
1865 THE UNIVERSITY OF MAINE
Managing Nitrogen in Organic Systems
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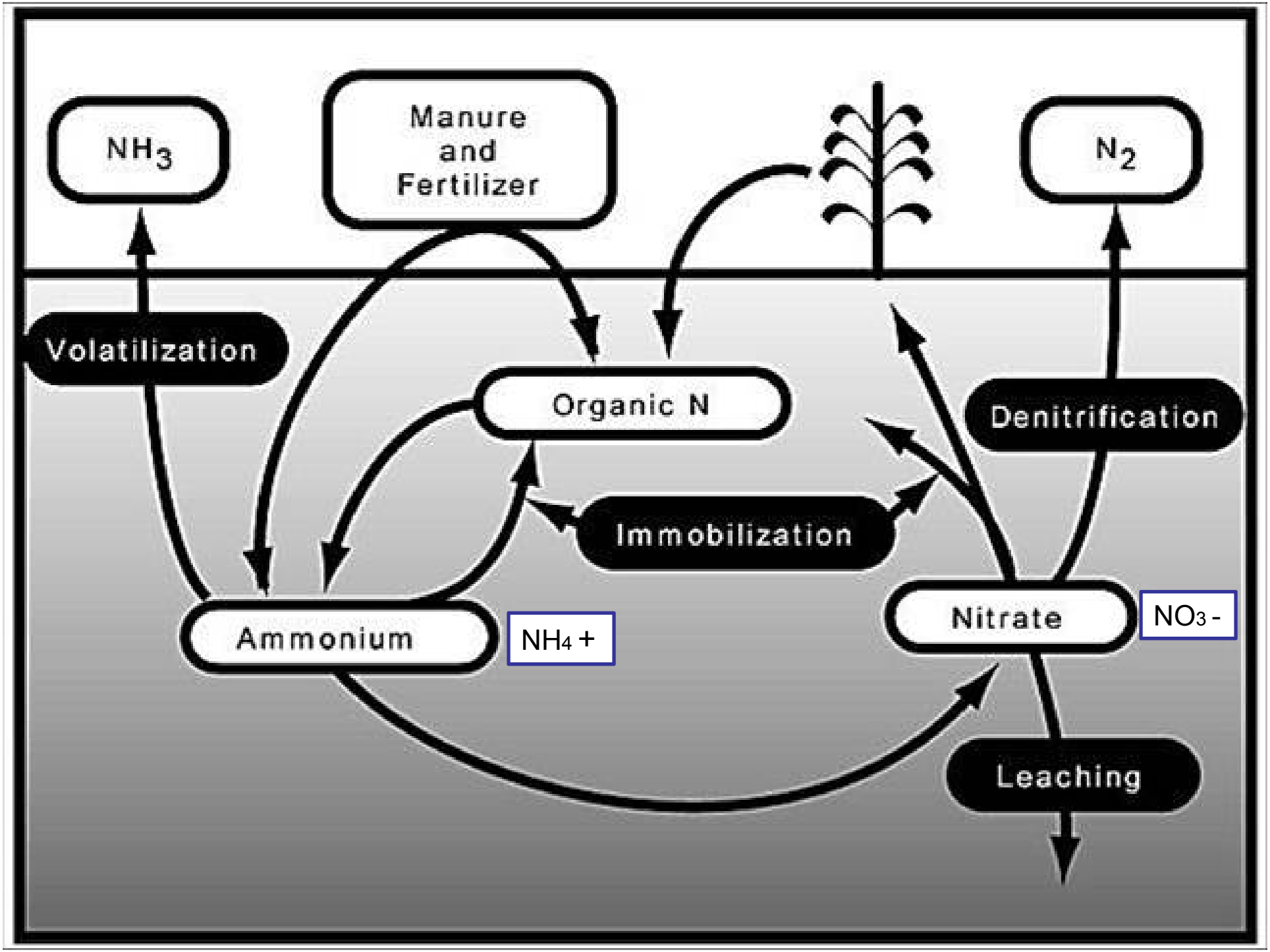
Maine Soil Testing Service
(umaine.edu/soiltestinglab)


NH_3
Manure and Fertilizer
N_2
Volatilization
Organic N
Denitrification
Immobilization
Ammonium
NH_4 +
Nitrate
NO_3 -
Leaching

Potato Nitrogen Uptake Profile

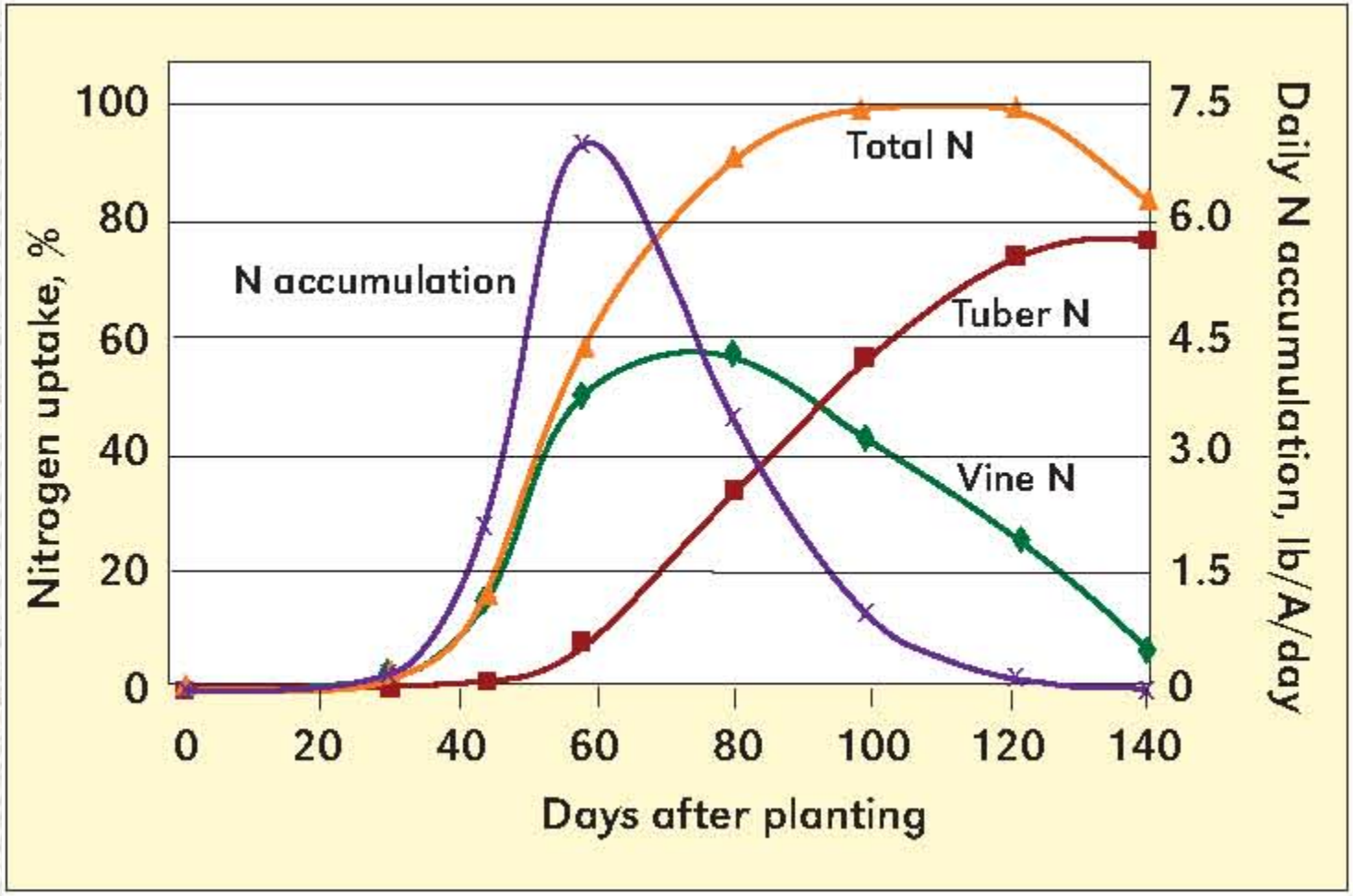


Figure 2. Seasonal N accumulation by Russet Burbank potato vines, tubers, and whole plants (left axis) and the average daily N accumulation rate (right axis) growing near Becker, Minnesota. Nitrogen uptake is expressed as a percent of the total seasonal accumulation.

Corn Nitrogen Uptake Profile

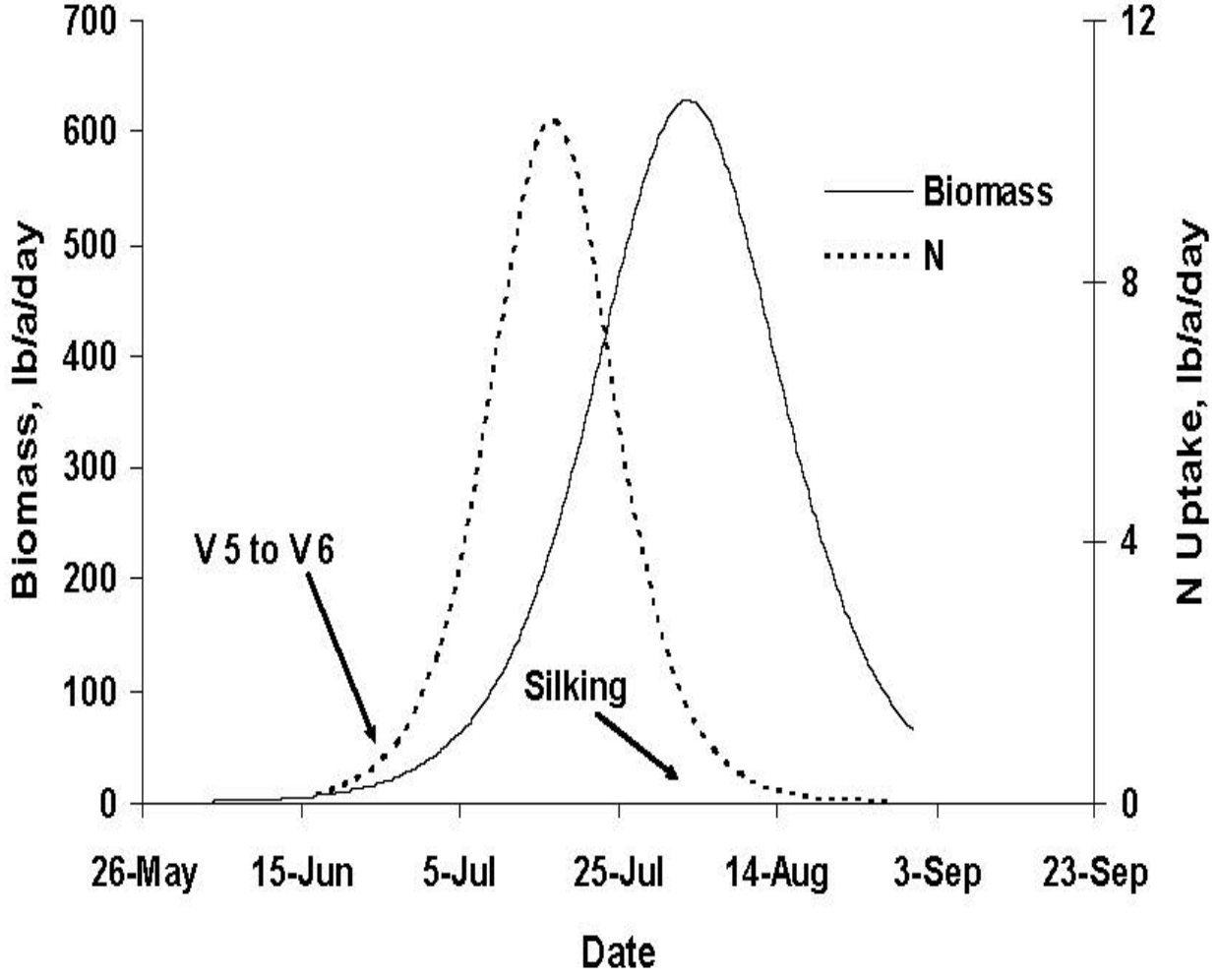


Figure 8.—Coho sweet corn daily above-ground biomass (dry matter) and nitrogen accumulation.

Non-Chemical Nitrogen Sources

- Plant or Animal Byproducts
- Animal Manures
- Cover Crops
- Compost
- Soil Organic Matter

Nitrogen Mineralization Studies
Organic N Fertilizers

- Agehara & Warnke, Michigan St. (2005)
  - 3 temperatures (15, 20, 25 C) x 3 moisture levels
- Hartz & Johnstone, Cal. Davis (2006)
  - 4 temperatures (10, 15, 20, 25 C)
- Gale, et. al (2006) –> OSU Calculator
  - 22 C
- Darby, UVM (2012)
  - 2 soil textures (sandy & clay), 22 C
- Cassidy-Duffey, et al, UGA (2020)
  - 22 fertilizers, 15 poultry litters, 11 composts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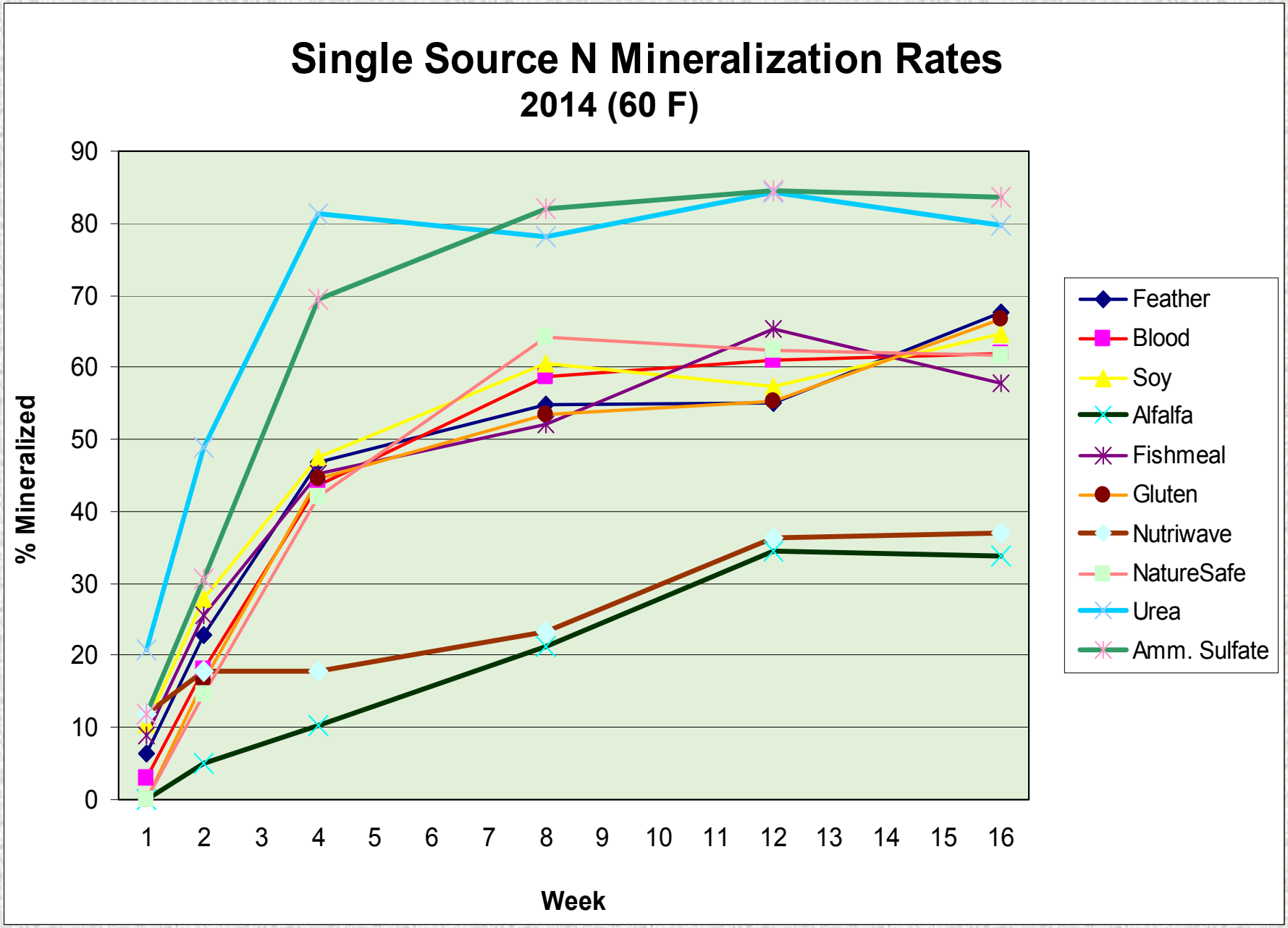
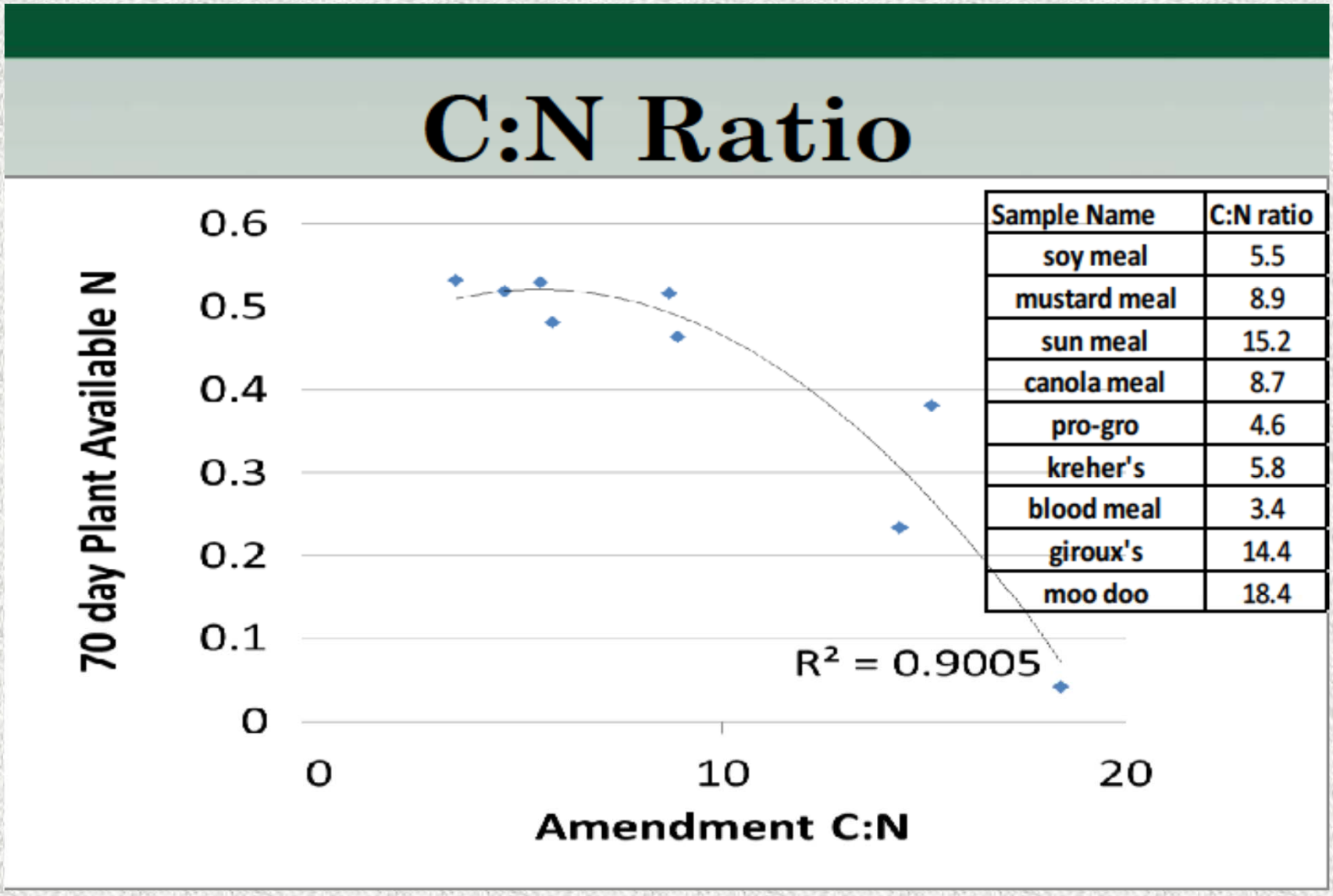

Single Source N Mineralization Rates
2014 (60 F)
% Mineralized
Week
0
10
20
30
40
50
60
70
80
90
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Feather
Blood
Soy
Alfalfa
Fishmeal
Gluten
Nutriwave
NatureSafe
Urea
Amm. Sulfate

Mineralization Rate Summary - UMaine 2014

	measured		mg/kg N	% total N mineralized to NO3-N				
Fertilizer	% N	C:N	applied	1 week	2 weeks	4 weeks	8 weeks	12 weeks
Feather	12.4	4.0	83	6.3	22.9	46.9	54.9	55.1
Blood	14.0	3.4	108	2.9	18.1	43.6	58.7	60.9
Soy	7.3	6.5	104	10.6	27.8	47.5	60.5	57.2
Alfalfa	3.0	15.1	118	0.0	5.1	10.2	21.2	34.5
Fishmeal	10.6	4.2	103	8.9	25.5	45.2	47.3	65.3
Gluten	9.4	5.3	104	0.0	16.5	44.5	53.5	55.2
Broiler	3.4	12.6	84	11.8	17.8	17.8	23.4	36.3
NatureSafe	13.3	3.9	102	0.0	14.7	41.9	64.1	62.4
Urea	46.4	0.4	101	20.7	48.8	81.2	78.0	84.4
Am. Sulfate	21.2	0.0	101	11.9	30.7	69.4	81.9	84.5

Mineralization Rate vs C:N Ratio

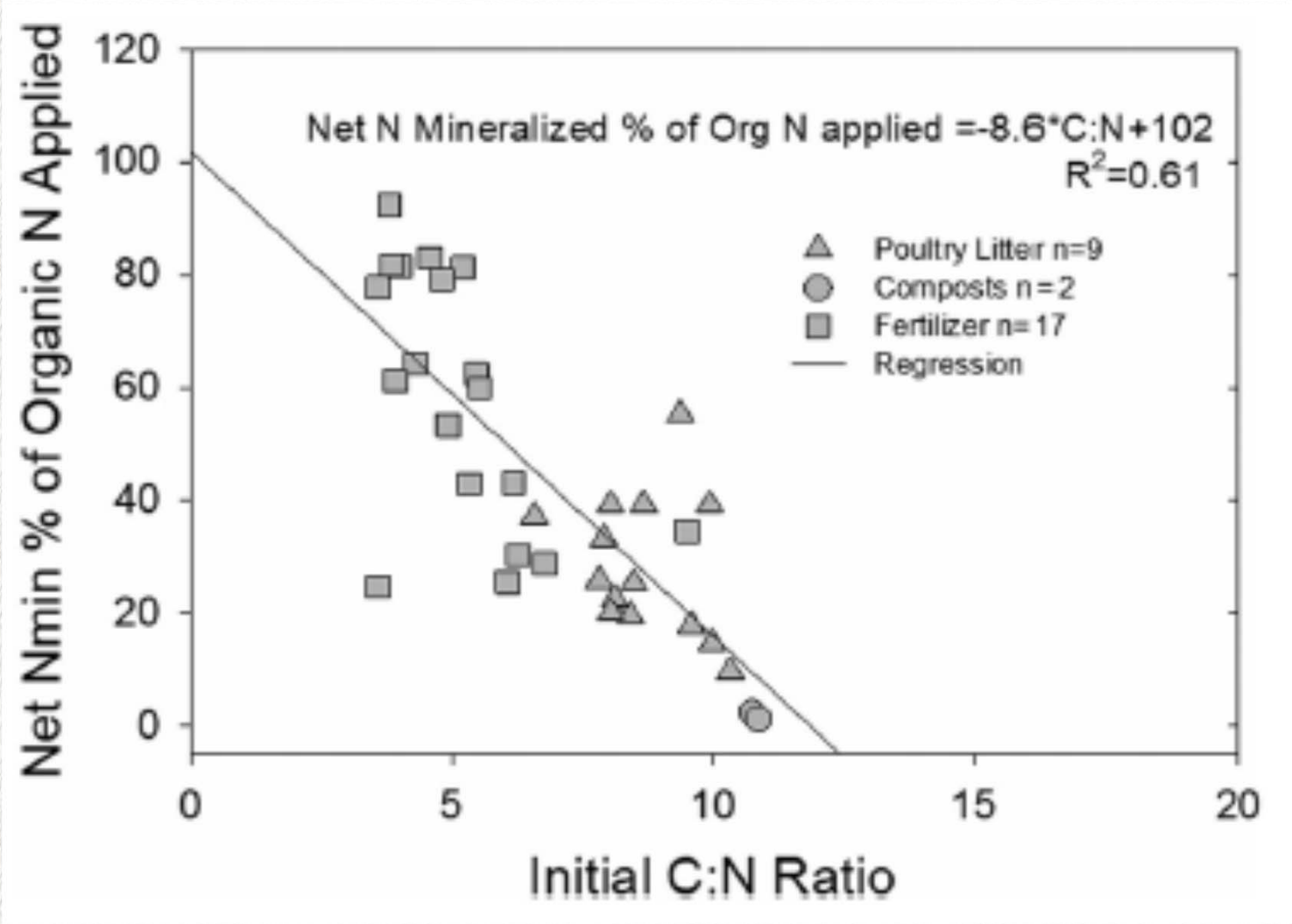
(Darby – 2012)



Sample Name	C:N ratio
soy meal	5.5
mustard meal	8.9
sun meal	15.2
canola meal	8.7
pro-gro	4.6
kreher's	5.8
blood meal	3.4
giroux's	14.4
moo doo	18.4

UGA Mineralization Study

(Cassidy-Duffy, et al. 2020)



N concentration, C/N, release of N.

(Soil Science, 1942, Vol 54: 411-423)

Fertilizer Material	N ratio %	Total C/N	Added N converted to nitrate in soil at %-20 days	%-40day
Seed Meals:				
Soybean meal	7.6	4.7	*61*	*65*
Cottonseed meal	7.2	5.4	49	54
Castor pomace	5.0	9.4	60	67
Cocoa meal	3.0	15	14	22
Plant materials:				
Alfalfa hay	2.8	21	24	32
Peanut hull meal	1.2	54	15	15
Wheat straw	0.31	197	-16	-15
Animal products:				
Hoof meal	14.3	3.3	65	68
Bone meal	4.2	3.5	7	10
Dried Blood	13.8	3.5	60	66
Dry fish scrap	9.3	4.4	59	63
Animal tankage	8.6	5.3	37	45
Manures:				
Peruvian guano	14.0	1.3	80	77
Horse manure	1.5	33	-19	-16

OSU Fertilizer Calculator

extension.oregonstate.edu/organic-fertilizer-cover-crop-calculators

Version 3	"As is" basis = weight or % nutrient in product at moisture level at which it is sold (i.e., wet weight)				"PAN" = plant-available nitrogen				Protection password = otco					
Instructions: Enter your information in yellow cells. Results are in green cells.														
MATERIAL	**FERTILIZER ANALYSIS (%) (ppm/10,000=%)**													
	Total % N from label ("as-is" basis) (% of product)	**Total % dry matter (% of product)**	**PAN at 28 days (% of amendment total N, dry wt basis) from Table 1**	**PAN after full season (% of amendment total N, dry wt basis) from Table 1**	**P_2O_5 (%)**	**K_2O (%)**	**Ca (%)**	**Mg (%)**	**S (%)**	**B (%)**	**Cu (%)**	**Fe (%)**	**Mn (%)**	**Zn (%)**
UNCOMPOSTED MATERIALS														
Alfalfa meal (2.5-0.5-2)	2.5	92	11	26	0.5	2.0								
Bat guano—high N (10-3-1)	10.0	90	60	75	3.0	1.0								0.0
Bat guano—high P (0-15-1)	0.0	89	0	0	15.0	1.0								
Blood meal (12.5-1.5-0.6)	12.5	91	60	75	1.5	0.6								
Bone meal (3-20-0.5)	3.0	95	17	32	20.0	0.5								
Chicken manure—dried (3.5-2-2)	3.5	85	32	47	2.0	2.0	7.0	1.0	0.5					
Corn gluten meal (9-0-0)	9.0	90	60	75	0.0	0.0								
Cottonseed meal (6-0.4-1.5)	6.0	90	60	75	0.4	1.5								
Feather meal (12-0-0)	12.0	93	60	75	0.0	0.0								
Feather meal (granulated) (13-0-0)	13.0	97	60	75	0.0	0.0								
Fertibor (15% B)	0.0	0	0	0						15.0				
Fish meal (10-6-2)	10.0	92	60	75	6.0	2.0								
Greensand (0-0-3)	0.0	97	0	0	0.0	3.0						0.0		0.0
Kelp meal (1.2-0.2-2.5)	1.2	88	0	5	0.2	2.5								
Meat and bone meal (7-8-0)	7.0	93	60	75	8.0	0.0								
Nature's Intent (9-3-4)	9.0	97	60	75	3.0	4.0	3.0		1.0					
Nutri-Rich (4-3-3)	4.0	91	36	51	3.0	3.0								
Perfect Blend (4-4-4)	4.0	90	37	52	4.0	4.0	7.0	0.7	3.0	0.0	0.1	0.1	0.1	0.5
Perfect Blend (7-2-2)	7.0	90	60	75	2.0	2.0	7.0	1.5	1.5	0.0	0.1	0.1	0.1	0.5
Soft rock phosphate (0-2-0)	0.0	99	0	0	2.0	0.0								
Solubor (20.5% B)	0.0	0	0	0						20.5				
Soy meal (6.5-1.5-2.4)	6.5	90	60	75	1.5	2.4		3.0						
Sulfate of potash (0-0-50)	0.0	99	0	0	0.0	50.0		0.0	17.0					
Sulfate of potash magnesia (0-0-22)	0.0	99	0	0	0.0	22.0		10.8	22.0					
Sup-R-Green (3-2-2)	3.0	73	32	47	2.0	2.0								
Zinc—Green Cypress (7% Zn)	0.0	0	0	0					3.4					7.0
			0	0										
			0	0										
			0	0										
			0	0										
			0	0										
COMPOSTED MATERIALS														
Composted dairy manure (1.5-0.5-0.5)	1.5	60	5	10	0.5	0.5	1.8							
			0	0										
			0	0										
			0	0										
			0	0										
comments to:	nick.andrews@oregonstate.edu													


Nitrogen from
Raw Manure

Manure C:N Ratios

(UK Project NT2106)

- Bedded cattle: 13.7, 15.6 (NH4 ~ 10% total N)
- Bedded swine: 9.3, 10.0 (NH4 ~ 10% total N)
- Poultry layer: 3.8, 5.0 (NH4 ~ 45% total N)
- Liquid cattle: 5.3, 9.6 (NH4 ~ 50% total N)
- Liquid swine: 1.9, 3.2 (NH4 ~ 75% total N)

Manure N Release Rates
(full mineralization)

- Ammonium-N: 2 – 4 weeks
  - similar to plant/animal meals
  - Incorporate to avoid volatilization loss

- Organic N: ¼ - ½ in 4 – 8 weeks
  - depends on soil temperature
  - depends on C:N ratio
  - ✓Remaining organic N over several years

Long Term Release Rates
Manure Organic N (Cornell)

- Year 1:
  - ➢55 % (poultry)
  - ➢35 % (all liquid)
  - ➢25% (all other solid)
- Year 2: 12 % (all sources)
- Year 3: 5 % (all sources)


Nitrogen from Cover Crops
(Green Manures)

Cover Crop Nitrogen Credits

- Grass sod plowdown
  - ✓50-60 lb N credit
  - ✓Release rate temp. dependent
- Legume sod plowdown
  - ✓50 % Stand: 90-100 lb N credit
  - ✓50+ % Stand: 120-130 lb N credit
  - ✓Release rate temp. dependent

➢ Cool soil release rate roughly 50% in 30-40 days
  - ✓assumes spring incorporation

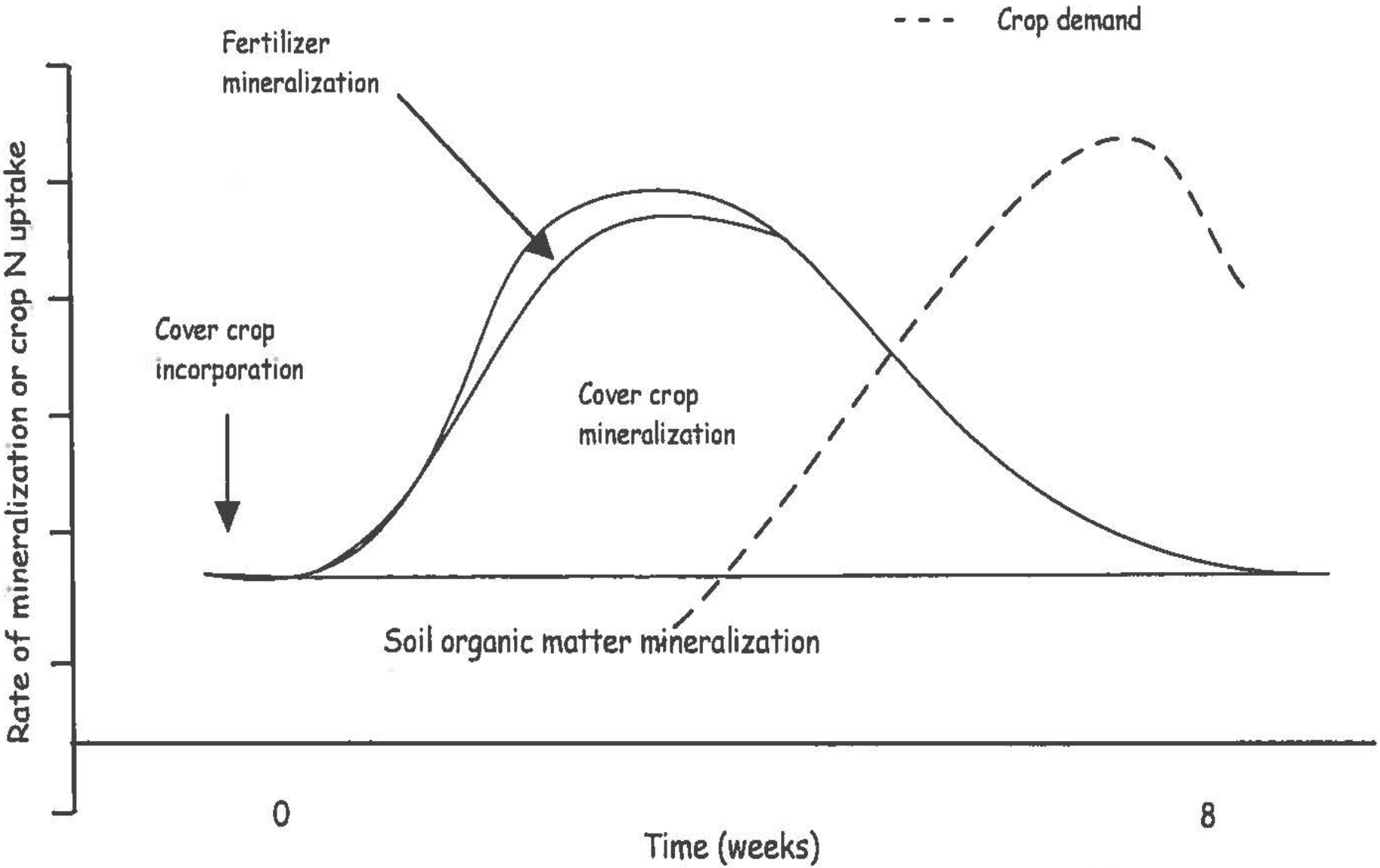


Fig. 2. Timing of nitrogen (N) mineralization from soil organic matter, cover crop residue, and organic fertilizer in relation to crop N uptake (from Gaskell et al., 2006).

Nitrogen Release Summary

"Fresh" Organic Matter

- C:N Balance Effect
  - < 10 C:N = rapid release of available N
    - ✓ most plant, animal meals, manures > 5 % N
  - 10-20 C:N = gradual release of available N
  - 20-40 C:N = slow or NO release of available N
  - > 40 C:N = tie up of available N (Immobilization)

Nitrogen Release Summary
"Fresh" Organic Matter

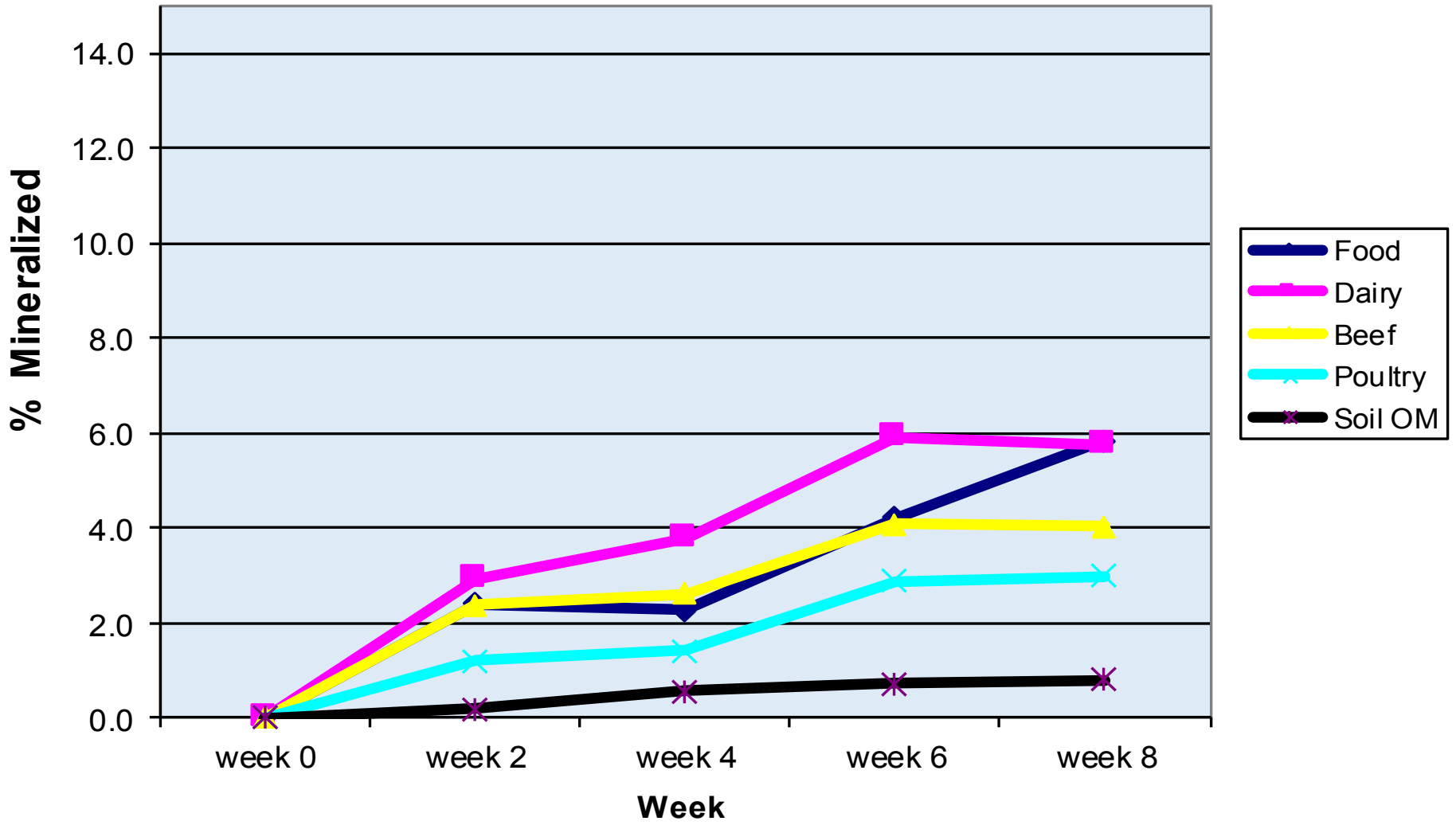
- Soil Temperature Effect
  - ✓Each 14-18 F (8-10 C) increase Doubles Rate
  - *Q10 Factor:* N mineralization rate change for every 10 C change in soil temperature
  - ✓Q10 = 2X to 3X in most studies

Nitrogen Release

from “Biologically Processed” Materials

Compost/Soil OM Organic N Mineralization Rates

2014 (70 F)



Compost Mineralization - University of Georgia (2020)

Source	C:N ratio	% Organic N Mineralized
C1	10.8	2.4
C2	12.7	4.8
C3	29.4	*Immobilized*
C4	10.7	1.3
C5	99.3	*Immobilized*
C6	16.6	*Immobilized*
C7	11.2	3.2
C8	46.0	*Immobilized*
C9	22.9	*Immobilized*
C10	15.4	2.7
C11	18.3	4.6

Best Nitrogen Mgt Practices

- Split N application
  - Soil OM and Compost for slow background release
  - Limit N fertilizer to ½ rate at planting (or slow source)
  - PSNT @ 3-4 weeks (if possible) to check available N
  - Sidedress @ 30 DAP with fast release N source

Best Nitrogen Mgt Practices

- Include legumes in rotation
  - Can provide 25-100 % total N requirement
  - Rapid release from immature/green stands
  - Slow release well into season from mature stands

Best Nitrogen Mgt Practices

- Break up traffic/tillage pans
  - Drastically improves soil drainage
  - Better able to infiltrate high rainfall events
  - ✓ Reduces denitrification losses from saturated soil

- ✓ Mechanical ripping

- ✓ Strong taproot crops (“bio-drilling”)
  - Sweet clovers
  - Canola
  - Tillage radish