NEWS & VIEWS

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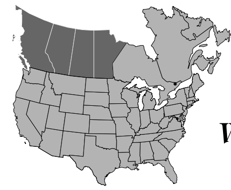

Dr. Adrian Johnston,
Western Canada Director
December 2000

# Forage Rejuvenation—Alternatives to Stand Termination

**IN WESTERN CANADA,** most forage stands for grazing and hay production are established as grass-legume mixtures. Over time, the productivity and livestock carrying capacity of these hay fields and pastures 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. In the initial years of stand degradation, legume growth becomes variable and eventually grasses dominate the sward. As grasses begin to dominate the stand, quality drops. In fact, the concentration of nutrients in ungrazed mature pasture grasses is commonly below optimum for efficient animal performance.

Various techniques have been used to improve unproductive stands, with fertilization using commercial fertilizer or livestock manure often being an effective means of restoring forage productivity and quality. 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. As a result, the use of fertilization of mature forage stands to both rejuvenate the stand and improve the forage quality can be important in managing established 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 nutrient supply. It is estimated that only 25 percent of improved pasture and hay, and 15 percent of alfalfa hay fields are fertilized. Given the level of nutrient removal by forages and these low levels of fertilizer addition, it is little wonder that farmers report that forage stands are maintained for only 3 to 5 years in high moisture regions of western Canada, and 6 to 9 years in the semi-arid areas. A low forage yield is the most commonly cited reason for terminating a forage stand. Recent research in Alberta and Saskatchewan indicates that there are some good opportunities to use fertilizer to rejuvenate established forage stands and avoid the cost of breaking.

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

| Crop | N | $P_2O_5$ | $K_2O$ | S |
|---|---|---|---|---|
| | - - - - - - - - - - | lb/A | - - - - - - - - - - | |
| Alfalfa–5 tons/A | 261-319 | 62-76 | 270-330 | 27-33 |
| Grass hay–3 tons/A | 92-113 | 27-33 | 117-143 | 11-14 |

[1] From Nutrient Uptake and Removal by Field Crops, Canadian Fertilizer Institute (www.cfi.ca)

## Alberta Hay Land Fertilization Results

A series of nutrient response trials was established on forage stands in northcentral Alberta. In one study evaluating hay yield responses, a two-year old alfalfa (*Medicago sativa* L.) and timothy (*Phleum pratense* L.) stand tested 1 part per million (ppm) for phosphorus (P), 223 ppm potassium (K), 6 ppm sulfur (S), and soil nitrogen (N) level was below the detectable limit. The fertilizer treatments included a complete blend of N (urea) at 90 lb N/A, P (triple superphosphate) at 67 lb $P_2O_5$/A, K (potassium chloride) at 78 lb $K_2O$/A, and S (ammonium sulfate) at 27 lb S/A, along with blends with

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each of the nutrients removed to determine which nutrient was most limiting to forage growth. Fertilizer was surface broadcast applied in the early spring and the forage harvested in July and September each year.

Results from this location indicate that while both N and P were limiting hay yield, P deficiency by far had the greatest impact (**Figure 1**). In fact, N accounted for approximately 23 percent of the forage yield response to fertilizer application, while P accounted for approximately 74 percent. High soil test K levels explained the lack of a response to K fertilizer application, and the application of S to the site in previous years would explain the absence of a S response. Given the low soil P levels at this location, the impact of fertilizer P on forage yield was not surprising.

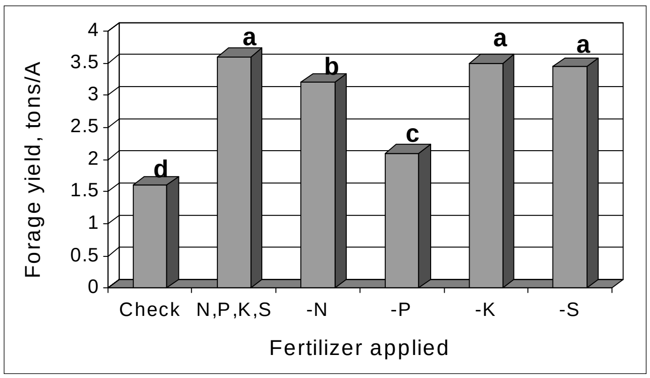


**Figure 1. Mixed forage hay yield response to fertilizer application, 1997-99.** Forage yields with the same letter are not significantly different using $LSD_{0.05}$.

Based on the large yield response to N and P application, a fertilizer rate study was established at this location. The N rates applied were 0, 45 and 90 lb N/A, with a blanket application of 67 lb $P_2O_5$/A, 78 lb $K_2O$/A, and 27 lb S/A. The P was applied at 0, 22 and 45 lb $P_2O_5$/A, with a blanket application of 90 lb N/A, 78 lb $K_2O$/A, and 27 lb S/A. The mixed forage stand showed a response to the first increment of both N and P applied (**Figure 2**). In the case of N, the majority of the response was recorded in the first cut in this two-cut harvesting system. However, with the P fertilizer addition improvements in dry matter yield were recorded in both the first and second cuts (data not shown). The absence of a response to the higher rate of P is supported by the yield and nutrient removal data in **Table 1**. The annual application of 22 lb $P_2O_5$/A is similar to the lower end of the removal rates in 3 tons/A hay yields.

## Alberta Pasture Fertilization Results

To evaluate the impact of fertilizer applications on a grazed pasture, the researchers selected a site that had been grazed for over 30 years, and was dominated by native grass species. A 6-inch soil sample collected at the site tested 2 ppm P, 276 ppm K, 5 ppm S, and had a soil N level below the detectible limit. Again, as in the hay land study, the stand was fertilized at the same rate for each

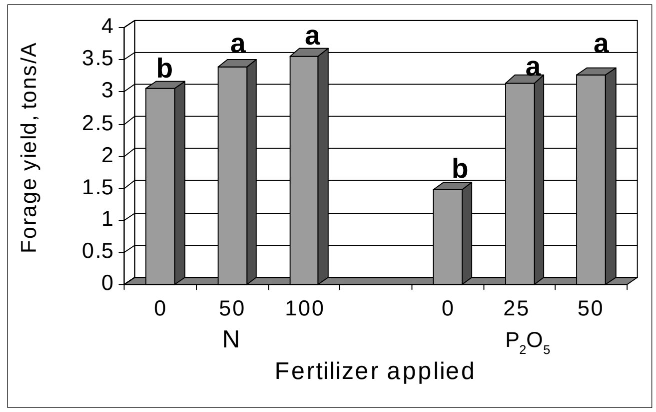


**Figure 2. Mixed forage hay yield response to N and P fertilizer application rates, 1997-99.** Forage yields with the same letter are not significantly different using $LSD_{0.05}$.

nutrient, broadcast applied in the early spring, and harvested once each year in July. Forage yield results indicate that this site was very responsive to N and P application (**Figure 3**). However, unlike the legume-grass mixture in the hay land, the native grass pasture yield response was dependent on both N and P application, given that the yield in the absence of either was almost identical. The removal of K from the fertilizer blend actually resulted in a yield increase compared to the control, an anomaly due to random variation in the site in 1999. Relative to the complete blend, removal of K had no effect on the native grass yield in either 1997 and 1998. Sulfur also had no effect on yield at this location.

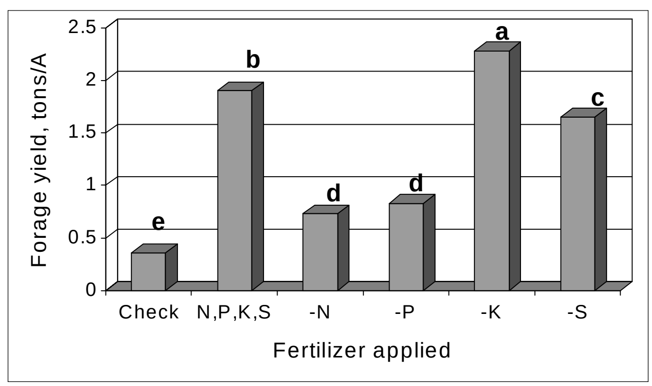


**Figure 3. Pasture forage yield response to fertilizer application, 1997-99.** Forage yields with the same letter are not significantly different using $LSD_{0.05}$.

An evaluation of the native pasture response to N and P rates resulted in increases in the forage yield and improved composition (**Figure 4**). Increasing the rate of N applied to the stand resulted in 60 and 130 percent increases in yield, at the 45 and 90 lb N/A rates, respectively. For P, the responses were 102 and 137 percent for the 22 and 45 lb $P_2O_5$/A rates. In the 0 N treatment, a blanket application of P, K and S resulted in the sward becoming dominated by Alsike clover (*Trifolium hybridum*). However, when N was applied at 45 and 90 lb/A, bromegrass (*Bromus inermis* Leyss.) dominated the stand with Alsike clover representing a minor component. In the P rate study, a blanket application of 90 lb N/A resulted in the stand being dominated by grass species, and increases in yield with P application were due to an increased growth of the grass species in the absence of Alsike clover.

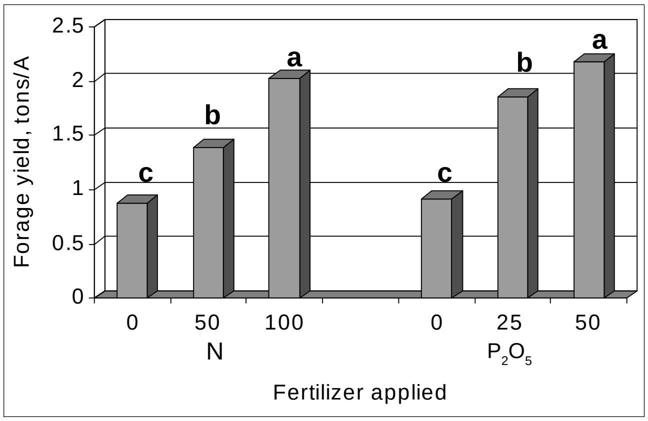


**Figure 4. Pasture forage yield response to N and P fertilizer application rates, 1997-99.** Forage yields with the same letter are not significantly different using $LSD_{0.05}$.

Finally, an interesting observation was made in this three-year fertilization project. On the hay land site, there was an impact over years of fertilizer P application (**Figure 5**). The results indicate that annual addition of P fertilizer was improving both the vigor and regrowth of the forage stand, leading to improved yields as the study progressed. In fact, the best forage yield was harvested in 1999, which also was the driest year of this study, further illustrating the role of correcting nutrient deficiencies in sustaining forage productivity under a wide range of conditions. The response was immediate on the hay land site, indicating the stand was only in the early stages of deterioration. However, on the 30-year old severely deterioated pasture stand, it took two years of fertilizer P application before a forage yield and composition response was recorded.

## Fertilizer Placement— Saskatchewan Pasture Fertilization Trials

The vast majority of fertilizer applied to forage stands is broadcast as dry fertilizer on the soil surface. As a result, the timing of fertilizer application can have a significant impact on both yield and quality response of the forage. The development of disc coulters to incorporate fertilizer into the soil has been suggested as a possible means of improving the response of forages to less mobile nutrients such as P and K. In earlier work in Alberta, Malhi reported that alfalfa yields were improved by 500 to 1,200 lb/A/yr when P was in-soil banded versus surface applied on an annual basis.

Field experiments were established on five grazing sites in Saskatchewan to evaluate the yield response of a smooth

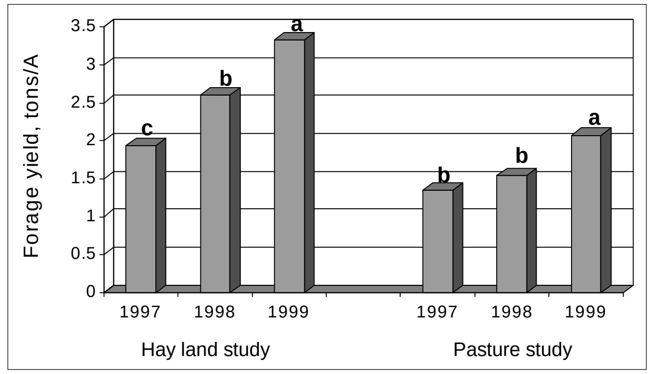


**Figure 5. Annual effect of P fertilizer application on forage yield over the three-year period, 1997-99.** Forage yields with the same letter are not significantly different using $LSD_{0.05}$.

bromegrass and alfalfa forage to surface and sub-surface fertilizer application. A fertilizer blend providing 90 lb N, 40 lb $P_2O_5$, 20 lb $K_2O$, and 10 lb sulfate $(SO_4)$-S/A was applied using either a dry product surface broadcast or fluid fertilizer injected 2.75 inches deep with a disc coulter. The fertilizer was applied once in the spring of 1994. In mid-July of 1994, 1995 and 1996, forage samples were collected from the treatments to determine yield and quality. The study also considered a number of mechanical treatments, such as burning, tillage, and mowing. However, they will not be considered in this summary.

Coulter injection of fertilizer resulted in a minor improvement in forage yield response relative to surface broadcast treatment at most study locations (**Table 2**). The majority of the cumulative response was from the application year and the second harvest year (data not shown), with few of the treatments showing any effect by the third (final) year. Both fertilizer treatments were rated as highly effective in improving forage yield, mineral content, and crude protein over the three-year study period relative to the mechanical treatments, either alone or in combination with surface broadcast fertilizer. These results support the use of fertilizer to sustain productive pasture forage yield and quality in the absence of mechanical disturbance of the established stand.

**Table 2. Effect of fertilizer treatments on cumulative grass-legume forage yield in established pastures in Saskatchewan (1994-96).**

| Location | Check | Surface broadcast[1] | Coulter banded[1] | Site mean |
|---|---|---|---|---|
| | - - - - - - Forage yield, tons/A - - - - - - | | | |
| Prince Albert A | 3.69 | 4.42 | 5.16 | 4.42 |
| Prince Albert B | 4.23 | 5.12 | 5.53 | 4.96 |
| Insinger | 4.96 | 6.32 | 7.04 | 6.10 |
| Pathlow | 3.47 | 5.01 | 4.98 | 4.49 |
| Rama | 3.28 | 5.54 | 5.28 | 4.70 |
| Treatment mean | 3.93 | 5.28 | 5.60 | |

[1] Both surface broadcast dry fertilizer and coulter banded fluid fertilizer were applied at a rate of 90 lb N/A, 40 lb $P_2O_5$/A, 20 lb $K_2O$/A, and 10 lb $SO_4$-S/A.

## Summary

Low prices for annual crops have increased interest in improving forage production to support farm operations diversified into beef cattle. High yielding and high quality forages use large amounts of nutrients, both from the soil and applied as manure or fertilizer. Developing a soil testing and nutrient management plan for forage stands that includes early spring fertilizer application will ensure sustained productivity of a quality product for an increased number of years. ■


**Reference:**


Lardner, H.A., S.B.M. Wright, R.D.H. Coen, P. Curry, and L. MacFarlane. 2000. The effect of rejuvenation of Aspen Parkland ecosystem grass-legume pastures on dry matter yield and forage quality. Can. J. Plant Sci. 80: 781-791.


### Conference Announcement: Western Canada Agronomy Workshop

The Canadian Fertilizer Institute (CFI) and Potash & Phosphate Institute of Canada (PPIC) are pleased to announce the 5th Biennial "Western Canada Agronomy Workshop", July 4-6, 2001 at the Lethbridge Lodge in Lethbridge, Alberta.

Features include:

- Invited papers from researchers and agronomists looking for solutions to production problems.
- Evening bear pit sessions are planned, including how to work with pest thresholds and "myth vs fact." Challenging field questions.
- Published proceedings that will provide answers to commonly asked questions.

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### Information Agriculture Conference Set for August 7-9, 2001

The popular Information Agriculture Conference series continues with InfoAg 2001 scheduled for August 7, 8 and 9. Organized by PPI and FAR, InfoAg 2001 will take place at the Adam's Mark Hotel–Airport, at Indianapolis, Indiana.

Dr. Harold F. Reetz, PPI Midwest Director, will serve as conference planning coordinator. Program tracks will be offered in four major components: Economics/Farm Management; Data Analysis/Tools; Site-Specific Nutrient Management; and Communications/Environment. As with previous Information Agriculture Conferences, an exhibit area will feature some of the latest in site-specific systems, data management, and communications technology. There will also be a return of the special Cyber-Dealer sessions targeting the business aspects of incorporating site-specific management systems services into retail supply and consulting businesses.

Individual registration fee for InfoAg 200l is $350.00 until July 15, and $450 thereafter.

More information and details are available by phone at (605) 692-6280 or fax (605) 697-7149, or the website at www.ppi-far.org/infoag2001.

### Contact PPI/PPIC/FAR on the Internet

You can reach the Potash & Phosphate Institute (PPI), Potash & Phosphate Institute of Canada (PPIC), and Foundation for Agronomic Research (FAR) on-line. Use one of the following as a URL to reach the website:

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