Pasture Nutrient Management

Dr. Heather Darby

The University of Vermont

Soil Test Report

Agricultural & Environmental Testing Laboratory
and UVM Extension

Prepared For:

Bedrock Farm
Wilma Flintstone
100 BC Lane
Vermontville, VT 05001

UVM Extension NW Crops & Soils /
Heather Darby
278 S Main St, Ste 2
St Albans, VT 5478

1-800-639-2130

Sample Information:
Order #:
Lab ID: **Corner piece**

Received: 11/21/2018
Reported: 12/7/2018
VT County: Grand Isle

Results

Nutrient	Low	Medium	Optimum	High or Excessive
Phosphorus (P):				
Potassium (K):				
Magnesium (Mg):				

Analysis	*Value Found*	*Optimum Range ** (or Average *)*	*Analysis*	*Value Found*	*Optimum Range ** (or Average *)*
Soil pH (2:1, water)	6.6		Boron (B)	0.3	0.3*
Modified Morgan extractable, ppm			Copper (Cu)	0.7	0.3*
Macronutrients			Zinc (Zn)	0.8	2.0*
Phosphorus (P)	3.9	4-7	Sodium (Na)	24.0	20*
Potassium (K)	85	100-130	Aluminum (Al)	27	35*
Calcium (Ca)	2585	**	**Soil Organic Matter %**	3.3	**
Magnesium (Mg)	110	50-100	**Effective CEC, meq/100g**	14.1	**
Sulfur (S)	11.0	11*	**Base Saturation, %**		
Micronutrients			Calcium Saturation	91.9	40-80
Iron (Fe)	4.1	7.0*	Potassium Saturation	1.6	2.0-7.0
Manganese (Mn)	11.6	8.0*	Magnesium Saturation	6.5	10-30

** Micronutrient and S deficiencies are rare in Vermont and optimum ranges are not defined; thus average values in Vermont soils are shown instead.*
*** Ranges shown are for Field Crops; Vegetable ranges are higher. Ranges for Calcium, Organic Matter, and Effective CEC vary with soil type and crop.*

Recommendations for Oats, Rye, Wheat, Triticale, Millet (3D)

Limestone (Target pH of 6.2)	Nitrogen, N	Phosphate, P_2O_5	Potash, K_2O
tons / Acre	**lbs / Acre**	**lbs / Acre**	**lbs / Acre**
0	**60**	**40**	**60**

Comments: **Yield Goal: 60. bushels / Acre**

Estimate nutrients supplied by manure - consult UVM Extension or Nutrient Recommendations for Field Crops in Vermont.
Add 10-20 lb/acre extra N in excessively drained (droughty) soils OR in somewhat poorly to poorly drained soils. Consult Extension Agronomists or References to estimate N credits from a grass or legume crop plowed down within the past 2 years.

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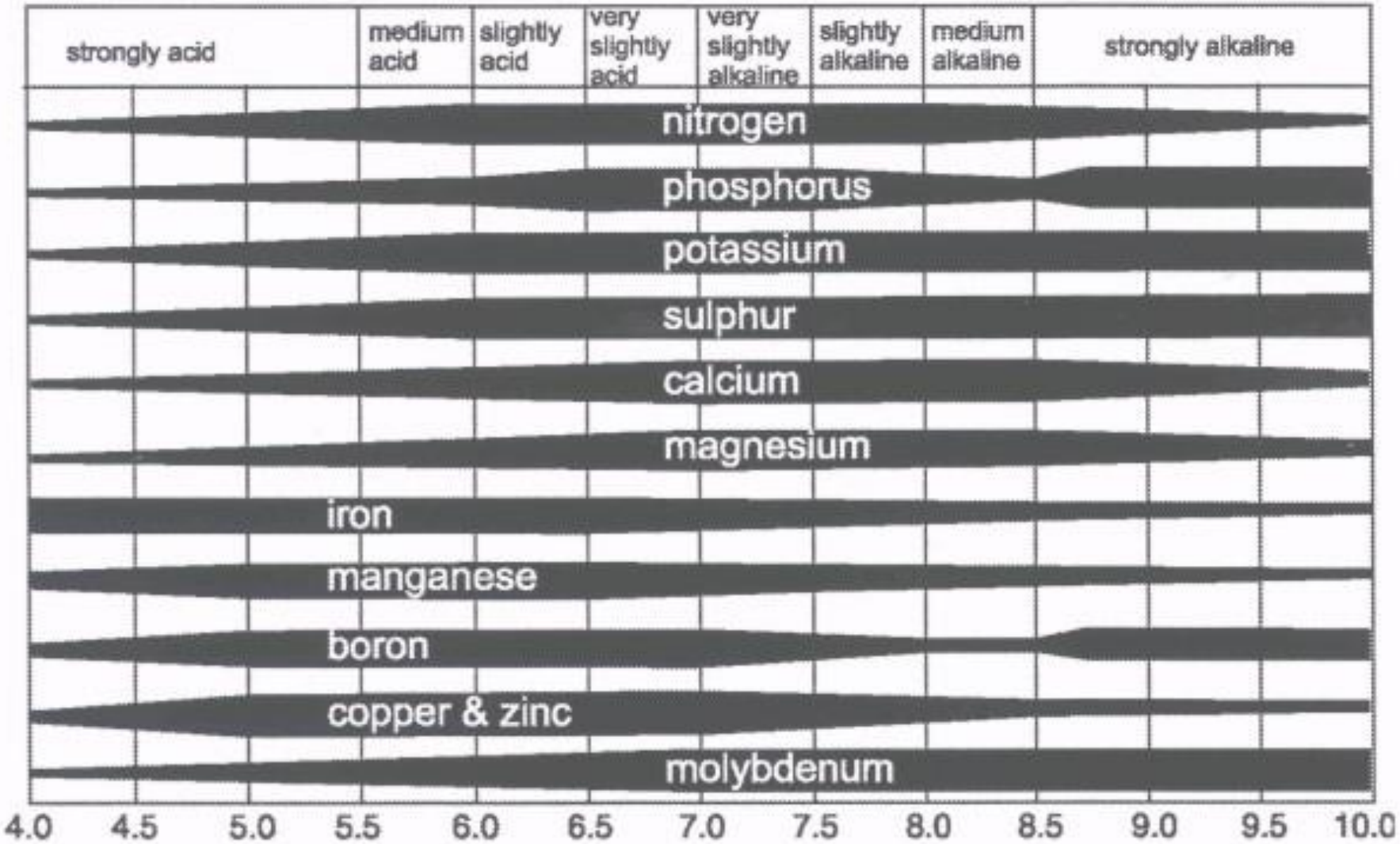
strongly acid
medium acid
slightly acid
very slightly acid
very slightly alkaline
slightly alkaline
medium alkaline
strongly alkaline
nitrogen
phosphorus
potassium
sulphur
calcium
magnesium
iron
manganese
boron
copper & zinc
molybdenum
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0

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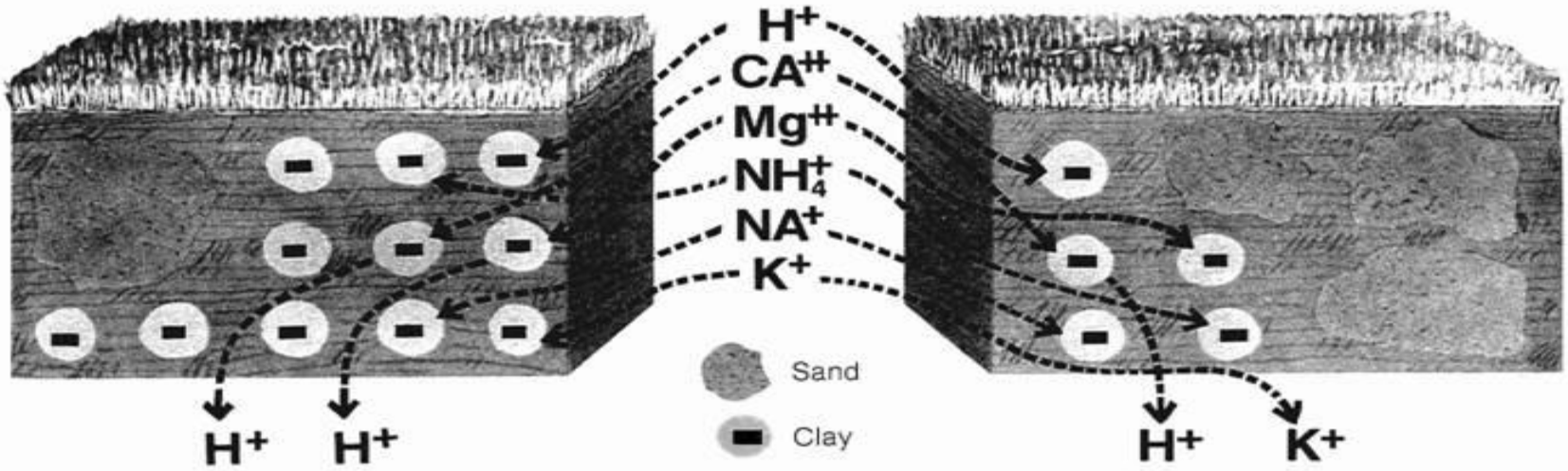
A SCHEMATIC LOOK AT CATION EXCHANGE

CEC 25

MORE CLAY, MORE POSITIONS TO HOLD CATIONS

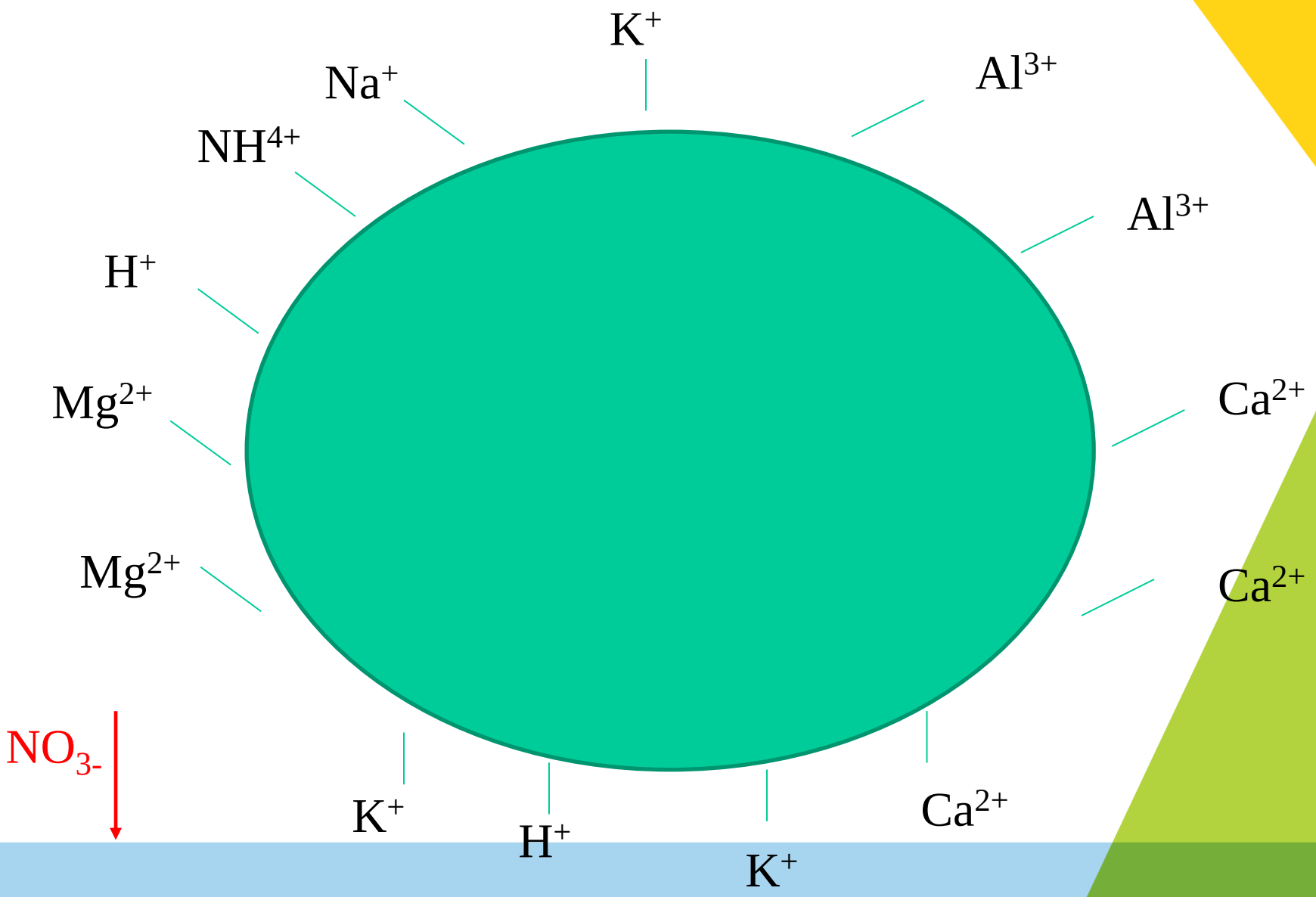
CEC 5

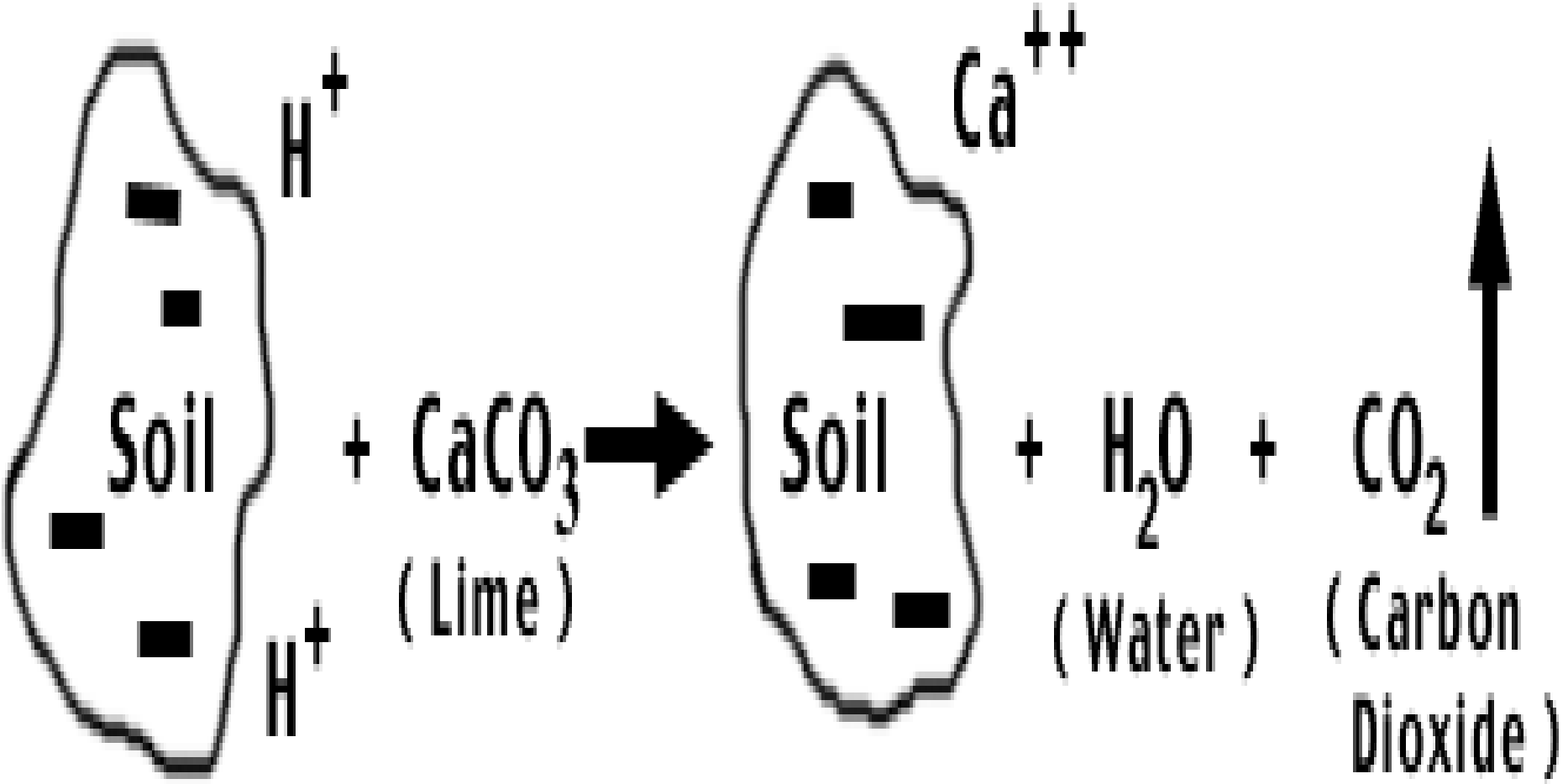
LOW CLAY CONTENT, FEWER POSITIONS TO HOLD CATIONS



50 CEC (Heavy Clay) ← **Common CEC Range** → **0 CEC** (Sand)

SOME PRACTICAL APPLICATIONS	
Soils with CEC 11-50 Range	Soils with CEC 1-10 Range
• High clay content • More lime required to correct a given pH • Greater capacity to hold nutrients in a given soil depth • Physical ramifications of a soil with a high clay content • High water-holding capacity	• High sand content • Nitrogen and potassium leaching more likely • Less lime required to correct a given pH • Physical ramifications of a soil with a high sand content • Low water-holding capacity


K+
Na+
Al3+
NH4+
Al3+
H+
Mg2+
Ca2+
Mg2+
Ca2+
NO3-
K+
H+
K+
Ca2+


H+
Soil
H+
+ CaCO3
(Lime)
Ca++
Soil
+ H2O
(Water)
+ CO2
(Carbon Dioxide)

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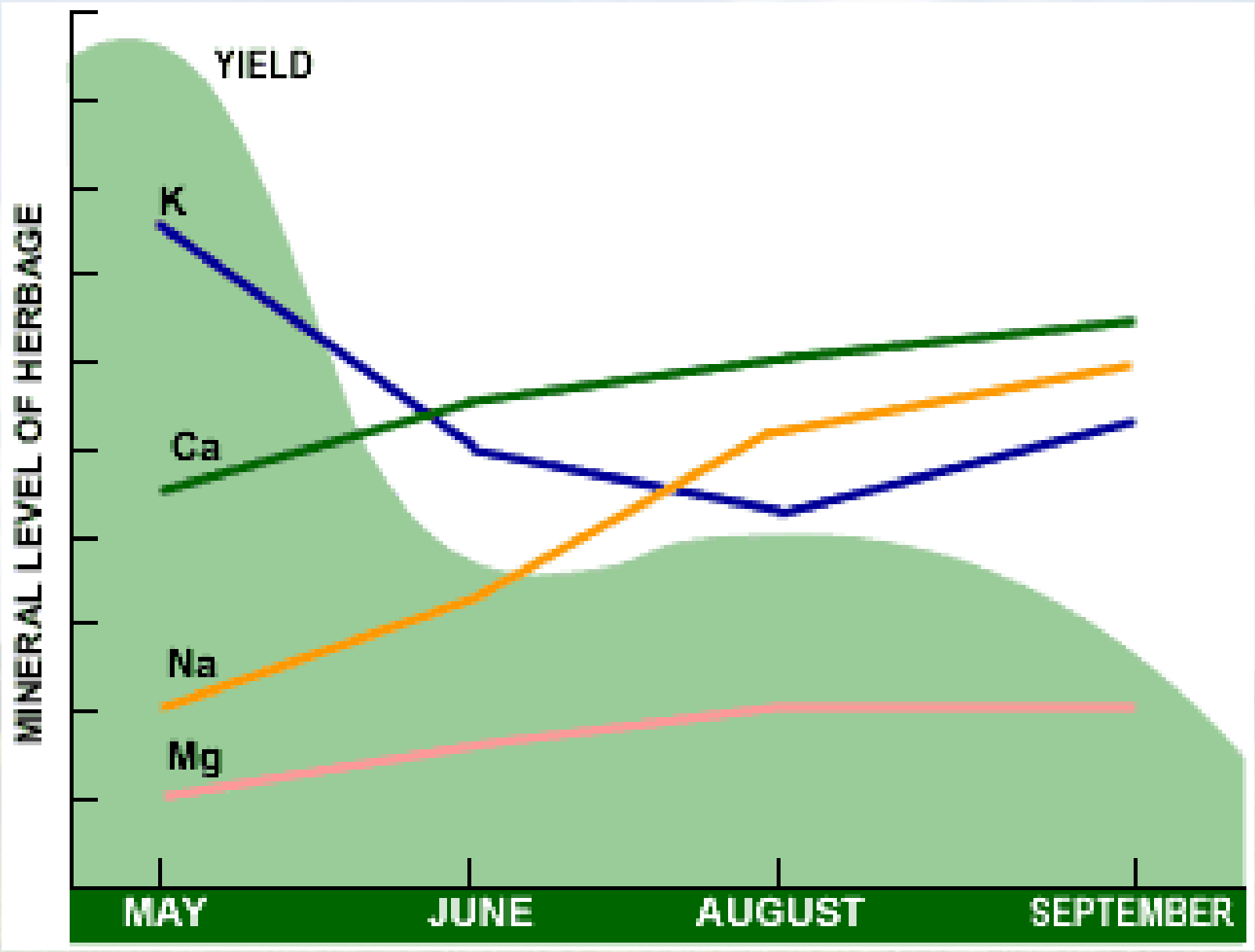
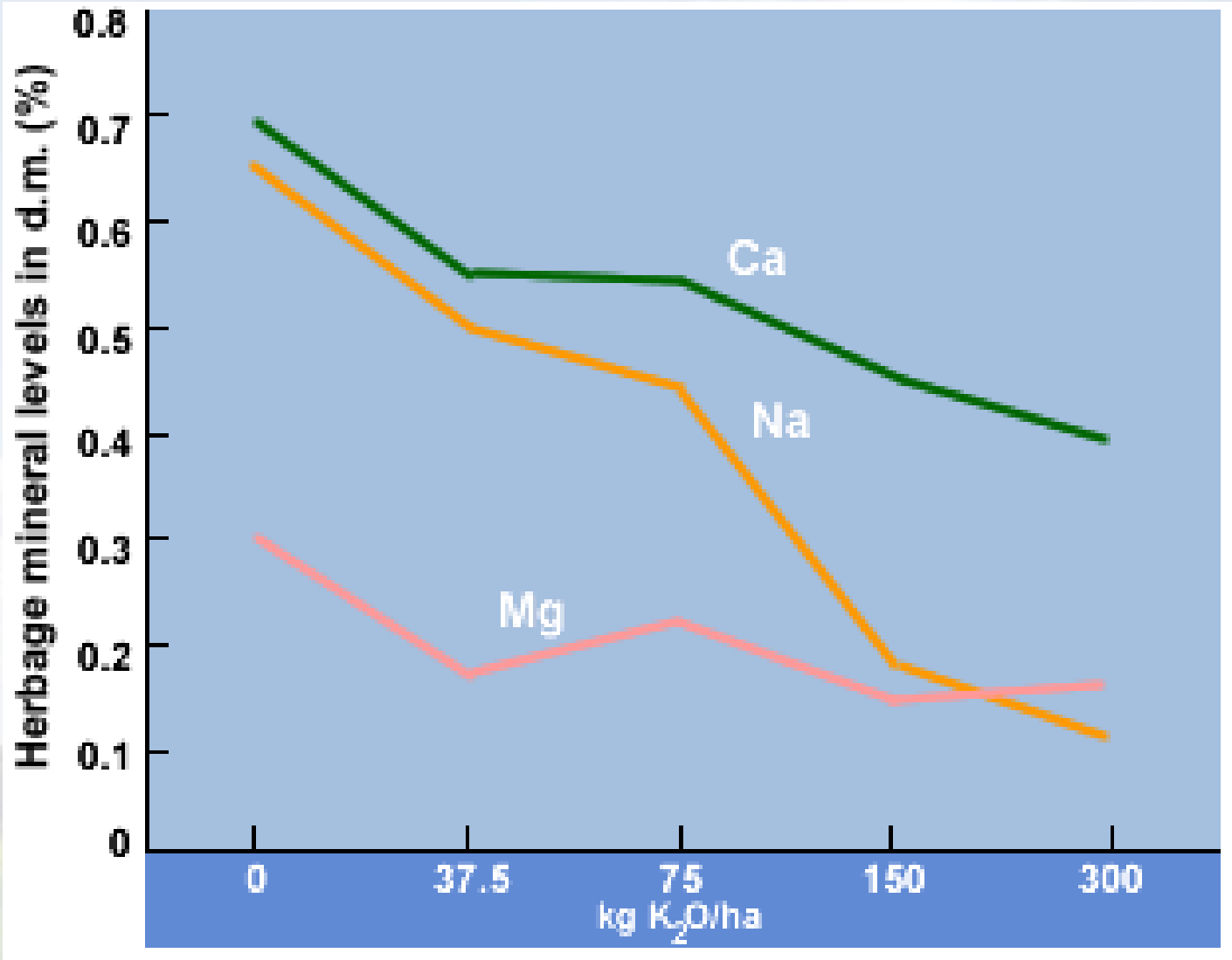
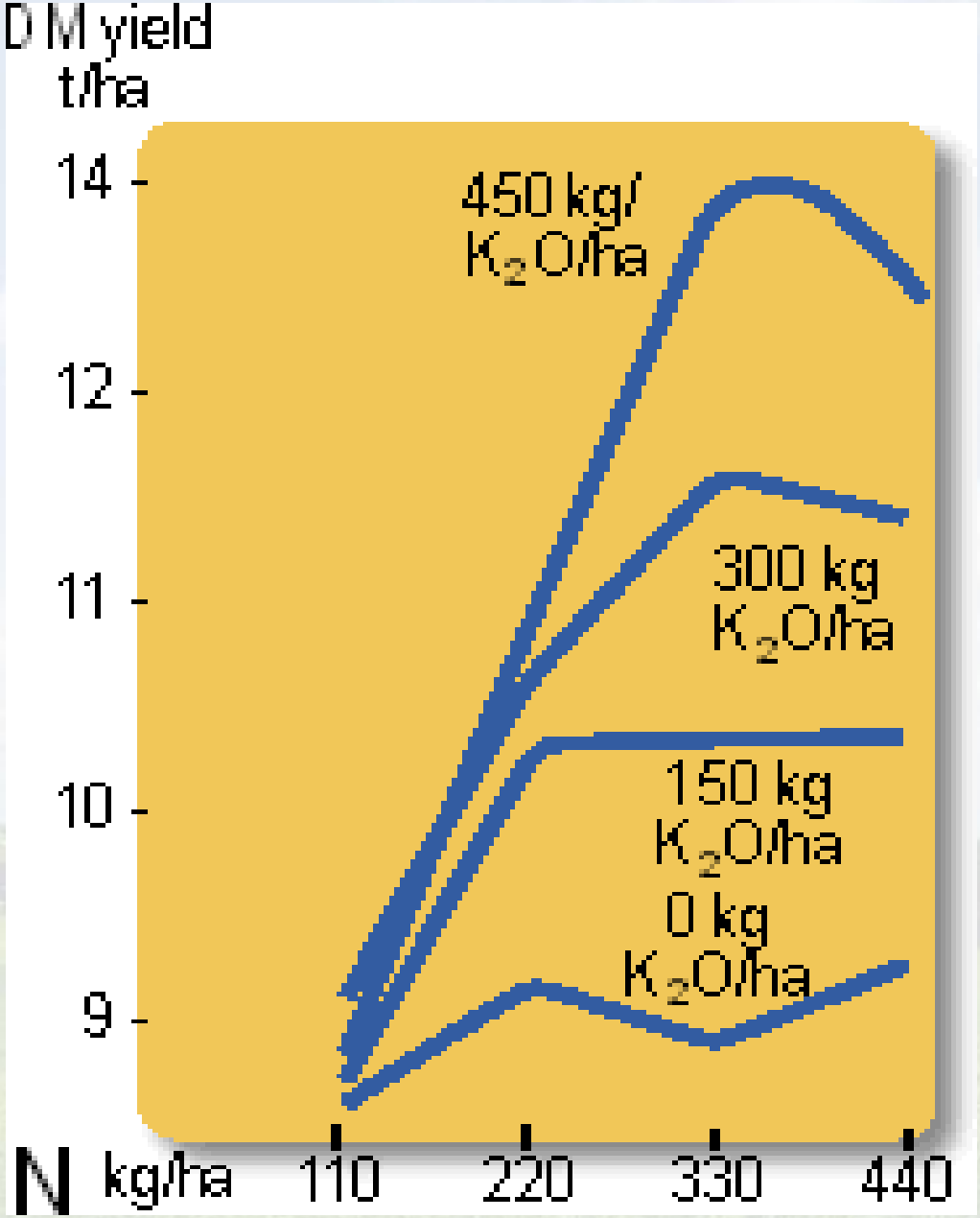

YIELD
K
Ca
Na
Mg
MINERAL LEVEL OF HERBAGE
MAY
JUNE
AUGUST
SEPTEMBER


Herbage mineral levels in d.m. (%)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Ca
Na
Mg
0
37.5
75
150
300
kg K2O/ha


D M yield
t/ha
14
12
11
10
9
450 kg/
K2O/ha
300 kg
K2O/ha
150 kg
K2O/ha
0 kg
K2O/ha
N kg/ha
110
220
330
440

Soil pH and Nutrient Availability

Table 1. Soil pH and Interpretation

5.0	5.5	6.0	6.5	7.0	7.5	8.0
Strongly Acid	Medium Acid	Slightly Acid	Slightly Acid	Neutral	Mildly Alkaline	Moderately Alkaline
			Best Range for Most Crops			

Problems in very acid soils	**Problems in alkaline soils**
*Aluminum toxicity to plant roots	*Iron deficiency
*Manganese toxicity to plants	*Manganese deficiency
*Calcium & magnesium deficiency	*Zinc deficiencies
*Molybdenum deficiency in legumes	*excess salts (in some soils)
*P tied up by Fe and Al	*P tied up by Ca and Mg
*poor bacterial growth	*bacterial diseases in potatoes
*reduced nitrogen transformations * Poor herbicide activity	

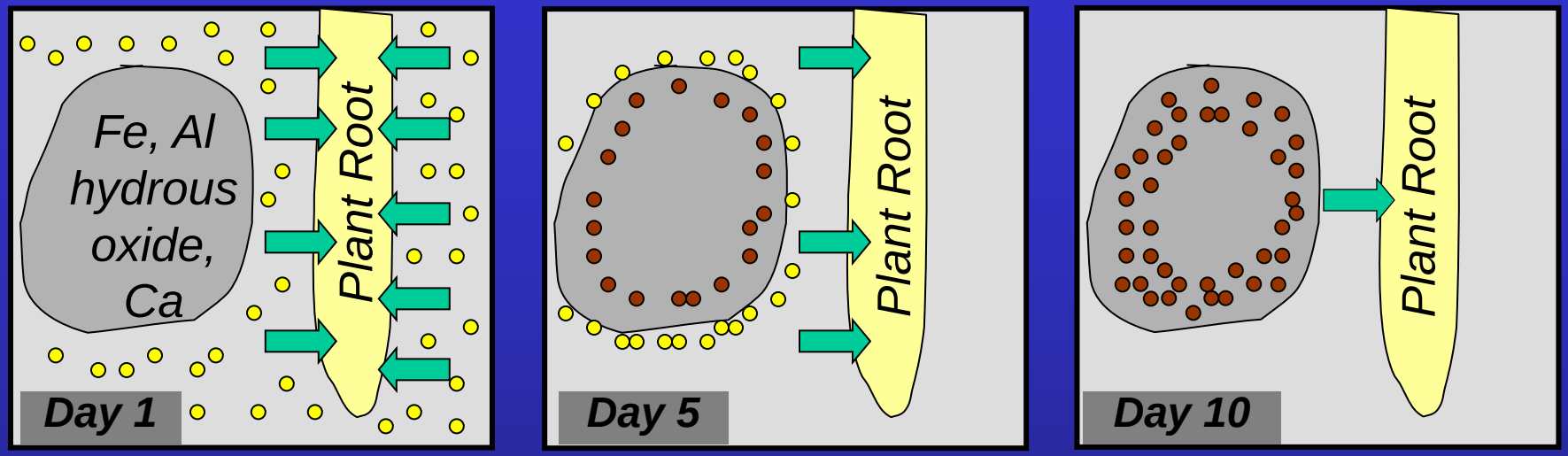
Soil pH and Nutrient Availability

- Nitrogen
  - Most Plants prefer NO_3^-
  - Need pH of 6.5 to 7.0 for nitrification
  - Need pH above 6.2 for legume growth
  - $NH_4^+ + 2O_2$ bacteria $NO_3^- + \mathbf{2H}^+ + H_2O$ **P**lant uptake.

Soil pH and Nutrient Availability

- Phosphorus
  - Low pH P binds with Al & Fe
  - High pH P binds with Ca
- Potassium
  - Higher pH releases K

3. P added to soils becomes fixed very rapidly.



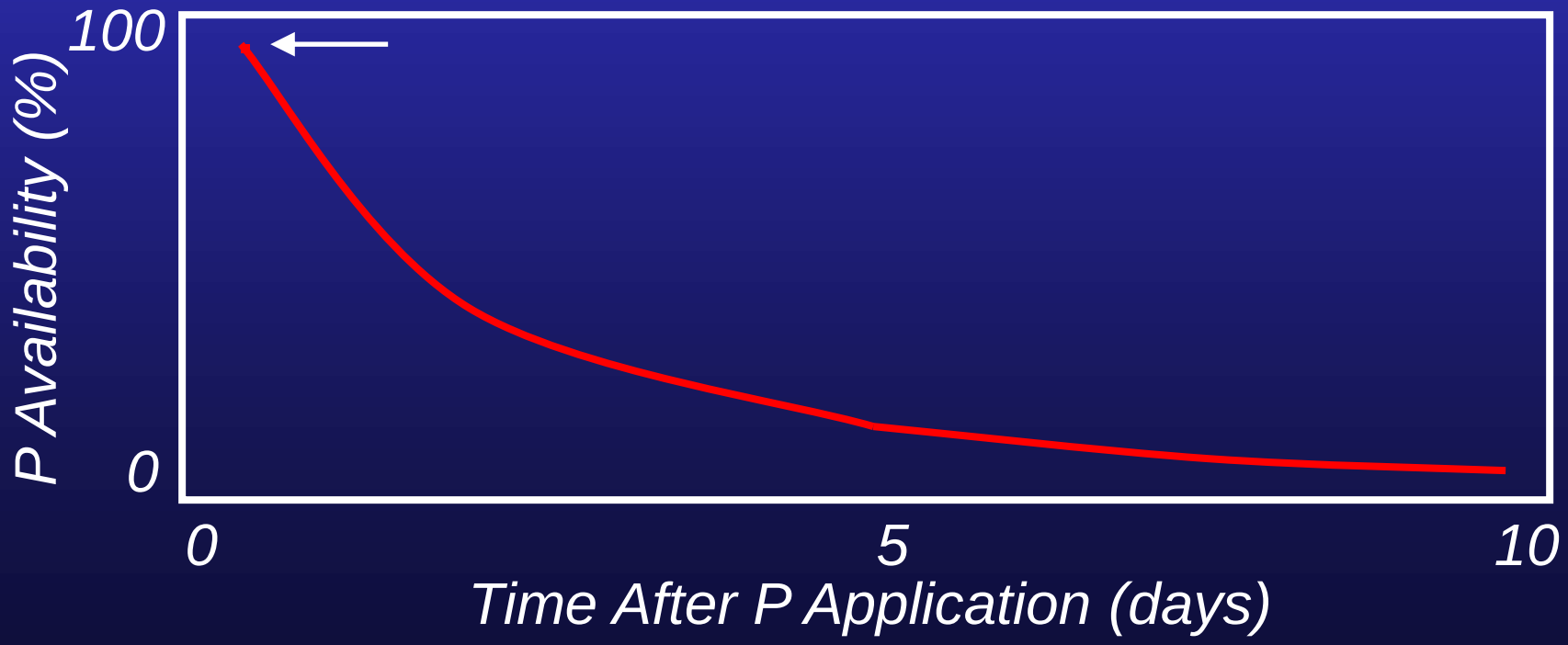


Table 8. Recommended nitrogen rates for perennial grass and grass-legume forages.

	Nitrogen to apply[1]	
	Per application	Total per year
	N to apply, lb/acre	
Grass (<30 legume)[2]		
Hay, high level management (5+ ton/acre)	50-75	200 - 240
Hay, medium level management (3-4 ton/acre)	50	120 - 160
Hay, low level management (2 ton/acre)	40-50	80
Pasture[3]	50	50 - 100
Conservation planting	40	40
Legume-grass mix (30-60% legume)		
Hay harvest	40	40 - 80[4]
Pasture	0	0
Conservation planting	0	0
Legume (>60% legume)	0	0

More legumes less N required

[1] Basing a nitrogen application on realistic yield goals is extremely important in order to avoid over applications of N.
[2] Yields are dry hay equivalent (12-15% moisture). One ton dry hay is equivalent to 2.5 tons haylage (65% moisture).
[3] Avoid N applications to pasture if over-seeding legumes or to encourage legume growth.
[4] If a spring nitrogen application is made, in some cases, a second application later in the season may benefit mixed hay stands.

Table 9. Recommended base phosphorus rates for selected available P and Al test values. (Adjust for specific crop based on Table 10.)

Reactive Al	Available P soil test						
	Low		Medium		Optimum[1]	High[2]	Excessive
	ppm						
	0.5	1.5	2.5	3.5	4.1-7	7.1-20	>20
ppm	P_2O_5 to apply, lb/acre						
10	60	60	40	40	20	0	0
20	65	60	40	40	20	0	0
30	75	55	40	40	20	0	0
40	90	65	40	40	20	0	0
50	100	70	45	40	20	0	0
60	110	80	50	40	20	0	0
70	120	90	55	40	30	0	0
80	120	95	60	40	30	0	0
90	120	105	65	40	30	0	0
100	120	115	70	40	30	0	0
110	120	120	75	40	30	0	0
120	120	120	80	40	30	0	0
130	120	120	85	40	30	0	0
140	120	120	90	40	30	0	0
150	120	120	95	40	30	0	0
160	120	120	100	40	30	0	0
170	120	120	105	40	30	0	0
180	120	120	110	40	30	0	0
190	120	120	115	40	30	0	0
200	120	120	120	40	30	0	0

Note: Table shows selected values within each category. Recommended P application rates are based on the equation in the text below.

[1] The recommended rate (20-30 lb P_2O_5/acre) is best applied as starter/row fertilizer at planting for corn or broadcast as a blend with other nutrients as a topdress on perennial hay forages.

[2] A low rate of starter fertilizer (10-20 lb P_2O_5/acre) is recommended, especially under conditions of early planting, limited drainage, or conservation tillage.

Higher Aluminum = Higher P rates required

Table 11. Recommended potassium rates for field crops.

	K soil test						
	Low		Medium		Optimum	High	Excessive
K, ppm	<25	26-50	51-75	76-100	101-130	131-160	>160
	K_2O to apply (lb/acre)						
Corn for silage[1]							
15-20 ton/acre	180	140	100	60	40	20[2]	0
20-25 ton/acre	200	160	120	80	60	20[2]	0
25+ ton/acre	240	200	160	120	80	30	0
Corn for grain							
90-120 bu/acre	120	80	40	30	20	20	
120-150 bu/acre	140	100	60	40	30	20	0
150+ bu/acre	180	140	100	60	30	20	0
Alfalfa (>60%)[3]							
Topdress							
2-4 tons/acre	280	240	200	160	100	40	0
5 tons/acre	320	280	240	200	140	60	0
6+ tons/acre	360	320	280	240	180	80	0
Establishment	240	200	160	120	80	40	0
Clover, trefoil, grass, alfalfa (30-60%)[3]							
Topdress							
2-4 tons/acre	220	180	140	100	60	0	0
5 tons/acre	240	200	160	120	80	40	0
6+ tons/acre	260	220	180	140	100	60	0
Establishment	180	140	100	80	60	0	0
Small grains, soybeans, buckwheat, dry beans, peas, millet	120	100	80	60	40	0	0
Conservation Planting	80	60	40	0	0	0	0

[1] Corn silage yields are wet tons/acre (30-35% DM).
[2] 10-20 lb K_2O/acre is recommended as row-applied starter under conditions of early planting, limited drainage, or conservation tillage.
[3] Yields are dry hay equivalent (12-15% moisture). One ton dry hay is equivalent to 2.5 tons haylage (65% moisture).

More Yield and/or more Legume = Higher K

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