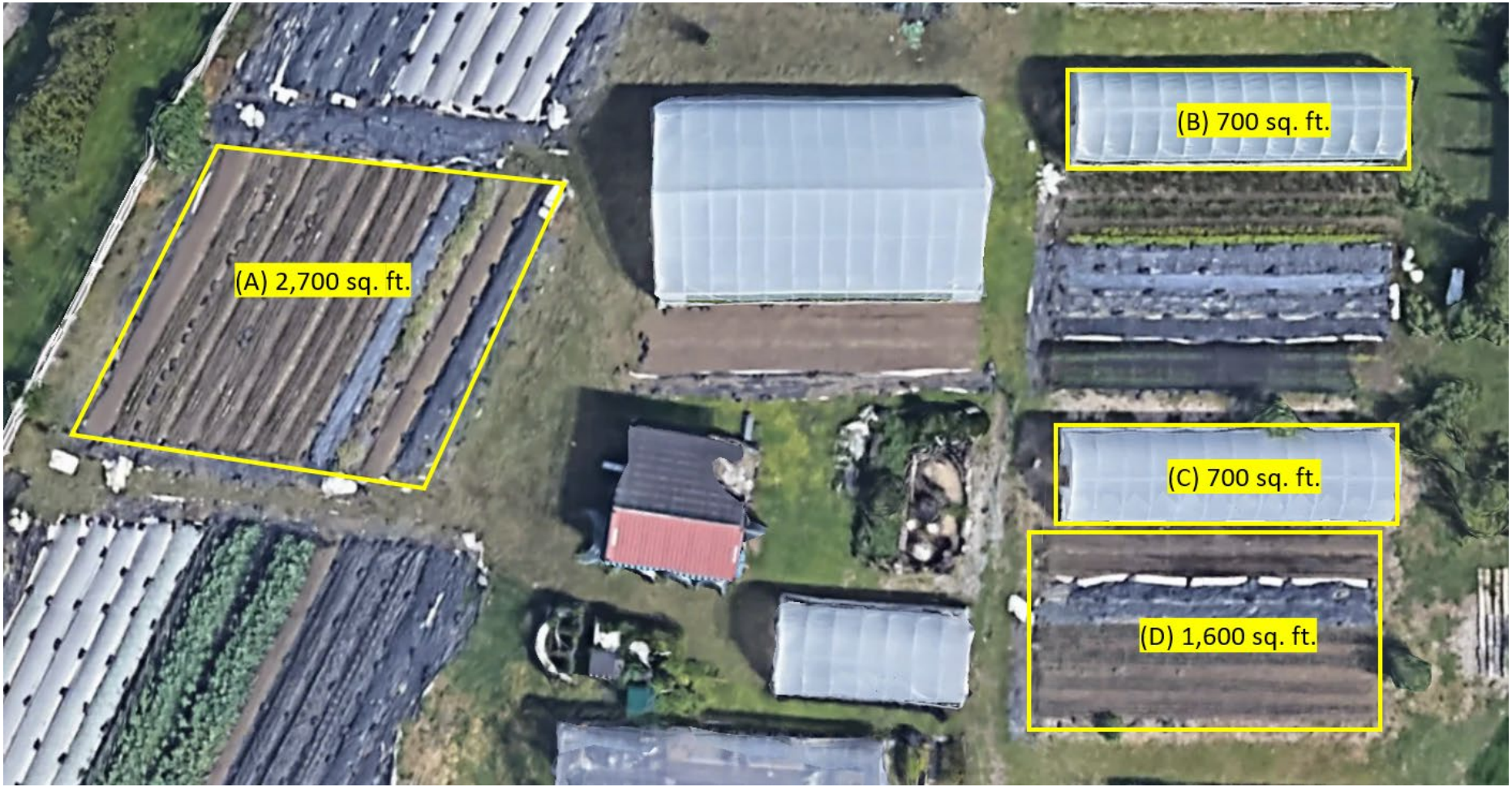
Nutrient Management

Kevin Allison
Marion County SWCD

Excel:
https://docs.google.com/spreadsheets/d/1hgyEnhoVsn8lNZa6_uEhRLkfsDP2Tbcm_6WcROaIb54/edit?usp=sharing


A5
A4
A3
A2
A1
<-- Cover crop windbreak -->


(A) 2,700 sq. ft.
(B) 700 sq. ft.
(C) 700 sq. ft.
(D) 1,600 sq. ft.

To: MARION CO. SWCD
STE 200
1200 MADISON AVE
INDIANAPOLIS, IN 46225-1616

Attn: KEVIN ALLISON

For: EC DEMO

Date Received: 01/25/2021
Date Reported: 01/27/2021

Sample ID: A1-2-3 **Lab Number:** 12624

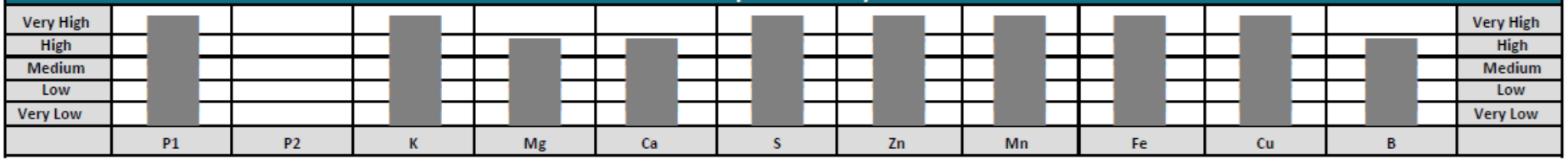
SOIL TEST REPORT

Test Results

Organic Matter %	Phosphorus Bray-1 Equiv ppm-P	Phosphorus Bray P2 ppm-P	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	pH Soil pH	pH Buffer pH	CEC meq/100g	Cation Saturation % K	% Mg	% Ca	% H	% Na
4.5	124		247	235	1850		6.8		12.2	5.2	16.0	75.8	3.0	

Sulfur S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts (1:2) mmho/cm	Nitrate NO_3-N ppm	Ammonium NH_4-N ppm	Bicarbonate-P P ppm	Chloride Cl ppm		Aluminum Al-M3 ppm
31	12.4	52	93	3.6	1.8							

Graphic Summary

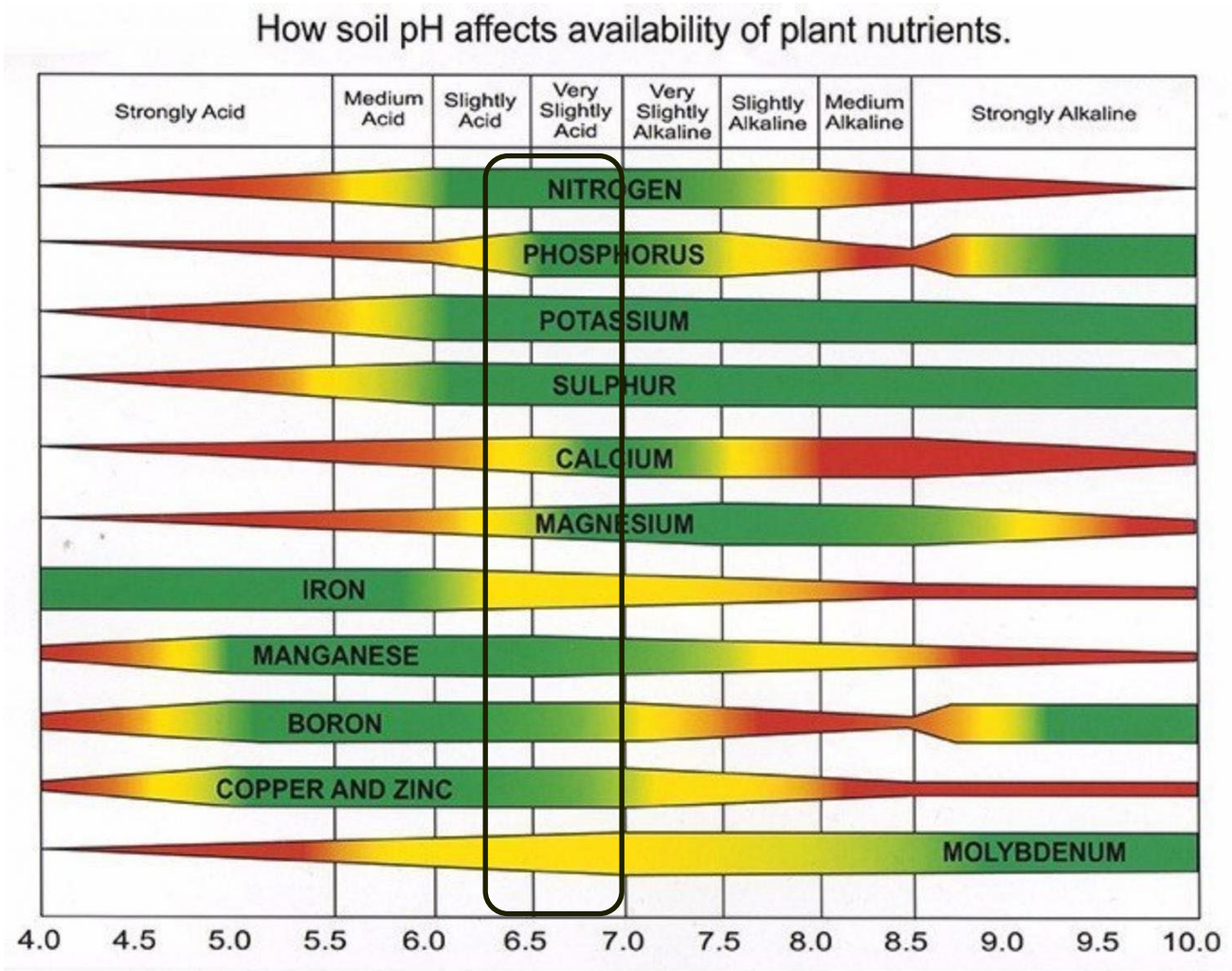


Soil Fertility Recommendations - Pounds per 1,000 Square Feet

Intended Crop	Yield Goal	Previous Crop	Lime	Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
Vegetable Garden		Vegetable Garden	0	4	0	0	0	0.0	0.00	0.00	0.00	0.00	0.00

Report reviewed and approved by our professional agronomy staff.

pH



SOURCE: https://www.emporiumhydroponics.com/what-is-ph-1-to-14

Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin - Table 5.3

Table 5.3. Amount of finely ground elemental sulfur (S) needed to lower soil pH (increase acidity).

	Soil organic matter content (%)					
Desired reduction in soil pH	0.5–2	2–4	4–6	6–8	8–10	> 10
	lb S/1,000 sq ft					
0.25	6	18	28*	40*	53*	62*
0.50	12	35*	56*	80*	106*	125*
1.00	24*	70*	112*	120*	212*	250*

* Do not apply more than 20 lb S/1,000 sq ft per year. Retest soil between applications.

Additional Considerations for Reducing pH (Wisconsin)

- Fertilizer products containing sulfate-sulfur are not effective in lowering soil pH. This includes products such as potassium sulfate (K_2SO_4) and gypsum ($CaSO_4$)
- To lower soil pH, elemental sulfur must be oxidzed to sulfate by soil bacteria, which may take several months or longer.
- Applying more than 20 lb S/1,000 sq ft per year is not recommended.

Adding lime – to increase pH

Mineral Soils: Most soils of the Great Lakes region fall into this lime recommendation category: CEC > 7.0 meg/100g and OM <10%. Lime recommendations are made using the buffer pH test result. The standard lime recommendation is made to raise the soil pH to 6.5.

Mineral Soils: Lime Recommendation (Pounds / 100 sq. ft)		
Buffer pH	Target pH = 6.9	Target pH = 6.5
6.8	6.89	4.59
6.7	11.48	9.18
6.6	16.07	13.77
6.5	20.66	18.37
6.4	25.25	20.66
6.3	29.84	25.25
6.2	34.44	29.84
6.1	39.03	32.14
6.0	43.62	36.73

Source: A&L Laboratories Inc., Lime Recommendations Fact Sheet

Nitrogen

TABLE 3.1 Ranking of annual vegetables based on relative nutrient requirements

Low	Medium	High
Beans, all	Brassica greens	Broccoli
Beet	Cucumber	Cabbage
Carrot	Eggplant	Cauliflower
Herbs	Pepper	Corn
Peas	Pumpkin	Lettuce
Radish	Spinach, chard	Potato
	Squash	Tomato
	Sweet potato	
	Watermelon	
	Winter squash	

Note: Vegetables are classified as having low, medium, or high nutrient requirements. These categories do not account for differences among varieties.

SARE Crop Rotations on Organic Farms

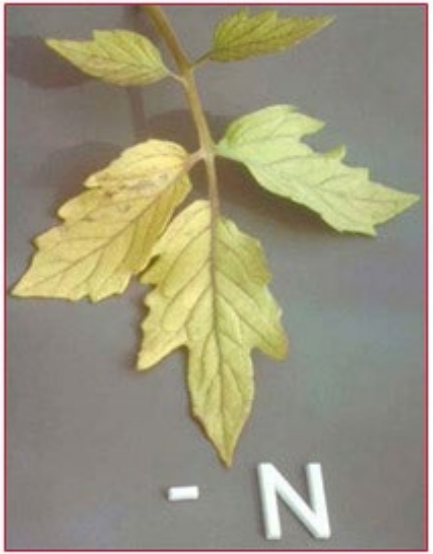
Table 1. Nitrogen requirement of vegetable crops based on seasonal nitrogen uptake

Low Total N Need <120 lb/acre	Medium Total N Need <120-200 lb/acre	High Total N Need >200 lb/acre
Baby greens	Carrot	Broccoli
Beans	Corn, Sweet	Cabbage
Cucumbers	Garlic	Cauliflower
Radish	Lettuce	Celery
Spinach	Melons	Potato
Squashes	Onion	
	Peppers	
	Tomatoes	

— Gaskell et al. 2006, Soil Fertility Management for Organic Crops

Nutrient Management Plan (590) for Organic Systems, Western State Implementation Guide

Nitrogen deficiency



Crop	Yield range per acre	Soil organic matter content (%)			
		< 2.0	2.0–9.9	10.0–20.0	> 20.0
		lb N/a to apply[a]			
Grass, reed canarygrass	4–7 ton	270	250	220	100
Grass, switchgrass, seeding[i]	1–3 ton	0	0	0	0
Grass, switchgrass, established[i]	1–5 ton	120	100	75	50
Hop[j]	1,000–1,500 lb	200	180	150	120
Lettuce	15–20 ton	120	100	80	40
Lupine	40–60 bu	10	0	0	0
Melon	8–10 ton	100	80	60	30
Millet	40–60 bu	80	60	40	20
Mint, oil	35–55 lb	120	100	80	50
Oat[c]	30–120 bu	60	40	20	0
Onion	400–600 cwt	150	140	130	120

Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin – Table 6.3

Phosphorous and Potassium

Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin - Table 7.4

Crop name	Yield goal (per acre)	P_2O_5 rate guidelines					K_2O rate guidelines					
		VL	L	O	H	EH	VL	L	O	H	VH	EH
		lb P_2O_5/a to apply[a]					lb K_2O/a to apply[b]					
Buckwheat	1,200–2,000 lb	60	50	20	10	0	65	50	20	10	5	0
Cabbage	8–12 ton	95	70	15	10	0	170	140	70	35	20	0
	12.1–20 ton	105	80	25	15	0	215	185	115	60	30	0
	20.1–30 ton	120	95	40	20	0	280	250	180	90	45	0
Canola	30–50 bu	85	75	45	25	0	125	110	80	40	20	0
Carrot	20–30 ton	125	100	45	25	0	340	310	240	120	60	0
Cauliflower	6–8 ton	100	75	20	10	0	150	120	50	25	15	0

New England - Beets

PLANT NUTRIENT RECOMMENDATION ACCORDING TO SOIL TEST RESULTS FOR BEET AND SWISS CHARD									
BEET AND SWISS CHARD	**NITROGEN (N)* LBS PER ACRE**	**PHOSPHORUS (P) LBS P_2O_5 PER ACRE**				**POTASSIUM (K) LBS K_2O PER ACRE**			
SOIL TEST RESULTS		**VERY LOW**	**LOW**	**OPTIMUM**	**ABOVE OPTIMUM**	**VERY LOW**	**LOW**	**OPTIMUM**	**ABOVE OPTIMUM**
Broadcast and Incorporate	75-100	150	100	50	0	300	150	75-100	0
Sidedress after 1st or 2nd cutting	30	0	0	0	0	0	0	0	0
TOTAL RECOMMENDED	**105-130**	**150**	**100**	**50**	**0**	**300**	**150**	**75-100**	**0**

Midwest Vegetable Production Guide for Commercial Growers

Lettuce example

Fertilizing

pH: Maintain a soil pH of 6.5 to 6.8 for **leafy greens**, and 6.0 to 7.0 for **herbs**. On muck soils maintain the pH at 5.5 to 6.0. Spinach is particularly sensitive to soil acidity.

Before planting apply 40 to 60 pounds N per acre, 0 to 150 pounds P_2O_5 per acre, and 0 to 200 pounds K_2O per acre. Adjust according to soil type, previous management, and soil test results for your state. For direct-seeded crops band an additional 40 pounds N and 40 pounds P_2O_5 per acre 2 inches to the side and 2 inches below the seed.

Sidedress with 30 to 60 pounds N per acre three to four weeks after thinning or transplanting, and again after each cutting.

Reduce the total amount of fertilizer N applied by the value of N credits from green manures, legume crops grown in the previous year, compost and animal manures, and soils with more than 3 percent organic matter. The total amount of N from fertilizer (including starter) and other credits should be 90 to 120 pounds N per acre for culinary herbs, up to 140 pounds N per acre for lettuce, and up to 170 pounds N per acre for spinach. For herbs grown for seeds, such as coriander, fennel, and dill, use 60 to 90 pounds N per acre.

CEC and
Base Saturation

Percent Base Saturation

Percent base saturation is the percentage of exchangeable potassium, magnesium, calcium, and hydrogen in the soil (total = 100%).

Nutrient	Ideal Levels	Common Levels
Potassium (K)	3% to 5%	1% to 8%
Magnesium (Mg)	12% to 16%	20% to 40%
Calcium (Ca)	70% to 75%	55% to 65%
Hydrogen (H)	0% to 5%	0% to 10%

Midwestern BioAg

Amendments

Table 4. Nutrient analysis (percent by weight) of common organic fertilizer materials (Gaskell et al., 2007)

Material	Nitrogen (% N)	Phosphorus (% P_2O_5)	Potassium (% K_2O)
Chilean nitrate	16	0	0
Blood meal	12	0	0
Feather meal	12	0	0
Fish meal/powder	10-11	6	2
Seabird & bat guano	9-12	3-8	1-2
Meat and bone meal	8	5	1
Soybean meal	7	2	1
Processed liquid fish residues*	4	2	2
Alfalfa meal	4	1	1
Pelleted chicken manure	2-4	1.5	1.5
Bone meal	2	15	0
Kelp	<1	0	4
Soft rock phosphate	0	15-30**	0
Potassium-magnesium sulfate	0	0	22
Cocoa shells	1	1	3
Cottonseed meal	6	2	2
Granite dust	0	0	5
Hoof & horn meal	11	2	0
Seaweed, ground	1	0.2	2
Muriate of potash (KCl)	0	0	60

* Note: all analyses are % by weight, as specified in state fertilizer laws. For liquids, product density (weight per gallon) should be used to calculate nutrient application rate: (g/ac)*(lb nutrient/g)=(lb nutrient/ac)

* *Soft rock phosphate provides only 1-3% of its P in acid soils, and little or no P in soils with pH over 7.

Table 4. Nutrient analysis (percent by weight) of common organic fertilizer materials (Gaskell et al., 2007)

Material	Nitrogen (% N)	Phosphorus (% P_2O_5)	Potassium (% K_2O)
Chilean nitrate	16	0	0
Blood meal	12	0	0
Feather meal	12	0	0
Fish meal/powder	10-11	6	2
Seabird & bat guano	9-12	3-8	1-2
Meat and bone meal	8	5	1
Soybean meal	7	2	1
Processed liquid fish residues*	4	2	2
Alfalfa meal	4	1	1
Pelleted chicken manure	2-4	1.5	1.5
Bone meal	2	15	0

Example fertilizer nutrient contribution		
N-P-K (%)	Lbs of product	Lbs of nutrient provided
5-3-5	12 lbs	
Nitrogen	5% x 12 lbs	.60 lbs N
Phosphorus	3% x 12 lbs	.36 lbs P
Potassium	5% x 12 lbs	.60 lbs K

Example fertilizer calculation for 100 square feet	
How much N do we want from this fertilizer?	0.4 lbs N / 100 sq. ft.
Question: How much feather meal needed?	
Feather meal is often labeled 12-0-0. The product's composition is 12% N, 0% P, and 0% K. If our goal is 0.4 lbs N / 100 sq. ft., then we should apply 3 lbs of feather meal per 100 sq. ft. Math: 12% x (pounds of product) = 0.4 lbs N so… 0.4 / 0.12 = **3 pounds of feather meal / 100 sq. ft.**	

Plant Nutrient Management in Hawaii's Soils P 141-143
Adapted from Rodale

Table 15-7. Organic fertilizer options. (Reprinted from *Growing Fruits and Vegetables Organically*, © 1994 by Rodale Press, Inc. Permission granted by Rodale, 400 S. 10th St., Emmaus, PA 18098. Information in brackets has been modified from the original table.)

Amendment	N-P-K ratio	Other nutrients	C/N ratio	Comments
Alfalfa hay	2.6 - 0.6 - 2.2	0.3% S; 1% Ca; 0.02% Mg; micronutrients	16	Well balanced, slowly available. Contains growth stimulants
Alfalfa meal or alfalfa pellets	2.7 - 0.5 - 2.8	0.2% S; micronutrients	15	Well balanced, more rapidly available than alfalfa hay. Contains growth stimulants.
Blood meal	13 - 2 - 0	Not a significant source of other nutrients	3	Rapidly available N. Stimulates microbes.
Bonemeal	3 - 2 - 0.5	24% Ca	-	Rapidly available P source. Mildly increases pH.
Compost (dry, commercial)	1 - 0.8 - 1	0.4% S; 0.2% Ca; 0.1% Mg; micronutrients	10–17	Balanced, slow release. Good choice for busy gardener.
Compost (homemade)	1 - 0.5 - 1 to 2 - 1 - 2	0.4% S; 0.2% Ca; 0.1% Mg; micronutrients	10–17	Balanced, slow release.
Cottonseed meal	6 - 2 - 2	Not a significant source of other nutrients	7	Rapidly available N source. May contain pesticides.
Egg shells	1.2 - 0.4 - 0.1	0.4% Ca; micronutrients	-	Should be crushed. Good compost addition.
Epsom salts	0 - 0 - 0	13% S; 10% Mg	-	Rapidly available Mg and S source.
Feather meal	11 - 0 - 0	Not a significant source of other nutrients	4	Rapidly available N source.
Fish emulsion	5 - 2 - 2	5% S	4	Rapidly available N source.
Fish meal	10 - 4 - 4	Not a significant source of other nutrients	4	Rapidly available N source.
Granite meal	0 - 4.0 - 0	Micronutrients	-	Very slow release of P Use to build soil reserves.
Grass clippings (fresh)	0.7 - 0.3 - 0.8	0.1% S; 0.2% Ca; 0.1% Mg	33	Balanced, slow release.
Greensand	0 - 0 - 7	Micronutrients	-	Very slowly available source of K. Use to build reserves.
Gypsum	0 - 0 - 0	17% S; 22% Ca	-	Slowly available source of S and Ca. Does not affect pH. Improves alkaline soil structure. Increases plant growth in

Amendment	N-P-K ratio	Other nutrients	C/N ratio	Comments
Kelp meal	1 - 0.2 - 2	3% S; micronutrients	-	Slow release of K and micronutrients. Contains growth stimulants.
Lime, oyster shell	0 - 0 - 0	38% Ca; 1% Mg	-	Slow release of Ca. Used to increase pH.
Limestone (dolomitic)	0 - 0 - 0	20% Ca; 10% Mg	-	Slow release of Ca and Mg. Used to increase pH.
Limestone (high - Ca)	0 - 0 - 0	26–36% Ca; 2–7% Mg	-	Slow release of Ca. Used to increase pH.
Manure, cow (dry)	2.0 - 1.0 - 2.4	0.5% S; 0.2% Ca; micronutrients	18	Best when composted.
Manure, horse	2 - 1 - 2.5	1% S; 0.2% Ca; micronutrients	22	Slow release when dry; rapid release when fresh.
Manure, poultry (dry)	4 - 3 - 1	0.2% S; 2% Ca; 0.3% Mg	7	Very rapidly available N and P. Should be composted; fresh manure will burn plants.
Oak leaves	0.8 - 0.4 - 0.1	Micronutrients	Variable	Very slow release. Improves soil structure.
Orchard grass (hay)	2 - 0.6 - 2.7	0.3% S	24	Balanced, slow release.May need rapidly available N source added.
Rock phosphate (hard rock)	0 - [15] - 0	[33]% Ca; micronutrients	-	Slowly available P and Ca. Will increase pH. Used to build reserves.
Sawdust	0.2 - 0.2 - 0.3	Not a significant source of other nutrients	Very high	Use only when well rotted. Add a rapidly available N source. Good soil conditioner and mulch for [acid-loving plants].
Soybean meal	6 - 1 - 2	0.8% Mg; micronutrients	7	Rapidly available nitrogen.
Sulfur ("flowers")	0 - 0 - 0	99.5% S	-	Used to lower high pH.
Sul-Po-Mag[6]	0 - 0 - 22	19% S; 10% Mg	-	Rapidly available K and Mg. Don't use with dolomitic lime.
Weeds (fresh)	2.4 - 0.8 - 3.8	2.3% Ca; micronutrients	17	Balanced, slow release.

Plant Nutrient Management in Hawaii's Soils P 141-143
Adapted from Rodale

Amendment	N-P-K ratio	Other nutrients	C/N ratio	Comments
Wheat straw	0.6 - 0.2 - 1	0.2% S; 0.2% Ca; 0.05% Mg; micronutrients	78	Very slow release.Used to improve soil structure. Should be applied with a rapidly available N source.
Wood ashes (leached)	0 - 1.6 - 5	15% Ca; micronutrients	-	Low P content, but rapidly available. Good source of K and Ca. Will increase pH. Can injure microorganisms. Do not use more than ½–¾ lb per 100 ft².
Wood ashes (unleached)	0 - 1.7 - 7	15% Ca; micronutrients	-	Low P content, but rapidly available. Good source of K and Ca. Will increase pH. Can injure microorganisms. Do not use more than ½–¾ lb per 100 ft².
Wood chips (deciduous)	0 - 0.2 - 2 to 0 - 1 - 3	Not a significant source of other nutrients	Very high	Very slow release. Do not apply without a rapidly available N source. Used to improve soil structure. May take >1 year to decompose.
Worm castings (Biocast)	0.5 - 0.5 - 0.3	Micronutrients	-	Excellent for improving soil structure.

Plant Nutrient Management in Hawaii's Soils P 141-143
Adapted from Rodale

Table 5: Fertilizers Approved for Organic Production

Typical Nutrient Content (by Weight) of Organic Materials
(Nutrient content varies)

	N (%)	P_2O_5 (%)	K_2O (%)	Mg (%)	Relative Availability
Alfalfa meal	3	0.5	2.5	0	slow/med
Dried blood	12	1	0.5	0	med/rapid
Bone meal (steamed)	3	15	0	0	med
Bone char	0	32 (16 available)	0	0	med
Compost (mature)	1	1	1	0	slow
Cottonseed meal	6	2	2	0	slow/med
Dried poultry manure	4	3	3	0	med
Hydrolyzed feather meal	12	0	0	0	med
Fish emulsion	5	2	0	0	rapid
Fish meal	9	7	0	0	
Bat guano	6	9	2	0	med
Manure (fresh)					
Dairy	0.5	0.2	0.5	0	med
Horse	0.5	0.2	0.5	0	med
Sheep	1.5	0.5	1	0	med
Poultry (broiler)	1.5	3	2	0	med/rapid
Peanut meal	8	1	0	0	slow/med
Soybean meal	7	2	2	0	slow/med
Wood ashes	0	2	5	0	rapid

Nutrient Management Guide for New England Vegetable Production, p 37

Peaceful Valley EST. 1976
FARM & GARDEN SUPPLY

Product Name	Organic Status	PART NUMBER	Major Nutrients							Biological & Humus			pH Adjusting		Use As Foliar	Soil Application			Nutrient Release Rate of Availability (months)		
			Over 4% N	Over 3% P	Over 3% K	Mg	S	Ca	Trace Minerals	Boosts Microbial Activity	Organic Matter	Humus or Humic Acids	Corrects Low pH	Corrects High pH		Solution Grade For Fertigation	Pelleted or Crumbles	Granulated, Powdered, or Meal	Immed. 0-1	Short Term 1-4	Long Term 4+
Insect Frass 2-2-2	WSDA cdfa	F500							●	●					●			●	●		
Kelp Extract 0-0-17	OMRI Listed cdfa	F1350			●				●	●					●			●	●		
Kelp, Liquid	cdfa	F1330							●	●		●			●	●			●		
Kelp Help, Liquid	WSDA cdfa	F1333							●	●		●			●	●			●		
Kelp Meal 1-0-2	OMRI Listed	F1440							●	●	●							●			●
Kelp Meal 1-0.1-2	OMRI Listed cdfa	F017							●	●	●							●			●
Kickstart™ Crumbles 6-1-2	cdfa	F369	●														●			●	
KMS (Potassium Magnesium Sulfate) 0-0-21.5	WSDA OMRI Listed cdfa	F2360					●		●						●	●			●		
Langbeinite 0-0-22	OMRI Listed cdfa	F002			●	●	●											●		●	
Lawn Restore® 9-0-2		F1500	●															●			●
Lime, Garden Prilled	OMRI Listed cdfa	F1571						●					●			●			●		
Limestone, Marblewhite 325		F1570						●	●				●		●	●			●		
Limestone Microna Ag H20	WSDA cdfa	F1575						●					●		●	●			●		
Manganese 1-0-0	OMRI Listed cdfa	F2412							●						●				●		
Manganese Sulfate	OMRI Listed cdfa	F1676					●		●						●	●			●		

Table 1. Categories of organic inputs used to predict PAN release from organic inputs in the calculator

Category	Decomposition rate in soil	Total C[1]	Total N	C:N ratio[1]	Cumulative PAN release	
					4 weeks	10 weeks
		% of dry wt.	% of dry wt.		% of total N[2]	% of total N
Fresh organic material	Moderate to rapid	35–45	1–12	40:1 to 4:1	<0–60	0–75
Cover crop residue	Rapid	35–45	1–4	40:1 to 10:1	<0–40	0–50
Finished compost	Very slow	15–30	1–3	20:1 to 10:1	0–5	0–10

[1]Total C and C:N are not used by the calculator to estimate PAN release. Calculator PAN estimates are based on total N concentration.

[2]For organic materials with low N concentrations (<1% in DM) predicted PAN is negative, indicating that PAN is consumed by microbes in soil (PAN is immobilized in microbial biomass).

OSU Organic Fertilizer & Cover Crop Calculator: Predicting Plant-available Nitrogen
https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/em9235.pdf

Compost Tests

CLC LABS®
325 Venture Drive • Lewis Center, Ohio 43035 • (614) 888-1663 • Fax (614) 888-1330

SUBMITTED BY
GREENCYCLE OF INDIANA,INC
4227 S. PERRRYWORTH RD
WHITESTOWN, IN 46075

SUBMITTED FOR:

ACCOUNT NO.: T241

REPORT DATE: JULY 28, 2017
REPORT REF.: 2047.047

REPORT OF ANALYSIS

LAB. NO: 248272
SAMPLE ID: COMPOST

TEST PARAMETER	DRY BASIS	UNITS
Total Nitrogen (N)	1.37	%
Total Phosphorus	0.17	%
As P2O5	0.39	%
Total Potassium	0.57	%
As K2O	0.68	%

Methods of analysis for nitrogen, phosphorus and potassium conform to TMECC 04.02-D, 04.03-A and 04.04-A, respectively.

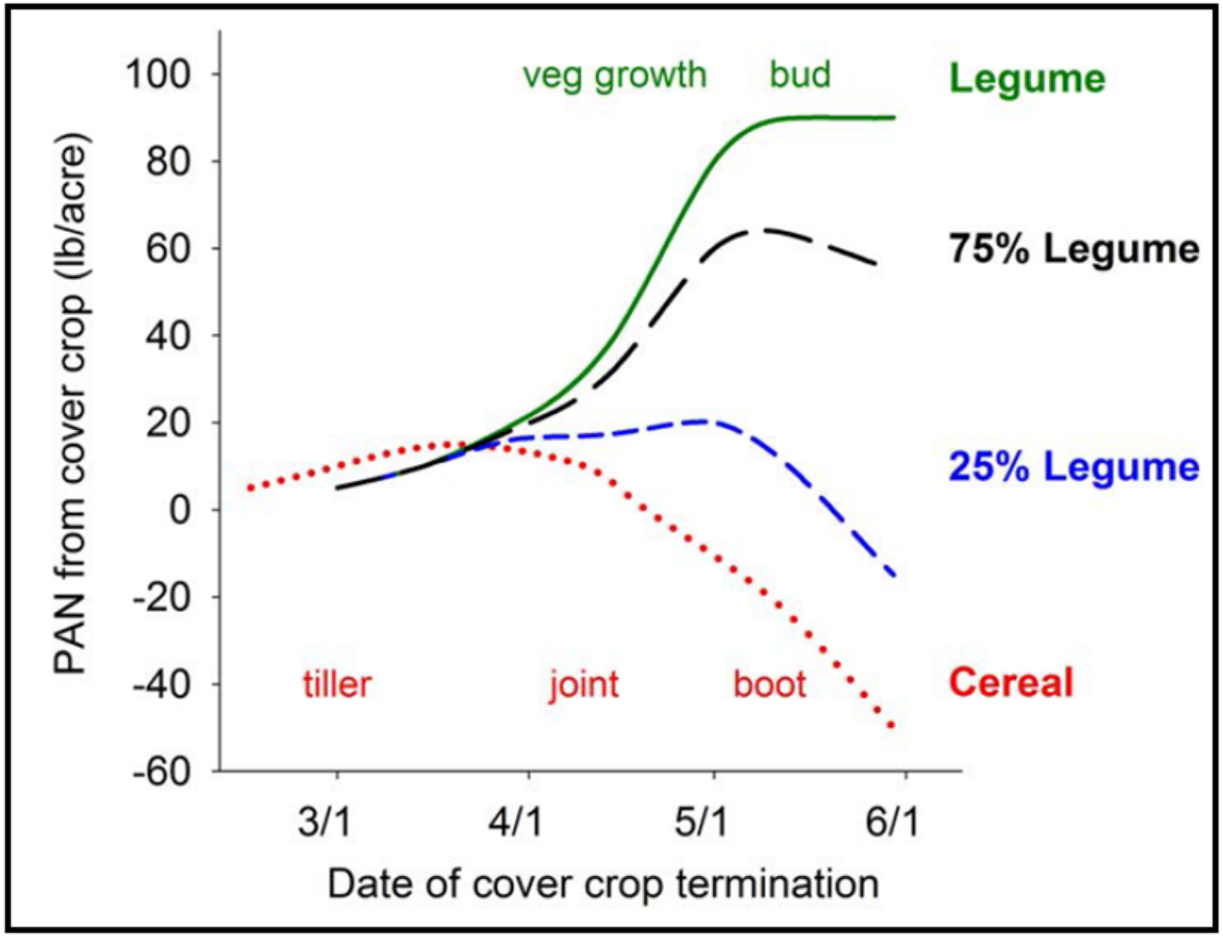
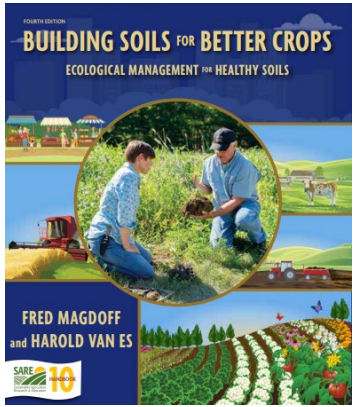


Figure from PNW 636, Estimating Plant-available Nitrogen Release from Cover Crops (Sullivan and Andrews, 2012), ©Oregon State University

				Bloodmeal	Feathermeal	Kelp Meal	Alfalfa Meal	Elemental Sulfur	Gypsum	K-Mag	Boron	Zinc Sulfate	Copper Sulfate	Re-Vita Pro 5-4-5	Bone Meal	Product A	Ammonium Sulfate	MAP	Guano	Potassium Sulfate	Compost	Product
	Goal	Actual	Amount	6	6															7		
Nitrogen	1.50	1.50	N	13	12	1	2.5							5	3	5	21	11				
Phosphrous	3.67	0.00	P2O5			0.3	1							4	13	10		61	12			
Potassium	4.00	3.73	K20		0.35	2.5	1			18.2				9		8				53		
Sulfur		1.28	S		0.4	2		90	16	22		17	12.5		2.5		24			18		
Calcium		0.04	Ca		0.6	2			21					9	12							
Magnesium		0.00	Mg			0.7				11					0.3	5						
Sodium		0.00	Na												5.7							
Boron		0.00	B								14.3											
Iron		0.00	Fe																			
Manganese		0.00	Mn																			
Copper		0.00	Cu										25									
Zinc		0.00	Zn									35										

THE ABCs OF NUTRIENT MANAGEMENT

a. Balance nutrient inflows and removals to maintain optimal levels and allow a little "drawdown" if nutrient levels get too high.
b. Enhance soil structure to increase plant capture of soil nutrients and reduce their loss in runoff by minimizing tillage, reducing compaction and promoting deeper rooting to access nutrients lower in the soil.
c. Build up and maintain high soil organic matter levels for biodiverse soils and to develop healthy plant roots.
d. Test manures and credit their nutrient content before applying fertilizers or other amendments.
e. If using liquid manure, consider soil injection to reduce N volatilization and potential loss of nutrients in runoff.
f. Test soils regularly to determine the nutrient status and whether or not manures, fertilizers or lime are needed.
g. Use regionally adapted nutrient recommendation tools.
h. Apply most nitrogen close to the time of crop uptake, and use recommendation tools that account for soil, weather and management practices.
i. Use forage legumes or legume cover crops to provide N to subsequent crops and to develop good soil structure.
j. Use cover crops to tie up nutrients during the off-season, enhance soil structure, reduce runoff and erosion, and provide microbes with fresh organic matter.
k. Maintain soil pH in the optimal range for the most sensitive crops in your rotation.
l. When P and K are very deficient, broadcast some of the fertilizer to increase the general soil fertility level, and band apply some as well.
m. To get the most efficient use of a fertilizer when P and K levels are at or below the medium or lower categories, consider band application at planting, especially in cool climates.



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