Forage Fact # 10

Date:
February , 2002

Field Liming Impacts Forage Production

Lime additions increase:

* pH of soil
* nutrient availability
* soil microbial activity
* forage quality
* plant density
* resistance to crop disease

For more information call:

* Glenn Hogberg, Progress (250) 843 7653.
* Dave Armstrong, Rolla (250) 759 4930.
* Sandra Burton, Farmington (250) 789 6885.

"Where we lived, near Chilliwack, anyone that was striving for production or forage quality added lime to their fields."

Dave Armstrong

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Research and Development Committee Seizes Opportunity

In the fall of 1999, the Peace River Forage Association of BC (PRFA of BC) had an opportunity to study the effects of field liming on forage production. LW Diamond Environmental Services, on contract to reclaim the Air Liquide Canada site in Dawson Creek, needed clean out and spread a pit of calcium hydroxide (hot lime) on agricultural fields. PRFA of BC's Research & Development Committee in conjunction with BC Ministry of Agriculture, Food & Fisheries took a leadership role in establishing study plots to evaluate the hot lime's effect on forages.

Two forage association members, **Glenn Hogberg** of Progress, and **Dave Armstrong** of Rolla were very interested in the project and oversaw the field lime application at different rates of application.

Research team examines soil properties.

Sandra Burton and Julie Robinson, with the direction of the R&D committee, established the research protocol for monitoring. A practical objective of the study was to compare industrial or hot lime to agriculture lime, and determine the economic feasibility of using lime on a forage field.

Hot Lime Application Rates and Ongoing Monitoring

Monte Bentley and Dave Armstrong discuss incorporation of hot lime into Dave's alfalfa/grass hay field.

At the two sites, monitored by the PRFA of BC, hot lime was applied at different rates. At Armstrongs', there was a control (no application) and a recommended rate (5 ton/ac) and at Hogbergs' four treatments were done: control, low (2 ton/ac), medium (3 ton/ac) and high rate (4 ton/ac).

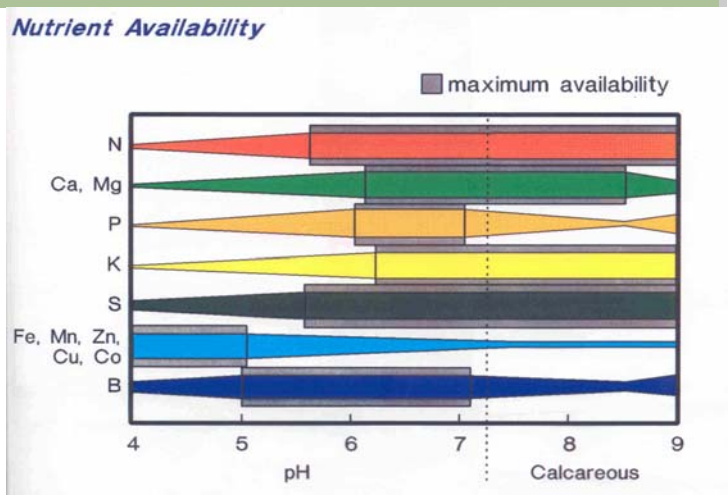
After liming, field monitoring for responses to the lime began. Factors observed were: incorporation of lime, soil pH, soil fertility, crop responses (densities, colors), crop resistance to disease, yields, and quality of feed.

Peace River Forage Association of British Columbia

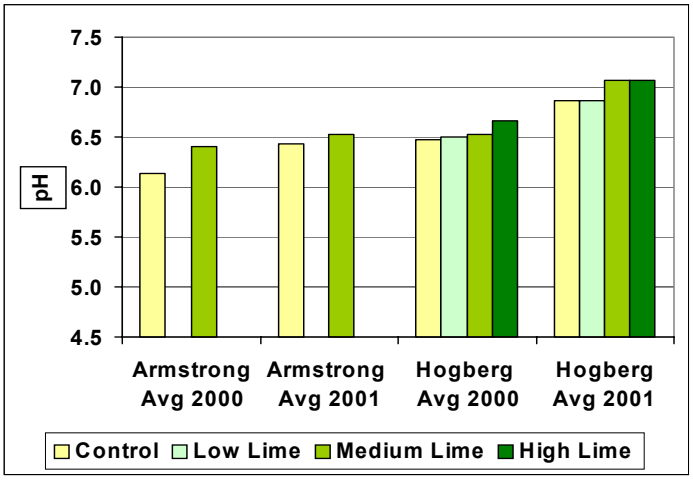
Liming Raises pH of Acidic Soils

Soil acidity is identified by the measurement of soil reaction (pH). The soil is alkaline when the pH is above 7.0; neutral at 7.0; and acid below 7.0. In practical terms, soils between pH 6.5 and 7.5 are considered neutral. Soils in the range 5.6 to 6.0 are moderately acid and below 5.5 strongly acid. The poor growth of a sensitive crop such as alfalfa may indicate an acid soil condition. However, a soil test is the only reliable way of determining whether soil is acid or not. A lime requirement test should be used to determine the application rate.

The pH of soil affects many factors related to the plant vigor, directly and indirectly. Many nutrients, such as nitrate and sulphate become more available to the crop at higher pH's. Some metals, such as aluminum and magnesium, that can be soluble and toxic at low pHs, are insoluble and not a problem for crop growth at high pHs.



Soil pH influences nutrient availability for plant uptake.



Comparing soil pH at Armstrongs' and Hogbergs' plots for different rates of applied lime.

A low pH affects the ability of rhizobium bacteria in the soil to fix atmospheric nitrogen into a plant available form. At low pHs, legumes and rhizobium die, decreasing the availability of nutrients to plants. An ideal pH for bacteria is higher than pH 5.5 or 6.0.

Prior to lime application in 1999, initial soil pHs were assessed by LW Environ. Services at 5.7 for Hogbergs' and 5.8 for Armstrongs'. This is lower than our measured pHs in the controls. Possibly the plots were too narrow to avoid mixing of lime into them by water and implements.

Monitoring the pH levels of the soil at the two plots, we saw an increase in the pH where lime was applied, especially 2 years after the lime application. Sulphate was one nutrient where levels were higher in soil and forage tissue at both Hogbergs' and Armstrongs' where lime had been applied. It is believed that these changes will last for 5 to 7 years depending on soil type.

Julie Robinson assessing oats.

Liming & Crop Responses – Plant Densities & Quality

Crop response to liming was monitored in several ways: measuring plant heights and densities, analyzing tissue and feed for forage quality, assessing leaf diseases and measuring yield response.

Plant density was one of the factors monitored as an indicator of crop response to the lime. In both the Armstrong's and the Hogberg's sites there was an increase in productivity indicated by an increase in the number of stems per square foot.

There was also an improvement in the quality of forage harvested in the plot that received lime over the control plot. In particular, lab analysis revealed higher protein levels in the plant tissues taken from the areas that had been limed.

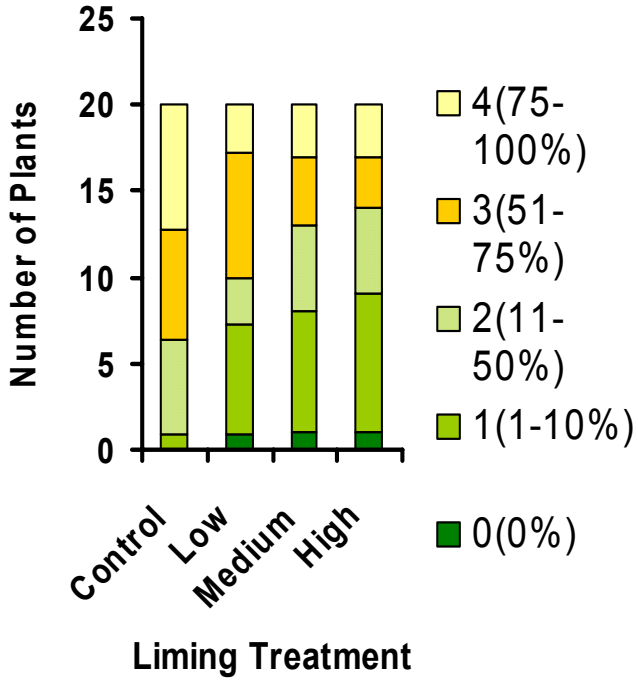
This improvement in forage tissue nutrients is important not only for the livestock producer, this also allows forage producers, such as Dave, to access a larger market and to attain a higher return on forage sales due to the increased value of the higher quality feed.

Liming and Leaf Disease Resistance

Percent of oat leaf affected by halo & stripe blight was less with liming

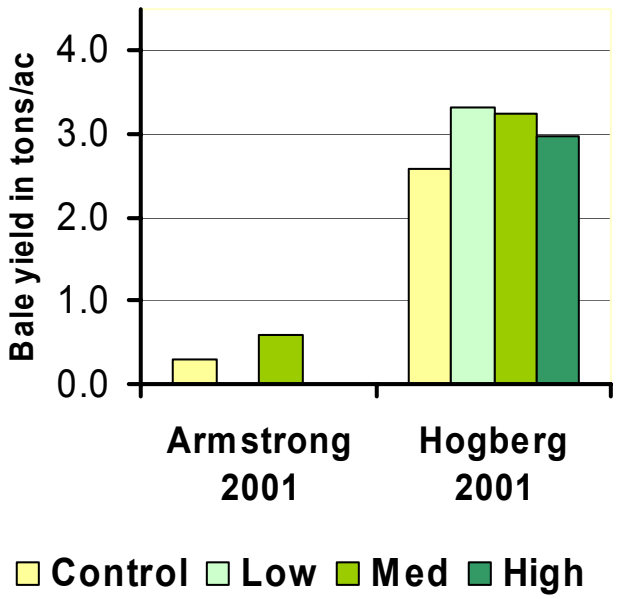
A visit to the Hogbergs' site this summer, resulted in some exciting observations regarding the incidence of disease in the oat field. In this field, oat plants were affected in different degrees by two plant diseases: halo and stripe blight. Samples were collected from each of the different application areas and the control. There were some remarkable differences.

At another field owned by Brian Haddow, barley head diseases were also more evident where no lime had been applied. It appears the plants grown on the limed sites had greater resistance to leaf and seed diseases.



Number of disease infected plants and degree of infection/ % of leaf effected out of 20 plants

Field Scale Forage Yields After Liming



Field scale yields of alfalfa/ grass bales at Armstrongs and feed oat bales at Hogbergs in 2001.

Both field scale and clipped estimates of yield were taken. Forage crop yield response to liming differed at the two locations.

At the Armstrongs', the yields were much lower than usual. Dave felt this was due to the extremely dry field conditions when lime was incorporated in 2000, and again in 2001 when he was establishing alfalfa. Even so, there was a yield improvement where the field had been limed.

At the Hogbergs in 2001, the increase in field scale bale weights were up to 1 ton/ac on the areas of the field that received lime. The clipped yields by hand showed an even more dramatic increase in yield of 1 to 2 ton/ac.

Glenn Hogberg in lodged feed oat crop fall, 2000.

Feed oats at Hogbergs:

* was severely lodged due to weather in 2000.
* yielded slightly higher in 2000 where lime was spread.
* yield increase more evident in 2001.

Properties of Liming Materials

	Chemical Formula	Amount to raise pH from 5 to 6	Cost per acre (3 tonne/ac)	Ease of incorporation	Ease of application
Hot Lime	CaOH	2 ton/ac	$61.50*	No extra cultivation needed	Manure spreader, Hard to spread evenly if liquid form more expensive
Agric. Lime	$CaCO_3$	3 ton/ac	$119.50**	No extra incorporation	Spread with floater truck Evenly spread

*Cost of lime not included because it is often an industry byproduct and donated.
** Trucking costs are variable. Check local prices for your area.

Armstrongs' hay yields:

- showed a greater response to liming in 2001 after better incorporation.
- had a higher alfalfa content in bales.

Economics of Liming

To compile an economic comparison of the costs and benefits of liming, the following assumptions were made, based on lab analysis and market prices:

1. Market value for the bales when there is a 2% protein gain increases by:
   - $2 per round bale and
   - $0.50 per small square bale.
2. Market value of the bales were assumed to be:
   - 65 to 75 lb square bale $ 3.50
   - 750 lb (dry) silage bale $23.50
   - 850 lb (dry) round bale $25.00

Costs of Liming

Hot Lime (CaOH):

N/A	lime material
$ 27.00/ ac	application
$ 34.50/ ac	trucking
$ 61.50/ ac	total

Agriculture Lime ($CaCO_3$):

$ 60.00/ ac	lime material
$ 25.00/ ac	application
$ 34.50/ ac	trucking
$119.50/ ac	total

Note: trucking costs may vary with distance and moisture (hot lime).

Benefits of Liming

Increase in income with 2% protein increase:

$12.50/ ton	square bale
$ 4.00/ ton	round bale (oat)
$ 4.00/ ton	silage bale (oat)

Increase in income with 2 ton/ac yield increase:

$175.00/ ac	square bale
$100.00/ ac	round bale (oat)
$ 94.00/ ac	silage bale (oat)

Based on assumed increases of 2% protein and 2 ton/ac of yield.

Dave and Linda Armstrong grow forage for premium horse hay market, using innovative baling and stacking methods.

Ranchers may want to consider the benefits of liming, if yields are increasing at rates of $^1/_2$ to 2 ton/acre. Especially if that increase in hay yield is accompanied by increased feed quality such as a 2% increase in the crude protein levels.

Arnold Bennett said "Maybe we should be looking at smaller scale applications, a few acres at a time." His point was: many ranchers can not afford a large investment, but may find a smaller one over time more economically feasible.

The investment in liming is not a single year project. This is especially true given the multi year benefits to be obtained from liming acidic soils. Taking into account the availability and cost of liming in the Peace country, there are substantial costs to producers. But there are also benefits in soil fertility, crop health, forage yields and forage quality, that will offset these costs over time.

Compiled by: Julie Robinson, Sandra Burton and Joy Sather, Winter of 2002
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