Maintaining Northern Forage Productivity with Fertilization

Dr. A.M. Johnston
Western Canada Director, Potash & Phosphate Institute

MOST NORTHERN FORAGE STANDS for grazing and for hay production are established as grass-legume mixtures. Over time, the productivity and livestock carrying capacity of these forages may decline, largely a result of reduced stand vigor, the invasion of unpalatable or less productive species, over-grazing, and poor soil fertility. Many farmers accept the gradual reduction in the proportion of legume forage in mixed forage stands, and reduced grass forage due to weeds, as a normal symptom of an aging stand.

With the high cost and time associated with forage stand termination and re-establishment, farmers are anxious to identify all options for sustaining a forage stand. Fertilization of mature forage stands rejuvenates the stand and improves forage quality. Fall provides an opportune time to soil test and apply nutrients like phosphorus (P) and potassium (K) to forage stands.

The nutrient requirements of top yielding forage crops are high, as shown in the estimates of crop removal in **Table 1**. Given that the entire crop biomass is removed in the fodder, growing forages is one of the fastest means of drawing down the soil's nutrient supply. In the absence of nutrient replacement, low forage yield ultimately leads to a decision to terminate a forage stand.

Table 1. Nutrient removal by forage grass and alfalfa crops[1].

Crop	N	P_2O_5	K_2O
	- - lb/t, dry matter basis - -		
Alfalfa	56	15	60
Bromegrass hay	36	13	59

[1]From Plant Nutrient Use in North American Agriculture, PPI/PPIC/FAR Publication 2002-1.

Understanding the composition of a forage stand plays an important role in getting the most out of nutrient applications. Grasses have a high demand for nitrogen (N) and, once established, they quickly consume any N released from the soil or applied as fertilizer. Legumes like alfalfa have the ability to fix their own N from the atmosphere and as a result their productivity is more dependent on soil supplies of P, K, and sulfur (S). In general, forage stands with less than 25% legume can be managed as a pure grass stand where N is the main nutrient. If the legume component is greater than 75% then the stand should be managed as a legume. The challenge is with forage stands that fall in between these ranges where some N is required to satisfy the grass, while too much N promotes grass production at the expense of the legume and stand productivity.

The response of forage crops to added N is often limited due to a P deficiency. While N alone will provide some yield response, it is the addition of both N and P that maximizes yields. As shown in **Figure 1**, a mixed forage stand (alfalfa and timothy) showed a significant response to additions of fertilizer N (90 lb N/A) and P (67 lb P_2O_5/A). Soil tests from the site revealed that it was very low in N and P, but sufficient in K and S. In fact, N accounted for approximately 23% of the forage yield response to fertilizer application, while P accounted for approximately 74%.

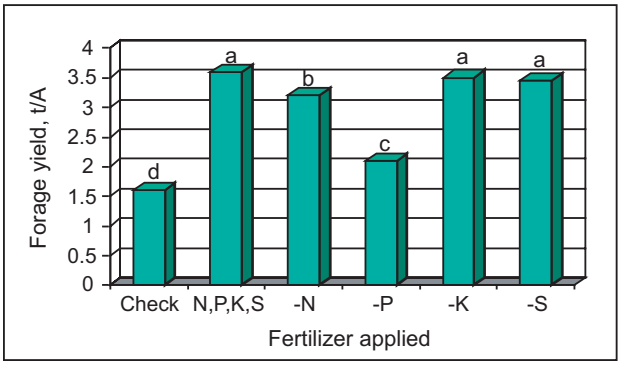

Figure 1. Mixed forage hay yield response to fertilizer application, 1997-99. Forage yields with the same letter are not significantly different using $LSD_{0.05}$ (p=0.05).

With annual crops, P deficiencies are often met with application of soil test recommended rates. However, with established forages the demand for P may exceed that recommended by soil test. This was illustrated on an old mixed forage stand that had low soil test N and P levels (**Figure 2**). The forage showed a 12% yield response to 80 lb N/A, a 76% response to the same rate of N and 30 lb P_2O_5/A, and a 161% response to the same rate of N and 90 lb P_2O_5/A. This response of the forage to the higher rate of P indicates that the N response was limited by the P supply, even when the soil test recommended rate was applied.

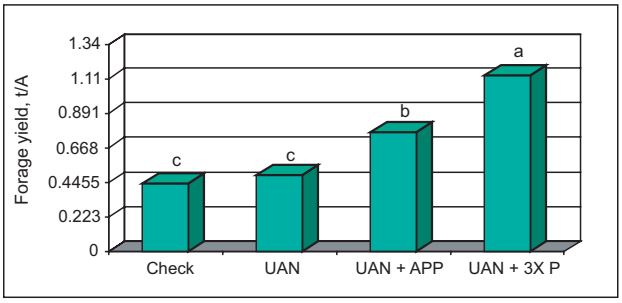

Figure 2. Alfalfa-brome hay response to N+P coulter-applied fluid fertilizer. Forage yields with the same letter are not significanlty different using $LSD_{0.05}$ (p=0.05).

This response of forages to higher rates of P fertilizer can also be achieved from successive annual applications. The data collected from 16 trials conducted in south central Alberta showed that annual applications of 35 lb P_2O_5/A to mixed alfalfa–grass stands resulted in progressive increases in yield response to P (**Figure 3**). The progressive increase in forage yield response was attributed to the slow movement of the surface-applied P down into the profile, and the stimulation of shallow surface root activity by alfalfa utilizing the fertilizer P. Improved P nutrition is also considered critical in improving both the vigor and regrowth of the forage stand, leading to improved yields as the study progressed.

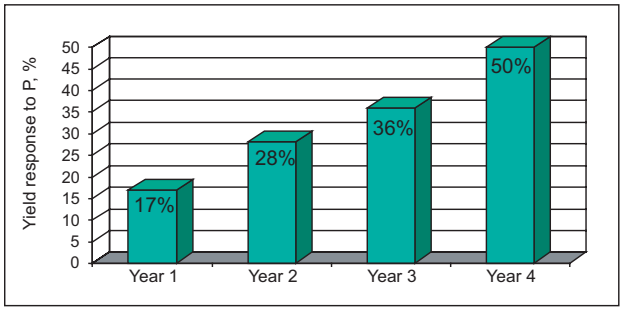

Figure 3. Phosphorus benefit increases with time.

Successful management of perennial forages for hay and pasture requires attention to nutrient supply and stand composition. Planning includes:

- Soil testing to establish soil nutrient supply.
- Forage stand assessment to determine legume and grass composition.
- Application of fertilizer N in balance with P, K, and S as required based on soil test levels and stand composition.
- Repeated application of residual nutrients like P and K to build stand vigor and regrowth potential.

Fall is an ideal time to apply P and K to hay and pasture fields, with any N and S requirements best suited to spring application. ■

For more information, contact:

Dr. Adrian M. Johnston
Western Canada Director
Potash & Phosphate Institute (PPI)
Potash & Phosphate Institute of Canada (PPIC)
12-425 Pinehouse Drive
Saskatoon, Saskatchewan, Canada S7K 5K2
Phone: (306) 956-0619
Fax: (306) 956-0605
E-mail: ajohnston@ppi-ppic.org

Ref. # 03090-AMJ