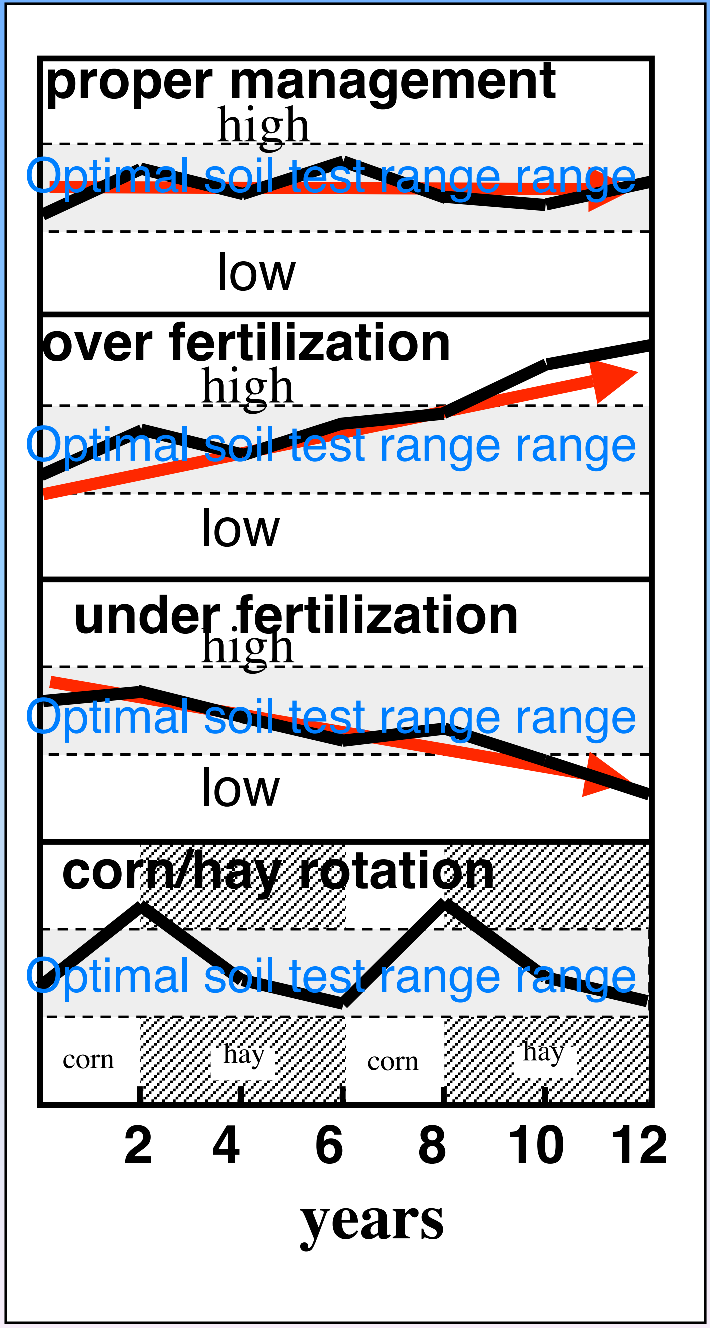
Getting the most from your soil tests

Soil testing is only one part of nutrient management

Nutrient flows

Nutrient cycles

Organic matter management



Soil test P and K trends under different fertility management regimes.

(Modified from The PennState Agronomy Guide, 1999)

Strategies for Improving Nutrient Cycles

- Reduce unintended losses.
- Enhance nutrient uptake efficiency.
- Tap local nutrient sources and credit their nutrients.
- Promote consumption of locally produced foods.

Strategies for
Improving Nutrient Cycles (cont.)

- Reduce exports of nutrients in farm products.
- Bring animal densities in line with the land base of the farm.
- Develop local partnerships to balance flows among different types of farms.

Manure and Sod Code Table						
Solid Manure	Liquid Manure	N, P_2O_5, K_2O, in manure subtracted from required application of fertilizer, when applied in fall& winter, spring or spring and then incorporated (covered)				
		Fall & Winter	Spring	Spring Covered		
(tonnes /Ha)	(m^3/Ha)	N (kg/Ha)	N (kg/Ha)	N (kg/Ha)	P_2O_5 (kg/Ha)	K_2O (kg/Ha)
Cattle or mixed livestock manure						
10	25	10	25	30	10	40
20	50	20	50	60	20	80
30	75	30	75	90	30	120
40	100	40	100	120	40	160
Swine manure						
10	25	15	30	40	20	25
20	50	30	60	80	40	50
30	75	45	90	120	60	75
40	100	60	120	160	80	100
Poultry manure						
5	15	15	30	35	35	50
10	30	35	70	85	70	100
15	45	50	100	120	105	150
20	60	70	140	170	140	200
Sod Plowed Down						
0		NONE			0	
1		LESS THAN 1/3 LEGUME			5	
2		1/3 TO 1/2 LEGUME			20	
3		1/2 OR MORE LEGUME			40	

Credits

- *Manure*
- *Rotation with legume*

Approximate amount of nutrients removed in harvested portion of selected crops (representative commercial yields)

	N	P	K
Agronomic crops	------lbs/acre-----		
corn grain	**100**	**7**	**25**
corn silage	**140**	**35**	**116**
alfalfa	**200**	**26**	**166**
grass hay	**160**	**20**	**125**
soybeans	**150**	**18**	**46**
Vegetables			
broccoli	**20**	**2**	**45**
brussel sprouts	**139**	**20**	**125**
carrots	**80**	**20**	**200**
lettuce	**95**	**12**	**110**
onions	**110**	**20**	**110**
potatoes	**150**	**19**	**200**
tomatoes	**100**	**10**	**179**
Fruits			
honeydew melons	**70**	**8**	**65**
apples	**35**	**9**	**63**
peaches	**68**	**10**	**86**

Getting the most from your soil tests

What do soil tests tell us?

What don't soil tests tell us?

Getting the most from your soil tests

Causes of confusion

- ✓ Different lab procedures
- ✓ Various ways to report results
- ✓ Numerous recommendation systems

Getting the most from your soil tests

✓ Different lab procedures

Different solutions used

Mehlich 1

Mehlich 3

Bray-1

Morgan

Modified Morgan

Bray-2

Olsen

Table 19.1 Phosphorus soil tests used in different regions.

Arid and semi-arid Midwest, West and Northwest (Buffered alkaline (basic) solutions)

Olsen and AB-DTPA

Humid Midwest, mid-Atlantic, and Southeast, Eastern Canada, North Central and Midwest (Dilute strong acids plus fluoride)

Mehlich 3 and Bray 1 (also called Bray P-1 or Bray-Kurtz P)

Southeast and Mid-Atlantic (Dilute strong acids)

Mehlich 1

Northeast (New York and most of New England), some labs in Idaho and Washington (Dilute weak acids)

Morgan or modified-Morgan or Mehlich 3

Table 4. Methods for determining lime requirement.

State	Method
AL	Adams-Evans
AR	pH & texture (Ca content)
FL	Adams-Evans
GA	Adams-Evans
KY	SMP buffer & pH
LA	Calcium hydroxide
MS	Modified Woodruff
NC	Mehlich buffer
OK	SMP
PR	Calcium hydroxide & calcium carbonate
SC	Modified Adams-Evans
TN	Adams-Evans
TX	Crop & pH, or HCl-Al
VA	None

	wt.	Solution	ratio	time
AL	5 g	Mehlich 1	1:4	30
AR	2 g	Mehlich 3	1:7	10
FL	5 g	Mehlich 1	1:4	5
GA	5 g	Mehlich 1	1:4	5
KY	2 mL	Mehlich 3	1:10	5
LA	2.5 g	Bray P2	1:20	15
MS	5 g	Lancaster	1:5	15
NC	2.5 mL	Mehlich 3	1:10	5
OK	2 mL	Mehlich 3	1:10	5
PR	1 g	Bray-Kurtz (P1)	1:10	5
SC	4 mL	Mehlich 1	1:5	5
TN	5 mL	Mehlich 1	1:4	5
TX	2 g	Morgan (mod.)	1:20	60
VA	4 mL	Mehlich 1	1:5	5

Getting the most from your soil tests

✓ Various ways to report results

lbs/acre

ppm

Index of 1 to 100

Elemental forms

P and K

Vs.

Oxide forms

P_2O_5 and K_2O

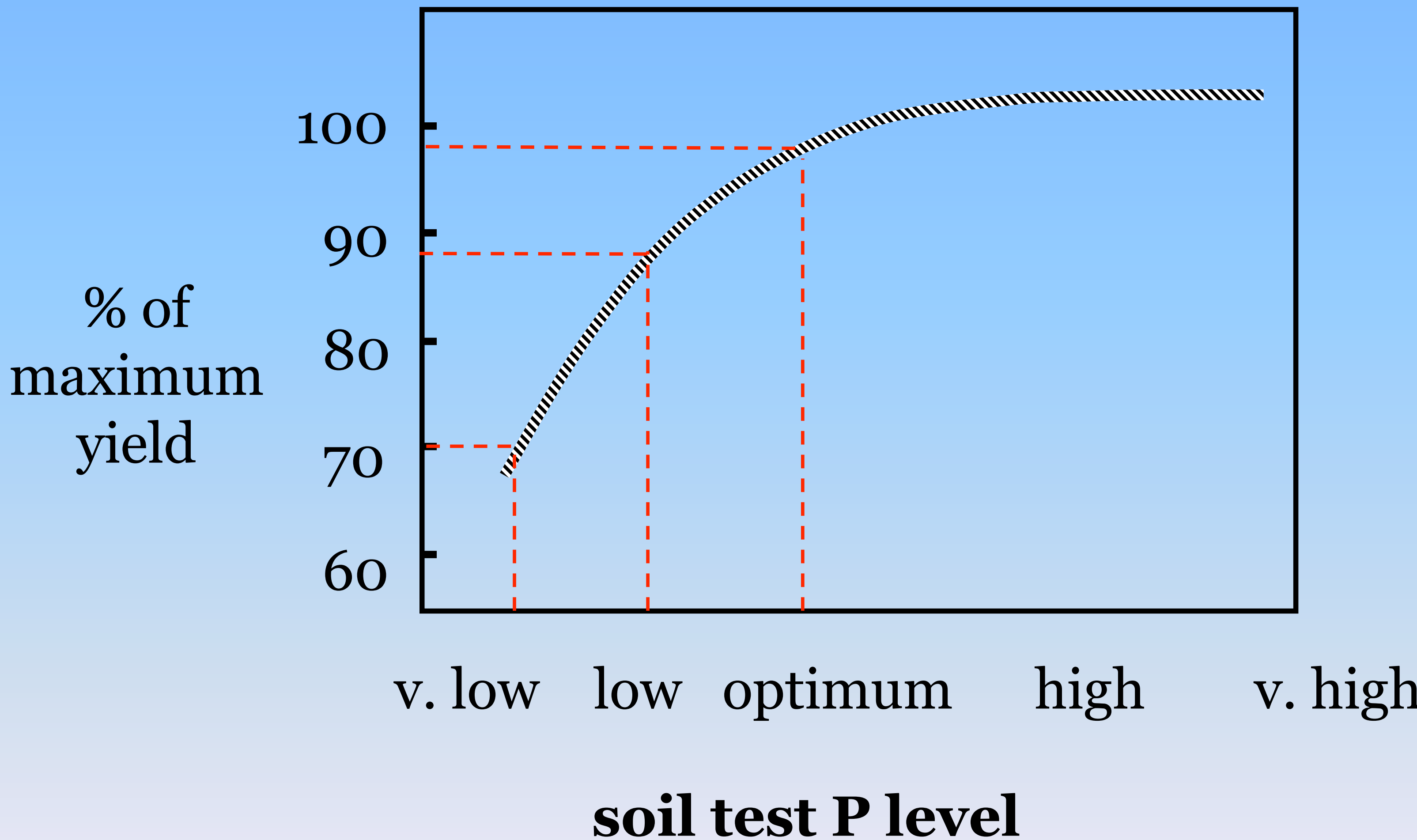
Getting the most from your soil tests

✓ Numerous recommendation systems

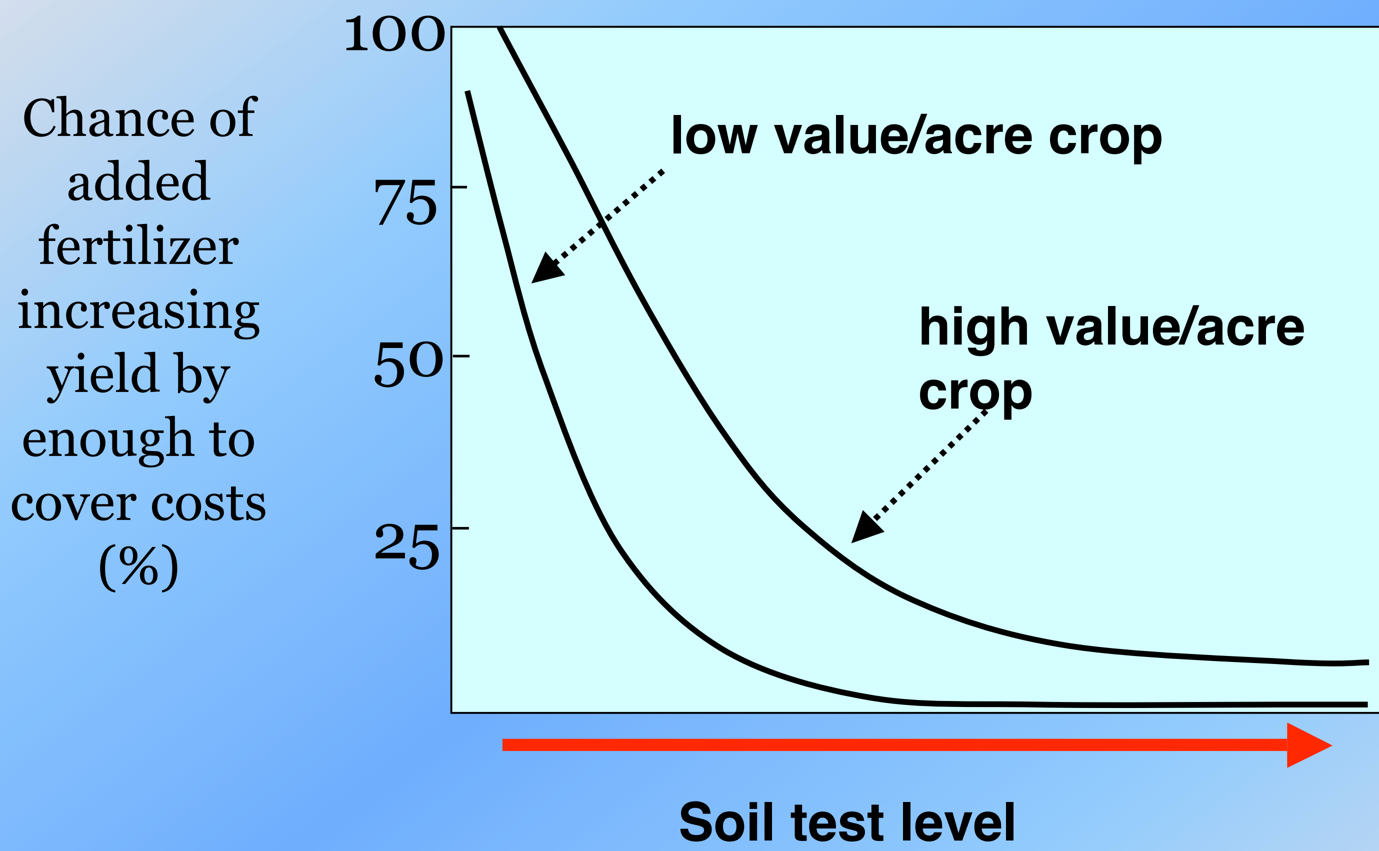
sufficiency

Build-up and maintain

Cation ratio balancing



Percent of maximum yield with different soil test levels.



The chances of getting an economic return to using fertilizer at different soil test levels.

Cation Ratio
vs.
Sufficiency System

The cation ratio system is used by some labs only for making K, Mg, and Ca

Does not effect N or P recommendations

Some labs blend the two systems for making K (PSU) or Mg (UVM) recommendations

Modified Morgan's Solution (Vermont)

Category	Low	Medium	Optimum	High	V. High
Available P	0–2	2–4	4–7	7–20	>20
K	0–50	51–100	101–130	131–160	>160
Mg	0–35	35–50	51–100	>100	----

NOTE: nutrients in ppm

For potash

Category	Low	Medium	Optimum	High	V. High
K (ppm)	0–50	51–100	101–130	131–160	>160
K_2O to apply	100–360	60–240	40–140	0—60	none

NOTE: Application is in lbs per acre of K_2O

For Phosphate

Category	Low	Medium	Optimum	High	V. High
Available P	0–2	2–4	4–7	7–20	>20
P_2O_5 apply	*60*	*40*	*20*	*0*	*0*
IF Al low (10 ppm)					

UVM soil test recommendation system takes reactive Aluminum into account. The more Al, the greater P needs to be added to increase soil test by a given amount. A high Al value can double the recommended P application at low and low-medium soil tests.

New Nouveau
Brunswick
C A N A D A

Agriculture, Fisheries and Aquaculture

Agriculture, Pêches et Aquaculture

CROP FERTILIZATION GUIDE

Rating	Soil test level	Soil P content (ppm P)	Soil K content (ppm K)
L-	Very low	< 10	< 18
L	Low	11–19	19-37
M	Medium	20–39	38-74
M+	Med. high	40–58	75-112
H	High	59–78	113-148
H+	Very High	> 78	> 148

P_2O_5 (ppm)		K_2O (ppm)	
V. Low	<23	V. Low	<22
Low	24-44	Low	23-44
Med.	45-90	Med.	45-88
Med. H.	91-135	Med. H.	89-135
High	136-164	High	136-178
V. High	>164	V. High	>178

PHOSPHORUS

Rating	Soil K level	Soil P content (ppm P)	Recommendations (kg P_2O_5 /ha)					
			Broccoli	Brussel Sprouts	Cabbage	Cauliflower	Cole Crops	Mixed Vegetables
L-	Very low	< 10	225	225	225	225	225	360
L	Low	11–19	225	225	225	225	225	240
M	Medium	20–39	160	160	160	160	160	120
M+	Med. high	40–58	90	90	90	90	90	120
H	High	59–78	90	90	90	90	90	120
H+	Very High	> 78	90	90	90	90	90	60

Basic Cation Saturation Ratio System

CEC	K(2-5%)	Mg 10-15%	Ca 65-75%
30	292	360	3900
28	274	336	3640
26	254	312	3380
24	234	288	3120
22	215	263	2860
20	195	240	2600
18	187	230	2340
16	176	218	2080
14	164	202	1820
12	152	183	1560
10	141	160	1300
8	129	135	1040
6	117	106	708
4	85	75	520
2	67	54	330

North Central Regional Extension Publication 533

Soil Cation Ratios for Crop Production

by George Rehm
Soil Science Department
University of Minnesota

One Hundred Years of Ca:Mg Ratio Research[1]

K.A. Kelling, E.E. Schulte and J.B. Peters[2]

The question of the importance of soil Ca:Mg ratios in the nutrition of crops and for making soil test recommendations has been raised many times over the past 100+ years. Recently this issue has surfaced again as a part of programs promoted as "sustainable farming systems" or friendlier to the land or other parts of the environment. As others before them, these businesses are promoting the use of calcitic limestone, or gypsum ($CaSO_4$) to bring Wisconsin soil into better cationic "balance".

[1]Kelling, K.A., E.E. Schulte, and J.B. Peters. 1996. One hundred years of Ca: Mg ratio research. New Horizons in Soil Science, Number 8-96, Dept. of Soil Science, University of Wisconsin, 10 p.

Our examination of data from numerous studies (particularly those of Albrecht and Bear themselves) would suggest that, within the ranges commonly found in soils, the chemical, physical, and biological fertility of a soil is generally not influenced by the ratios of Ca, Mg, and K. The data do not support the claims of the BCSR, and continued promotion of the BCSR will result in the inefficient use of resources in agriculture…

—Kopittke and Menzies (2007)