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FORAGE TECHNICAL BULLETIN

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Impact of alfalfa and fertilizer on pastures: Forage Quality

Introduction

The quality of forage has a major impact on animal performance and is therefore an important consideration for producers. High quality forage is an invaluable tool for improving both milk and meat production in grazing animals.

Producing high quality forage is dependent on many factors, including pasture type, grazing management, soil fertility and of course, the weather. Animal performance is also dependent upon the animal's capacity to consume forage (known as voluntary dry matter intake) and the digestibility of the forage. Forage quality can be estimated by evaluating the nutrient composition; however, there is currently no one method that completely assesses forage quality.

Good pasture management, such as adding legumes and/or fertilizer, will go a long way towards the development of good quality forage.

Research Study

A ten-year grazing study was conducted at the Agriculture and Agri-Food Canada Brandon Research Centre from 1994-2004. The goal was to study how grass-based pastures can be improved by adding fertilizer or alfalfa.In the spring of 1994, pastures were established on a Souris fine sandy loam. The study used rotational grazing on four combinations of pasture type and fertilizer management. There were two different pasture types (100% grass or mixed alfalfa-grass) and two different fertilizer treatments (no fertilizer, or spring fertilization to full soil test recommendation levels). This resulted in a total of four treatments, shown in Table 1.

Table 1. Pasture Types and Fertilizer Treatments used in the Study

1) Meadow bromegrass No added fertilizer	3) Meadow bromegrass + Alfalfa No added fertilizer
2) Meadow bromegrass + Fertilizer	4) Meadow bromegrass + Alfalfa + Fertilizer

The grass-only pastures were seeded with 10 lb/acre "Paddock" meadow bromegrass. The mixed alfalfa-grass pastures were seeded with 7 lb/acre "Paddock" meadow bromegrass and 3 lb/acre "Spredor II" alfalfa. Starting in 1995, fertilizer was surface applied as a dry blend prior to grazing each spring. The concentration of each nutrient in the blend was based on soil samples collected the previous fall.

From 2000 to 2004, forage samples were taken as grasser steers entered each paddock, providing 5 years of data. The samples were analysed to determine forage quality, including the following:

- Voluntary dry matter intake
- Crude protein (CP)
- Total digestible nutrients (TDN)
- Acid and neutral detergent fibre (ADF and NDF)
- Calcium (Ca) and phosphorus (P) content
- Relative feed value (RFV)

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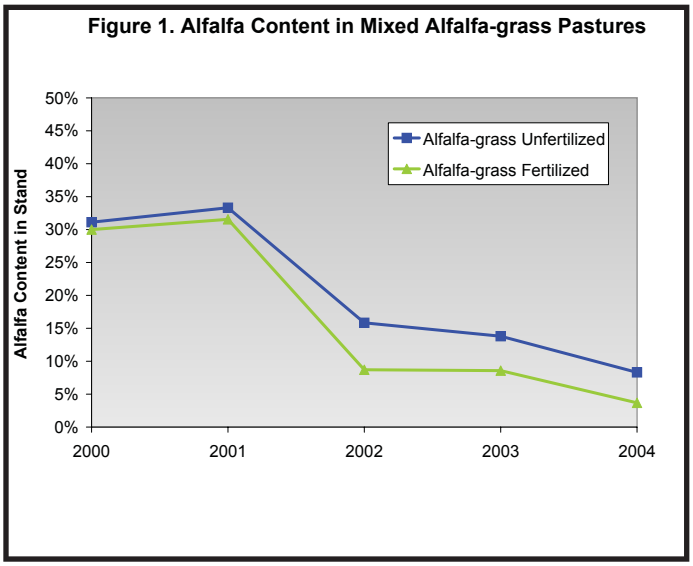
Administration du rétablissement agricole des Prairies

Forage Quality

Results were averaged over the entire grazing season. The results show the quality of the forage available to grazing cattle, but because of selective grazing, individual animals may have consumed higher or lower quality forage.



Study Results

Alfalfa Content in Pastures

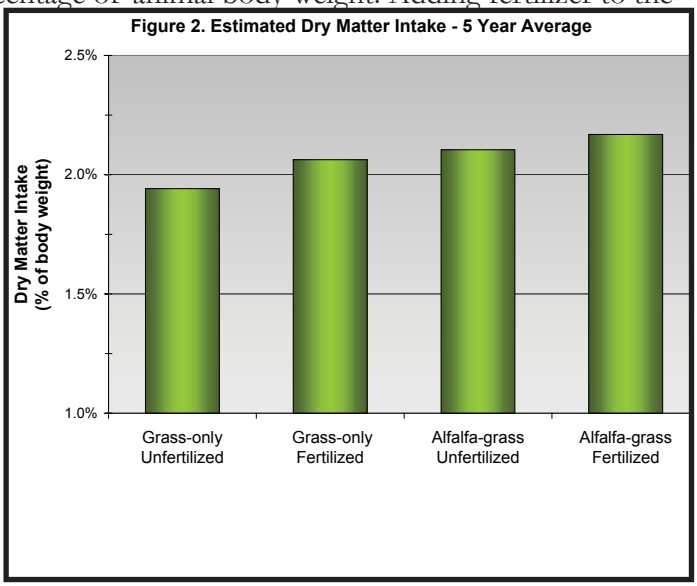
Figure 1 shows the alfalfa content in mixed alfalfa-grass pastures over the five years of the study. When the study started in 2000, the alfalfa content was approximately 30%. Alfalfa content declined over time, and by the fifth year of the study, alfalfa represented less than 10% of the forage biomass. This decline in alfalfa content affected many of the measurements of forage quality. Alfalfa content of pasture biomass was also affected by the use of fertilizer with fertilized pastures having a more rapid decline in alfalfa content than unfertilized pastures.

Dry Matter Intake

Voluntary dry matter intake measures an animal's forage consumption. It measures how much forage dry matter animals consume when there is an adequate amount of palatable forage available. Dry matter intake is the factor that causes the most variation in the quality of forage consumed by an animal.

The maximum dry matter intake is estimated using the neutral detergent fibre (NDF) value. It's assumed that animals can only consume a maximum of 1.2% of their body weight as NDF (1.2 lb per 100 lb of body weight). As NDF values rise, dry matter intake drops.

Figure 2 shows dry matter intake, measured as a percentage of animal body weight. Adding fertilizer to the grass-only pastures consistently reduced NDF values, which increased estimated dry matter intake. Figure 2 shows that adding fertilizer to alfalfa-grass pastures also increased dry matter intake. However, this increase is due to only one year – 2003 – a post-drought year, when dry matter intake was higher on fertilized alfalfa-grass pastures compared to unfertilized alfalfa-grass pastures.



Including alfalfa in the unfertilized pastures improved dry matter intake every year except 2004, by which time the alfalfa content of had dropped below 10% of the stand.

Compared to pastures with either added fertilizer or added alfalfa, adding both alfalfa and fertilizer provided an additional advantage in three of the five years of

Forage Quality

the study. However, in 2002 (drought year) and 2004 (when alfalfa content dropped below 10% of the stand) there was no added advantage from the combination of fertilizer and alfalfa.

Total Digestible Nutrients (TDN)

The total digestible nutrient content (TDN) is a measurement of the digestibility and available energy content of forages. The acid detergent fibre (ADF) content was used to estimate TDN.

Fertilizer application increased TDN in every year of the study (Figure 3). Figure 4 shows that adding alfalfa increased TDN slightly when averaged over the five-year study. Adding alfalfa increased TDN in three out of the five years; the exceptions were the drought year of 2002, and in 2004 when alfalfa levels dropped below 10%. There was no additional benefit from adding both alfalfa and fertilizer to grass based pastures.

The lowest TDN value in the study was 53%, seen in the unfertilized grass-only pasture in 2002. A TDN value of 53% is equal to mature brome hay. The maximum TDN seen in the study was 65% for the fertilized pastures in 2003, which is equal to a 50:50 blend of mid-bloom alfalfa hay and oat grain.

Relative Feed Value (RFV)

The relative feed value (RFV) estimates forage quality by comparing it to full bloom alfalfa hay, which has an RFV of 100. RFV is estimated from acid and neutral detergent fibre contents (ADF and NDF). ADF is used to estimate digestibility while NDF is used to estimate intake. Forages with high RFV are expected to result in greater productivity.

Figure 5 shows that including alfalfa in the pastures increased the RFV in four of the five years of the study. The only exception was in 2004, when the alfalfa content of the pastures dropped below 10%.

Adding fertilizer to either grass-only or alfalfa-grass pastures increased the RFV in every year except 2000.

Note that Figure 5 (RFV) looks very similar to

Figure 3. Effect of Fertilizer on Total Digestible Nutrients (TDN) 5 Year Average

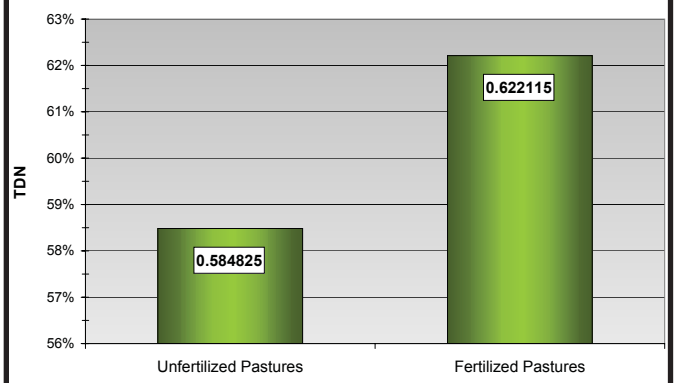


Figure 4. Effect of Alfalfa on Total Digestible Nutrients (TDN) 5 Year Average

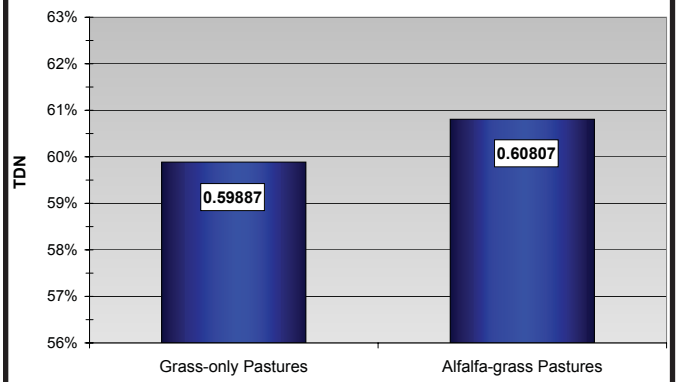


Figure 5. Relative Feed Value (RFV) - 5 Year Average

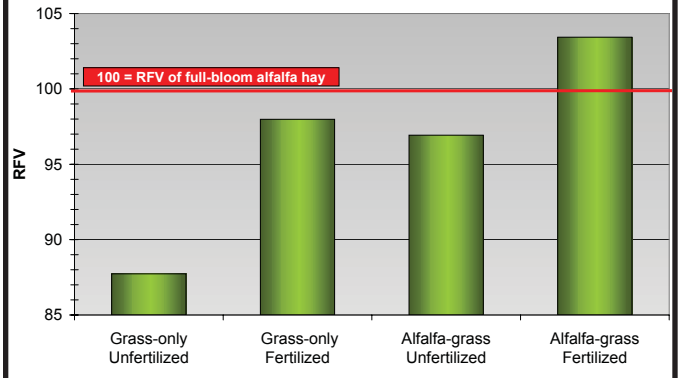
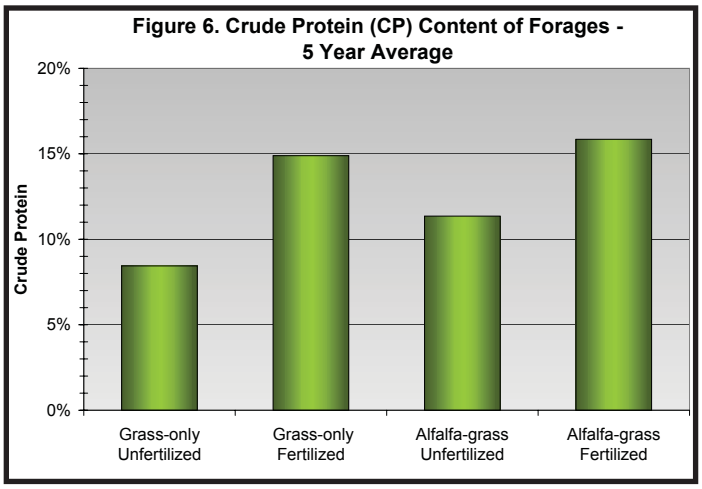


Figure 2 (dry matter intake) because dry matter intake is very important in determining RFV.

Crude Protein

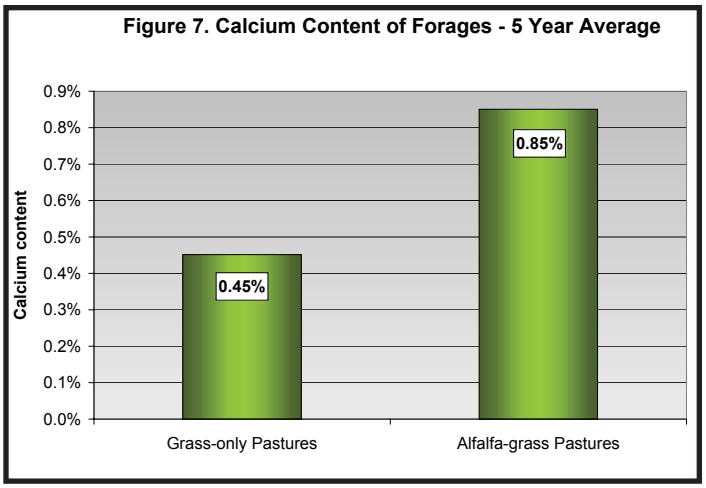
Figure 6 shows that the crude protein (CP) content of forage was increased by adding alfalfa and/or fertilizer to grass pastures. In three of the five years of the study, the crude protein content was increased the most by having both alfalfa and fertilizer added to grass pastures.

The crude protein content of the unfertilized grass-only pastures averaged 8.4% during the five-year study. This is low enough to be marginal or deficient for grasser steers or cow-calf pairs unless the cattle selectively grass the higher crude protein portions of the available forage (NRC 1996).



Calcium

Figure 7 shows the calcium (Ca) content of forage. Fertilizer had no effect on the calcium content in either the grass-only or alfalfa-grass pastures. Because of this, results from the fertilized and unfertilized pastures are combined and Figure 7 shows only the difference due to alfalfa. Calcium content was increased by adding alfalfa to the pastures in every year except 2004, by which time the alfalfa content dropped below 10%. Although lower, even the grass-only pastures (both fertilized and unfertilized) contained enough calcium to meet the requirements of grasser steers and cow-calf pairs.



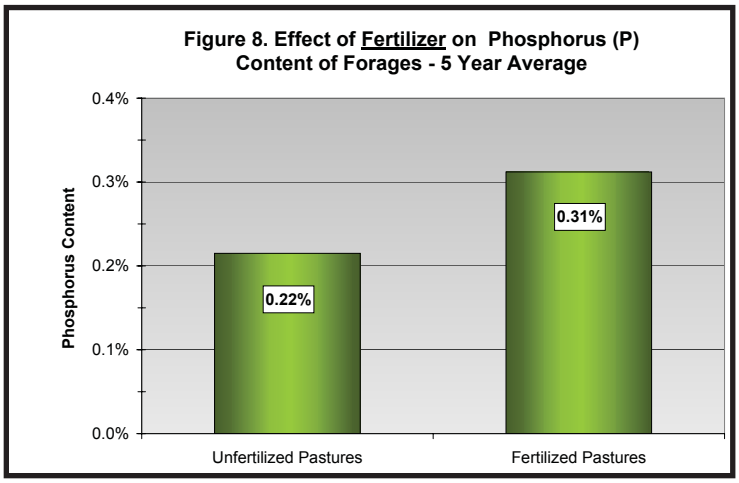
Cattle are capable of using body reserves of calcium to buffer against short-term minor deficiencies provided that adequate calcium is available again at a future date. The calcium content of forage is related to the calcium content of the soil it is grown on. Lower calcium levels would be expected on low calcium soils.

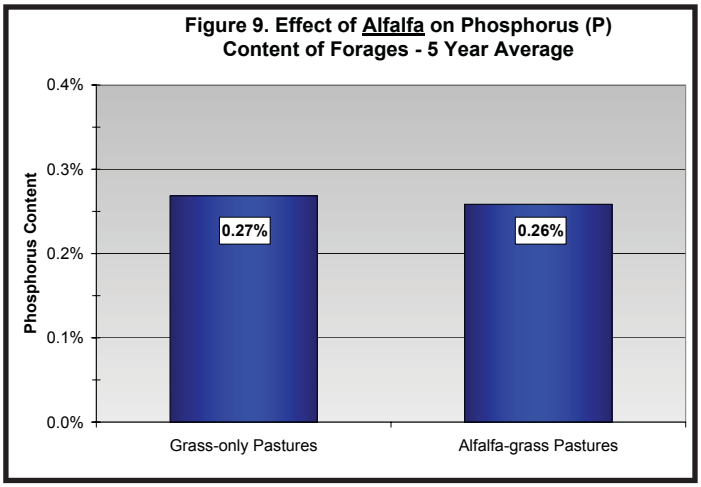
Phosphorus

The phosphorus (P) content of forage was increased substantially by fertilizer application (Figure 8 next page). However, Figure 9 (next page) shows that averaged over the 5-year study, adding alfalfa to grass-based pastures did not affect forage phosphorus content. The exception was in 2003 when forage from alfalfa-grass pastures had lower phosphorus content than grass-only pastures. There was no additional benefit from adding both alfalfa and fertilizer to grass-based pastures.

The phosphorus content of forage from all pastures, both fertilized and unfertilized, was adequate to meet phosphorus requirements of all classes of cattle. However, the phosphorus content of forage from the unfertilized pastures was borderline. Similar to calcium, the phosphorus content of forage tends to reflect the phosphorus content of the soil the forage is grown on, and cattle are able to use body reserves of phosphorus to buffer against short-term minor phosphorus deficiencies.

Forage Quality





Conclusion and Recommendations

Adding alfalfa or fertilizer to grass-based pastures increased the forage quality of the pastures, but each affected different measures of forage quality, as shown in Table 2. Some of the effects of fertilizer, such as increased TDN and crude protein, could have been achieved if the alfalfa content in the pastures had been higher.

Table 2. Effect of Adding Alfalfa or Fertilizer on Forage Quality

Adding alfalfa at time of seeding increased:	Adding fertilizer increased:
• Dry matter intake (forage consumption) • Crude protein • Calcium content	• TDN • Crude protein • Phosphorus content

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Sources:

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NFTA. 2008. Laboratory Procedures. http://www.foragetesting.org/files/LaboratoryProcedures.pdf Accessed: Feb 25, 2008.

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