Fall Fertility for Forages

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LATE SUMMER AND FALL offer timely opportunities to supply nutrients removed by harvest. Whether your forage crop is legume or grass, it takes a lot out of the soil. Restoring soil phosphorus (P) and potassium (K) fertility is an important aspect of managing for optimum productivity.

A soil test is the foundation of a sound forage fertility program. Unfortunately, many forage producers don't have time to sample as often as needed. High-producing fields should be sampled every year, because nutrients turn over rapidly. Each cutting removes large amounts of P and K. Manures, when applied, return large amounts of P and K.

Forage analysis can give a timely update of your soil nutrient balance. Forage quality varies greatly from one harvest to the next. Crude protein, fibre, digestibility, and minerals all affect the health of your herd. Analyzing the forage from each major cut helps you make decisions on nourishing your animals. The same analysis can help you make decisions on fertilizing your forages.

Mineral content depends on the forage species and whether harvested as hay or haylage (see **Table 1**). Note how widely they vary. Analyzing your hay can save money on mineral supplements, and ensure that your livestock are getting healthy nutrition. Interpreted correctly, the analysis can also indicate the crop's mineral nutrition.

To find whether your forage crop is getting enough P and K, compare your forage analysis to the critical nutrient concentrations listed in **Table 2**. These figures are for whole forages at typical harvest times.

There are a number of additional factors you will need to consider to interpret these levels correctly.

Hay tends to have lower mineral concentrations than haylage, for two reasons. Hay is more likely to receive rain after cutting, and thus nutrients (especially K) can leach out. Haylage shrinks as it ferments, and the resulting loss of carbohydrates increases the relative concentration of minerals.

Grass forages frequently run out of nitrogen (N). If your grass hay is not a dark, healthy green when first cut in late May or early June, it is likely lacking N. Plants short of N will test lower in most minerals, including N, P, and K. Critical levels of P and K increase with higher levels of N.

The stage of cutting greatly affects mineral content. Nutrient concentrations typically decline as maturity advances. Thus, early cuttings have higher mineral levels than later cuttings.

The optimum K level for yield may not be enough

Table 1. Concentrations of P and K in forages.

Forage	P, % mean	P, % SD[1]	K, % mean	K, % SD[1]
Hay				
Legume hay, 1st cut	0.27	0.05	2.44	0.53
Mixed hay, 1st cut	0.25	0.05	2.04	0.52
Grass hay, 1st cut	0.23	0.06	1.81	0.58
Silage				
Legume haylage	0.29	0.05	2.55	0.54
Mixed haylage	0.28	0.05	2.39	0.58
Grass haylage	0.25	0.07	2.33	0.76

[1]SD=standard deviation. About 68 percent of samples fall within a range of one SD above and below the mean.

Table 2. Critical nutrient concentrations (dry matter basis) for P and K in whole forages at typical harvest times.

Species	P, % Deficient[1]	P, % Sufficient[2]	K, % Deficient[1]	K, % Sufficient[2]
Cool-season grasses				
Bromegrass	0.25	0.30	2.0	2.7
Kentucky bluegrass	0.18	0.28	1.5	2.0
Orchardgrass	0.18	0.24	2.0	2.6
Reed canarygrass	0.21	0.29	1.4	2.5
Ryegrass	0.28	0.36	2.1	2.8
Tall Fescue	0.24	0.34	2.2	2.8
Timothy	0.20	0.28	1.4	2.0
Warm-season grasses				
Coastal bermudagrass	0.18	0.25	1.3	1.5
Johnsongrass	0.16	0.20	1.2	1.6
Dallisgrass	0.26	0.28		2.1
Sorghum-sudan hybrids	0.14	0.20	1.5	1.9
Legumes				
Alfalfa	0.25	0.35	1.6	2.7
Alsike and white clover	0.25	0.34	1.5	2.3
Birds-foot trefoil	0.24	0.32	1.6	2.1
Red clover	0.24	0.44	1.8	2.4

[1]Deficiency level: level below which yield is less than 80 to 90 percent of potential
[2]Sufficiency level: level at which yield is 90 percent or more of potential

for longevity of the stand. Both grasses and legumes depend on K for winter hardiness and persistence. Most legumes and cool-season grasses need to contain between 2 and 3 percent K for optimum stand longevity, even if the critical concentration for short-term yield is lower.

When soils become built up in K, it's possible that forage K levels can go well above what is necessary. Both legumes and cool-season grasses may accumulate more than 4 percent where soils are rich in K. For most cattle, forage K levels above 3 percent are unnecessary, but not harmful. However, dry cows are sensitive to K during the last 3 to 4 weeks before calving. Levels of 2 percent K or greater in the forage, on a dry matter basis, result in greater risk of milk fever and retained placentas. On the other hand, lactating cows consuming warm-season grasses like Coastal bermudagrass may become deficient in K, particularly under heat stress. The level desired for the cattle (2 percent) may exceed the level needed for optimum grass yield (see **Table 2**).

High levels of K can inhibit availability of calcium (Ca) and magnesium (Mg) to livestock. But P can increase Mg levels in forage and improve its availability to animals. Keeping these minerals in balance is key to managing problems with grass tetany.

When your crop tests in the sufficiency range, and soil tests indicate no deficiencies, it's still a good idea to replace what the crop removes. Standard tables give only an approximation of what is removed. You can calculate it more accurately from your forage analysis.

Forage analysis is usually expressed as a percentage of dry matter. Hay will often contain 7 to 10 percent moisture (dry matter of 90 to 93 percent), so you will need to convert tons of hay to tons of dry matter. For haylage, the conversion is similar, but the dry matter levels are more variable, ranging from 27 to 56 percent.

Forage analysis gives the amounts of P and K in elemental form. To convert from P to the P_2O_5 requirement in fertilizer, multiply by 2.29. To convert from K to K_2O, multiply by 1.2.

For example, let's consider how much P_2O_5 and K_2O are needed to replace what a hay crop of 4 tons per acre removes.

Hay, 4 ton/A @ 10% moisture = 90% DM x 4 ton/A x 2000 lb/ton = 7,200 lb/A of dry matter

If the forage analysis indicates 0.35% P and 3.1% K, then

P_2O_5 removed = 0.35% x 7,200 lb/A x 2.29 = 58 lb/A

K_2O removed = 3.1% x 7,200 lb/A x 1.2 = 268 lb/A

The most important time to apply P and K to established stands is in early fall, just before the critical fall period when root carbohydrate reserves are being built up. This would follow the last cut, or second-to-last cut if a late fall harvest is planned. In high-production forage fields, split the annual application to avoid salt toxicities. Half the P and K should be applied after the first cut and the remaining half in early fall.

To broadcast or band? In many areas, broadcast will be as effective as banding. Banding in established stands, even with coulter discs, can disturb the plants. However, in calcareous soils low in P, banding has proved more effective than broadcasting. Where potential for surface runoff is high, broadcasting P may increase the risk of harming water quality. However, forages play an important role in protecting water quality by preventing soil erosion and reducing run off.

Would variable rate technology (VRT) pay? Forages are at least as variable across the field as any other crop, if not more so. Site-specific soil testing and yield mapping may be less common with forages than with higher value crops, but simple techniques to map the pattern of nutrient removal and soil nutrient status have good potential for profit.

If forages are properly valued, fertilizing is profitable. For alfalfa grown on soil low in K, net returns to K fertilizer alone can amount to $70 to $85 per acre, valuing the hay at $110 per ton and assuming a cost of 14 cents per pound for K_2O.

Years of intensive work with Coastal bermudagrass at the University of Georgia showed that 200 lb/A each of P_2O_5 and K_2O boosted yields from 5.7 to 7.3 ton/A. Valuing the hay at $65 per ton, K fertilizer as above, and P_2O_5 at 25 cents per pound, works out to a net return to P and K fertilizer of $26 per acre. In Louisiana, applying 330 lb/A of K_2O boosted bermudagrass yields by 1.3 tons/A, providing a net return of $38 per acre.

Many producers undervalue grass. A study in New Brunswick indicated that the most profitable rate of commercial fertilizer for a timothy stand, maintained 26 years without reseeding, was 140-90-129 lb/A/yr of N, P_2O_5, and K_2O. **Your own most profitable rate will depend on how you value your hay and how you manage your crop for optimum yields of quality forage.** ■

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