

# NEWS & VIEWS

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## Managing P and K Fertility for Forages

**WHETHER** your forage crop is legume or grass, it takes a lot out of the soil. Applying manure and fertilizer to restore soil phosphorus (P) and potassium (K) fertility is an important aspect of managing hayfields for optimum productivity.

### Soil Testing and Plant Analysis

A soil test is the foundation of a sound forage fertility program. Unfortunately, many forage producers don't have time to sample as frequently as necessary. High producing fields should be sampled every year, because nutrients turn over rapidly. Each cutting removes large amounts of P and K, and manures, when applied, return large amounts. Keeping the system in balance demands frequent monitoring.

Forage analysis can give you a timely update on your soil nutrient balance. Forage quality varies greatly from one harvest to another. Crude protein, fiber, digestibility, and minerals all affect the health of your herd. Analyzing the forage from each major cut makes sense from an animal nutrition point of view. The same analysis can help you make decisions on fertilizing forage.

### Mineral Content of Harvested Forages

Mineral content depends on the forage species and whether the crop is harvested as hay or haylage (**Table 1**). Note the wide variation in P and K contents, as indicated by the standard deviations. Analyzing your hay can save you a lot of money on mineral supplements, and ensure that your livestock are getting healthy nutrition. Interpreted correctly, the mineral 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 in eastern Canada and the northeast U.S.

**Table 1. Concentrations of P and K (percent dry matter basis) in forages of eastern Canada and the northeast U.S.**

Forage	Phosphorus, %		Potassium, %	
	mean	SD <sup>1</sup>	mean	SD <sup>1</sup>
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
Hay, 2nd cut	0.29	0.04	2.14	0.47
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
Corn silage	0.23	0.03	1.00	0.24

<sup>1</sup> SD = standard deviation. About 68 percent of samples fall within a range of one SD from the mean.

**Table 2. Critical nutrient concentrations (percent dry matter basis) for P and K in whole forages at typical harvest times in eastern Canada and the northeast U.S.**

Species	Phosphorus, %		Potassium, %	
	Def. <sup>1</sup>	Suff. <sup>2</sup>	Def. <sup>1</sup>	Suff. <sup>2</sup>
Grasses				
Orchardgrass	0.18	0.24	2.0	2.6
Bromegrass	0.25	0.30	2.0	2.7
Ryegrass	0.28	0.36	2.1	2.8
Tall fescue	0.24	0.34	2.2	2.8
Kentucky bluegrass	0.18	0.28	1.5	2.0
Timothy	0.20	0.28	1.4	2.0
Reed canarygrass	0.21	0.29	1.4	2.5
Legumes				
Alfalfa	0.25	0.35	1.6	2.7
Birds-foot trefoil	0.24	0.32	1.6	2.1
Red clover	0.24	0.44	1.8	2.4
Alsike and white Clover	0.25	0.34	1.5	2.3

<sup>1</sup> Deficiency limit: levels lower than this yield less than 80 to 90 percent of potential.

<sup>2</sup> Sufficiency level: levels associated with yields 90 percent or more of maximum potential.

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



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## Factors Affecting Mineral Content

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 you first cut it in late May or early June, it is likely short on 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 affects mineral content greatly. Nutrient concentrations typically decline as maturity advances. Thus, early cuttings have higher mineral levels than later cuttings. The critical concentration of P is actually a function of the amount of dry matter in the sward and its N concentration. The nature of the function is being researched in a project underway in Quebec and will be the topic of a future article.

The optimum K level for yield may not be enough for longevity of the stand. Both grasses and legumes depend on K for winterhardiness and persistence. Most forages need to contain between 2 and 3 percent K for optimum longevity, even if the critical concentration for short-term yield is lower.

## Luxury Consumption

When soils become built up in K, it's possible that forage K levels can go well above what is necessary. Both grasses and legumes may contain as much as 4 to 5 percent K on soils rich in K. For most cattle, forage K levels above 3 percent are not necessary, but also are not harmful. However, dry cows can be very sensitive to high K levels during the last three to four weeks before calving, resulting in higher frequencies of milk fever and retained placentas.

In addition, high levels of K can inhibit availability of calcium (Ca) and magnesium (Mg) to livestock. On the other hand, 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.

## Replacing Crop Removal

When your crop tests in the sufficiency range and soil tests indicate no deficiencies, it's still a good idea to replace what you remove. 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 elemental P and K. 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 2,000 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 = 267 lb/A

## When to Apply

**The most important time to apply P and K to established stands is in the early fall, just before the critical fall period when root carbohydrate reserves are being built up.** In high-production forage fields, it is wise to split the annual application to avoid salt toxicities...half after the first cut, and the remaining half in early fall.

Before establishing new stands of forage, soil tests are extremely important. If soil test levels are low, it is much more practical to build up soil P and K before seeding when the nutrients can be mixed into the topsoil. Building soil P and K in established stands can only be done slowly, as these nutrients do not move rapidly down from the surface.

## Does it Pay?

If forages are properly valued, fertilizing is profitable. 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 of N,  $P_2O_5$  and  $K_2O$  per acre each year. 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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