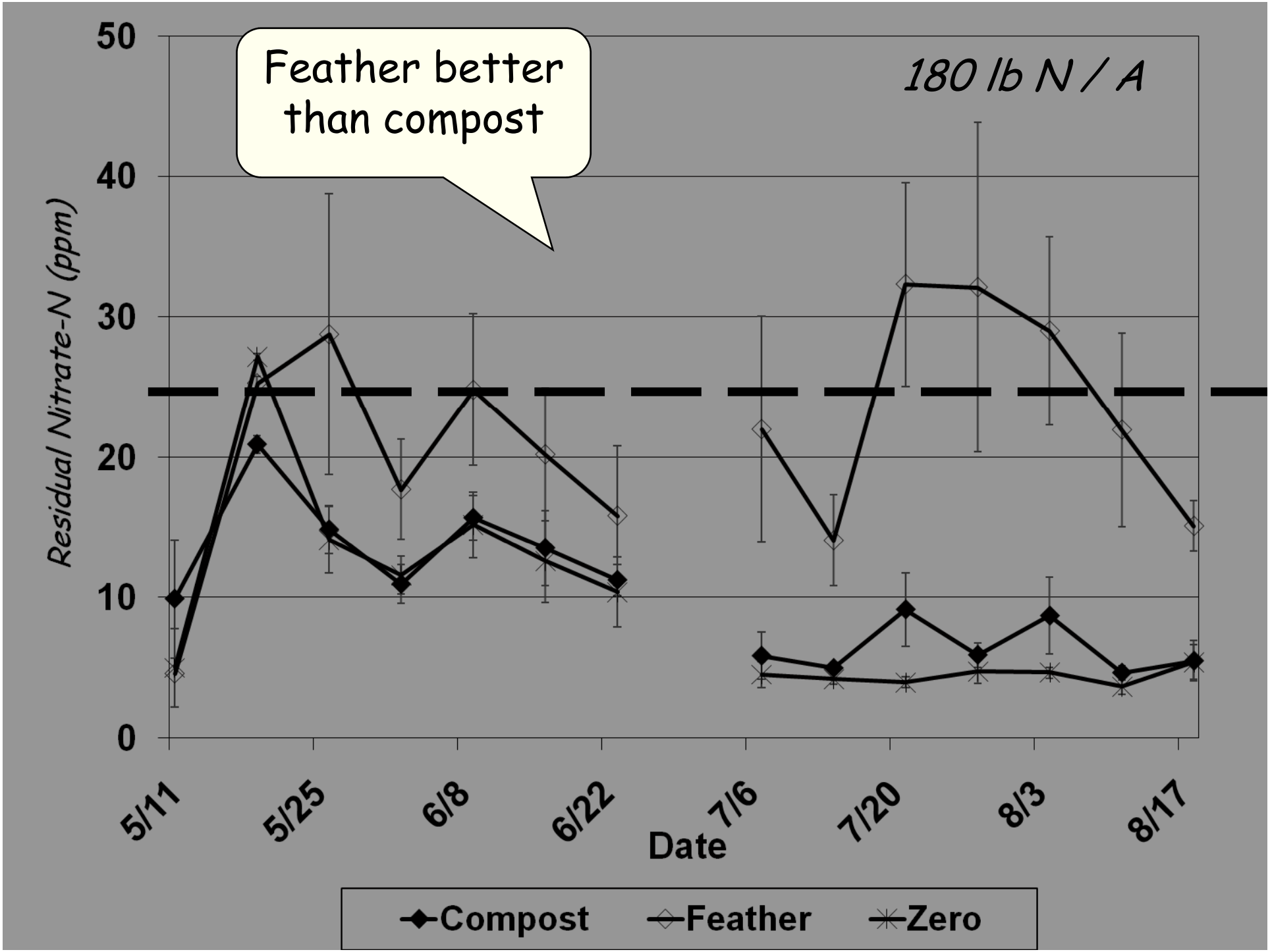
- *Release of N for 6-8 weeks - temperature?*
  - then returns to soil background levels
- *Chilean sodium nitrate used in some programs*
  - soluble - severe restrictions
- *Other potential organic fertilizer N sources evaluated*
  - vary in N cost and N mineralization rate.
- *Materials evaluated include: seabird guano, liquid fish, pelleted chicken manure, feather meal, corn meal, blood meal, liquid soybean - meal among others.*

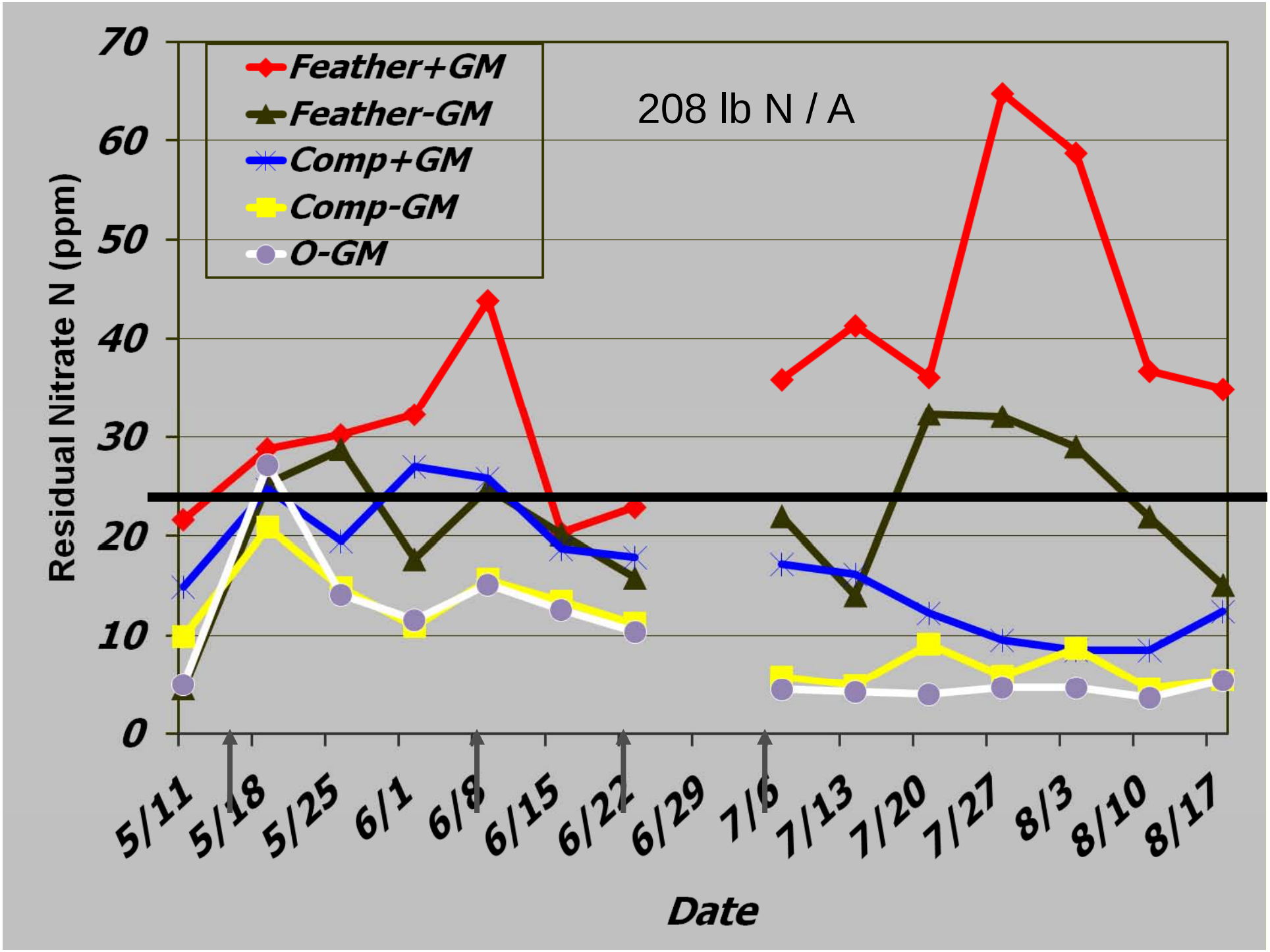

Compost
Residual Soil
Nitrate-N
(ppm)
60
50
40
30
20
10
0
5/11
5/25
6/8
6/22
7/6
7/20
8/3
8/17
8/31
Date
0
120
208
296
N
Applied
(lb/A)


Residual
Soil Nitrate-
N (ppm)
Feather Meal
80
70
60
50
40
30
20
10
0
5/11
5/18
5/25
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
8/17
Date
0
120
208
296
N Applied
(kg /ha)


- - - Crop demand
Fertilizer mineralization
Cover crop incorporation
Cover crop mineralization
Soil organic matter mineralization
Rate of mineralization or crop N uptake
0
8
Time (weeks)


180 lb N / acre
When does N come available?
Residual Soil Nitrate-N (ppm)
100
90
80
70
60
50
40
30
20
10
0
May 14
3
5
7
9
11
13
15
Date / Week
Compost
PellChick
Fishmeal
Phytamin
LiqFish
Feather
GranGuano
= N applied


Feather better than compost
180 lb N / A
Residual Nitrate-N (ppm)
50
40
30
20
10
0
5/11
5/25
6/8
6/22
7/6
7/20
8/3
8/17
Date
Compost
Feather
Zero


Feather+GM
Feather-GM
Comp+GM
Comp-GM
O-GM
208 lb N / A
Residual Nitrate N (ppm)
70
60
50
40
30
20
10
0
5/11
5/18
5/25
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
8/17
Date

		Percent of initial organic N mineralized		
Product	Temp (°F)	1 week	4 weeks	8 weeks
Pelleted poultry manure	59	4	16	21
	77	10	23	36
Sea bird guano	59	49	57	60
	77	45	48	54
Pelleted sea bird guano	59	42	61	64
	77	46	60	67
Fish powder	59	51	55	61
	77	48	60	64
Feather meal	59	42	56	59
	77	50	64	63
Blood meal	59	41	60	64
	77	51	67	70

	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**

Cost / lb Total Avail. N

(Hartz and Johnston, 2006)

Organic Liquid N Sources

- *Variation in types, costs, suitability for micro-irrigation.*
- *Sieve size critical for drip and micro-irrigation*
  - affects value as N source.
    - does N stay behind the filter with organic matter?
- *Some growers choose to use cheap tape and replace with each vegetable crop but this avoids problem of N availability.*
- *Additional work needed*

Other organic fertilizer problem areas

- *lack uniformity*
- *bulky,*
- *unstable,*
- *inconsistency --> hidden management costs*
- *higher cost and variability for research*

- *<u>Liquid</u> organic N sources for use in micro irrigation systems – can be some of most cost effective but additional disadvantages associated with N that is removed by filters.*

Summary

- *Green manure or pre-plant compost are most economical organic N sources but many crops need supplemental N.*
- *Diverse organic amendments available as N nutrient sources but bulk, uniformity, stability problems slow development of reliable response data.*
- *Other N amendments - feather meal, guano, liquid fish, among others – vary widely in N availability but more efficient than compost for later season N.*
- *Liquid organic fertilizers also variable. Smaller particle size necessary for micro-irrigation should aid N availability.*

http://vric.ucdavis.edu/selectnewtopic.organic.htm

Mark Gaskell and Richard Smith. 2007. ***Nitrogen Sources for Organic Vegetable Crops.*** *HortTechnology 17: 431-441*

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