Table 1. Interpretation of soil test values for phosphorus (P) determined by Bray P_1, Mehlich-3, or Olsen extractants and potassium (K) determined by ammonium acetate or Mehlich-3 extractants for surface soil samples (6- to 7-inch deep cores).

	Wheat, alfalfa	All crops except wheat, alfalfa		All crops	
		Subsoil P		Subsoil K	
		Low	High	Low	High
	ppm				
Relative level	Bray P_1 or Mehlich-3 P			Ammonium Acetate or Mehlich-3 K	
Very low (VL)	0–15	0–8	0–5	0–90	0–70
Low (L)	16–20	9–15	6–10	91–130	71–110
Optimum (Opt)	21–25	16–20	11–15	131–170	111–150
High (H)	26–30	21–30	16–20	171–200	151–180
Very high (VH)	31+	31+	21+	201+	181+
	Olsen P				
Very low (VL)	0–10	0–5	0–3		
Low (L)	11–14	6–10	4–7		
Optimum (Opt)	15–17	11–14	8–11		
High (H)	18–20	15–20	12–15		
Very high (VH)	21+	21+	16+		
	Mehlich-3 ICP				
Very low (VL)	0–20	0–15	0–10		
Low (L)	21–30	16–25	11–20		
Optimum (Opt)	31–40	26–35	21–30		
High (H)	41–50	36–45	31–40		
Very high (VH)	51+	46+	41+		

Phosphorus and Potassium Recommendations

The recommended amounts of P_2O_5 and K_2O are based on research conducted in Iowa during many years. Applying the recommended rates for the very low and low soil test categories will result in profitable crop responses in that year and at the same time increase soil test values after crop harvest because of significant residual effects from the applied P and K.

The recommended P and K rates for the optimum soil test category are based on average nutrient removal in harvested crop parts (grain, silage, straw, and hay). The fertilization amounts shown in the tables for the optimum soil test category use default yield levels. These can be adjusted to a field-specific yield. The nutrient content per unit of yield for Iowa agronomic crops is given in Table 2.

Table 2. The nutrient content of harvested crops used to calculate nutrient removal and recommended amounts of P_2O_5 and K_2O for optimum soil test category.

		Pounds per unit of yield	
Crop	Unit of Yield	P_2O_5	K_2O
Corn	bu	0.375	0.30
Corn silage	bu grain equivalent	0.55	1.25
Corn silage	ton, 65% H_2O	3.50	8.0
Corn stover*	ton	5.9	25.0
Soybean	bu	0.80	1.5
Soybean stover*	ton	2.8	9.9
Oat and straw	bu	0.40	1.0
Oat straw	ton	5.0	33.0
Wheat	bu	0.60	0.30
Wheat straw	ton	4.0	25.0
Sunflower	100 lb	0.80	0.70
Alfalfa	ton	12.50	40.0
Red clover	ton	12.0	35.0
Trefoil	ton	12.0	35.0
Vetch	ton	12.0	47.0
Smooth bromegrass	ton	9.0	47.0
Orchardgrass	ton	14.0	68.0
Tall fescue	ton	12.0	66.0
Timothy	ton	9.0	32.0
Perennial ryegrass	ton	12.0	34.0
Sorghum-sudan	ton	12.0	38.0
Switchgrass	ton	12.0	66.0
Reed canarygrass	ton	9.0	47.0

*Nutrients in corn and soybean stover reflect content at plant maturity (dry matter based), and will therefore be more representative of stover harvested immediately after grain harvest. Corn stover is an average content of all aboveground plant components except grain. Soybean stover is nutrient content only of stems.

Micronutrients Recommendations

Iowa State University recommends only zinc (Zn) for corn and sorghum based on soil testing. The Zn soil test has been calibrated on Iowa soils. Zinc recommendations for corn and sorghum are given in Table 13.

Soil test procedures for the other micronutrients have not been calibrated because of either lack of or inconsistency of occurrence of deficiencies with the exception of iron deficiency on soybean. Iron deficiency on soybean occurs on high pH (calcareous) soils in central and north central Iowa and can be predicted by soil occurrence as shown in soil survey reports. Development of soybean varieties tolerant to low iron availability in calcareous soils has been an acceptable solution to the problem.

Table 13. Zinc recommendations for corn and sorghum production.

	Zinc Soil Test (ppm)		
Soil Test Category:	**Low**	**Marginal**	**Adequate**
DTPA Extractable Zn:	0–0.4	0.5–0.8	0.9+
	Zn to apply broadcast (lb/acre)		
	10	5	0
	Zn to apply in band (lb/acre)*		
	2	1	0

*Recommendation for amount to apply in band is based on other states' information.

Limestone Recommendations

Limestone recommendations (Table 14) are given in pounds of pure fine calcium carbonate ($CaCO_3$). The recommended amounts listed in Table 14 are for different soil Buffer pH, intended soil pH, and depth of soil to be neutralized. Actual rates of limestone to apply are calculated from the recommended $CaCO_3$ rate (Table 14) and the effective calcium carbonate equivalent (ECCE) of the limestone product to be applied (ECCE is determined for all agricultural limestone sources in Iowa). Soil pH is used to determine whether or not to lime the soil. The SMP Buffer (also termed the Ohio Buffer) solution has been calibrated to determine the amount of lime required to increase soil pH to a specific pH.

Recommendations are given to increase soil pH to 6.5 or to 6.9. Soil pH 6.0 is considered to be sufficient for grass pastures and grass haylands. Soil pH 6.9 is recommended for alfalfa. Soil pH 6.5 is considered to be sufficient for corn and soybean. Because of high pH (pH > 7.4) in the subsoil of the Clarion-Nicollet-Webster, Galva-Primghar-Sac, Moody, Ida-Monona, Marshall, and Luton-Onawa-Salix soil associations, soil pH 6.0 is considered sufficient for corn and soybean grown in these soil associations, but when liming is required, lime is recommended to raise soil pH to 6.5.

The amount of limestone recommended is adjusted for the incorporation depth from tillage, which determines the volume of soil to be neutralized. The equivalent depth for no-till is considered to be 2 to 3 inches.

Table 14. Lime recommendations, based on SMP Buffer Test, are given in pounds of pure fine calcium carbonate ($CaCO_3$) to increase soil pH from its present level to pH 6.5 or 6.9 for the depth of soil to be neutralized.

	Depth of soil to be neutralized*							
Buffer	**2 inch**		**3 inch**		**6 inch**		**8 inch**	
pH	**pH 6.5**	**pH 6.9**	**pH 6.5**	**pH 6.9**	**pH 6.5**	**pH 6.9**	**pH 6.5**	**pH 6.9**
	- $CaCO_3$ to apply (lb/acre) -							
7.0	0	400	0	600	0	1,100	0	1,500
6.9	0	600	0	1,000	0	1,900	0	2,500
6.8	200	900	300	1,400	600	2,700	800	3,600
6.7	400	1,200	700	1,800	1,300	3,500	1,700	4,700
6.6	700	1,500	1,100	2,200	2,100	4,400	2,800	5,900
6.5	900	1,700	1,400	2,600	2,800	5,200	3,700	6,900
6.4	1,200	2,000	1,800	3,000	3,500	6,000	4,700	8,000
6.3	1,400	2,300	2,100	3,400	4,200	6,800	5,600	9,100
6.2	1,700	2,600	2,500	3,900	5,000	7,700	6,700	10,300
6.1	1,900	2,800	2,900	4,300	5,700	8,500	7,600	11,400
6.0	2,200	3,100	3,200	4,700	6,400	9,300	8,600	12,400
5.9	2,400	3,400	3,600	5,100	7,100	10,100	9,500	13,500
5.8	2,600	3,700	4,000	5,500	7,900	11,000	10,600	14,700
5.7	2,900	3,900	4,300	5,900	8,600	11,800	11,500	15,900

*Soil pH 6.9 is recommended for alfalfa. Soil pH 6.5 is considered to be sufficient for corn and soybean. Because of high pH subsoils in the Clarion-Nicollet-Webster, Galva-Primghar-Sac, Moody, Ida-Monona, Marshall, and Luton-Onawa-Salix soil associations, soil pH 6.0 is considered sufficient for corn and soybean grown in these soil associations, but when liming is required, lime to soil pH 6.5. Soil pH 6.0 is sufficient for grass pastures and grass hayland.