Muskoka Lime Trial Project

Muskoka SCIA Major Project
(Interim Report)

Purpose:

The objectives of the trial were to examine 1) whether higher than recommended rates could maintain target soil pH levels longer; 2)effects of levels of lime on soil nutrients, organic matter, crop yields and quality and; 3) effects of applying limestone at lower than recommended rates. This document reports the results after 5 years . The trial will continue for another 2 years to determine long term effects.

Across most of the Laurentian Shield, and particularly in Muskoka , agricultural soils are acidic and must be limed on a regular basis to achieve optimum crop growth and yields. While recommended lime rates have been generally effective in raising the soil pH to target levels, farmers have found that the effect of lime is short-lived, and repeat applications are needed after a few years . Others were concerned that recommended rates were too high and wished to test the effectiveness of lower rates.

A long term trial was set up in 2005 in which different lime rates were applied in replicated trials on 6 farms in Muskoka. A Major Grant in 2005 funded part of the costs for limestone, trucking and soil analyses, with all Grant funds accounted for in the 2006 report to OSCIA. Initial results are found in Crop Advances: Field Project Reports, Vol 2, Feb 2006 . OMAFRA/ OSCIA. Pp 105-107.

Methods:

Farmers' field plots ranged from 0.2 to 1ha . A baseline soil test was made in 2005 before lime was applied. Samples were analyzed at Agri-food Laboratories, using a Basic III set of tests before lime was applied, and again in 2009, with Basic I test in the other years . Four farmers applied lime at recommended, 1.5 times and 2 times recommended rates. Two farmers applied lime at lower than recommended rates,

Table 1. Initial status of sites in Muskoka Lime Trail - 2005

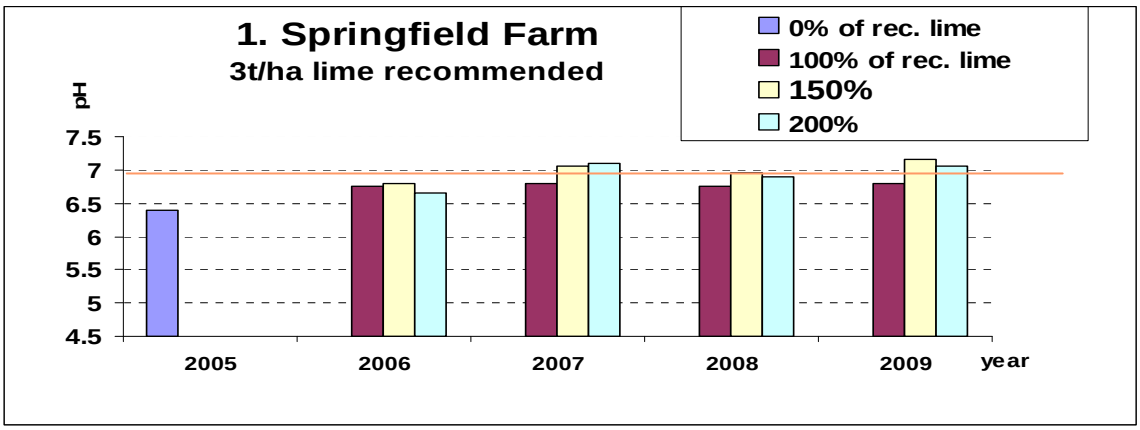
Site	Farm	Soil Texture	Prior Lime (yrs.)	pH	CEC MEQ/100g	Lime Recommended t/ha
1	Springfield	Sandy loam	5	6.3	8	3
2	Brooklands	Sandy loam	10+	6.3	9	4
3	Mallard Siding	Sandy loam	12	5.6	9.5 (37?)	6
4	Grenville	Silt-loam	Hort. lime at seeding	5.9	17	7
5	Pearcey	Clay-sandy	none	5.8	20	7
6	Quinton	Clay Loam	none	5.3	22.2	15

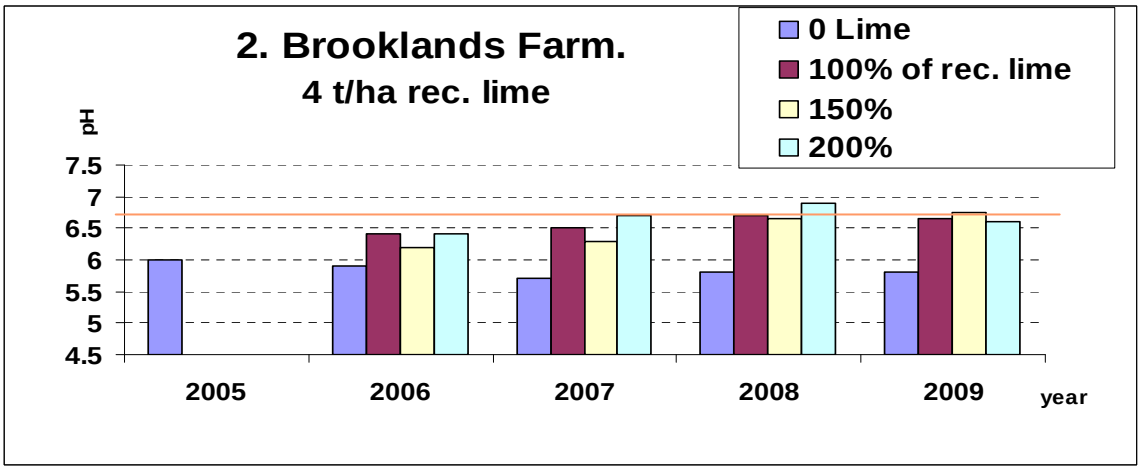
ranging from 15% to 100% of recommended lime. Although, for ethical reasons, farmers were not asked to include a zero lime control, two farmers did include a zero control in their trials. Calcitic limestone with an Ag Index of 70 was applied in fall 2005 or spring 2006 at all sites, using lime spreaders (3 sites) or with the lime evenly placed over manure in manure spreaders (3 sites). Lime was immediately incorporated using discs at all sites.

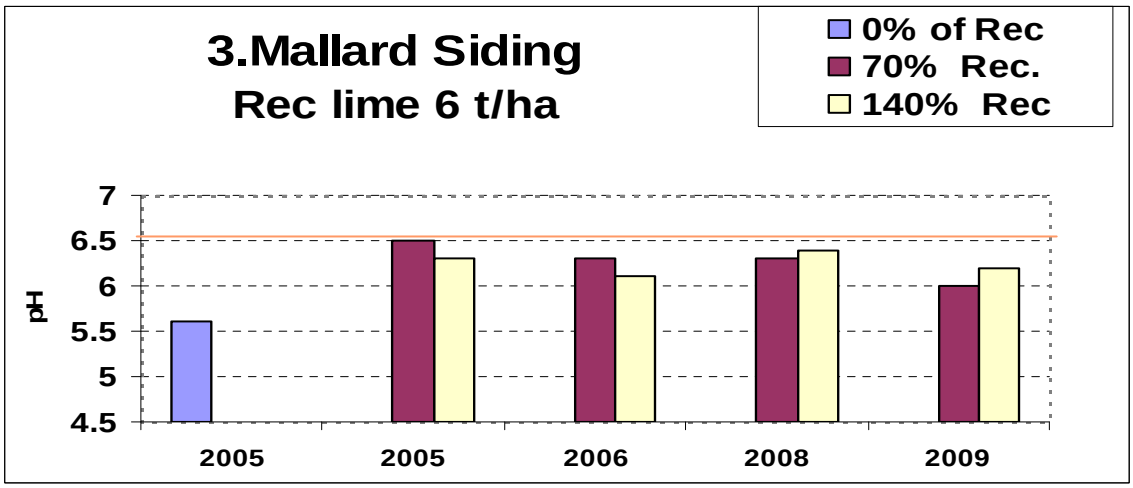
In table 1, sites are arranged in order of level of lime recommended. All sites required lime , and varied widely in soil texture. As expected, light soils possess lower CEC values and lower recommended lime to raise pH levels to a 6.5-6.8 target. Sites were considered broadly representative of soils and soil management in Muskoka . During the trial period sites, normal farm practices were followed at each site for Oats / orchardgrass hay (Site 1); Strawberries/ green manure (site 2);Barley/oats underseeded for hay (site 3); Organic vegetables (site 4); and oats underseeded with legume/ grass hay mixture (sites 5 and 6).(at site 4 an error was made in the analysis of initial baseline soil test, reflected in table 1)

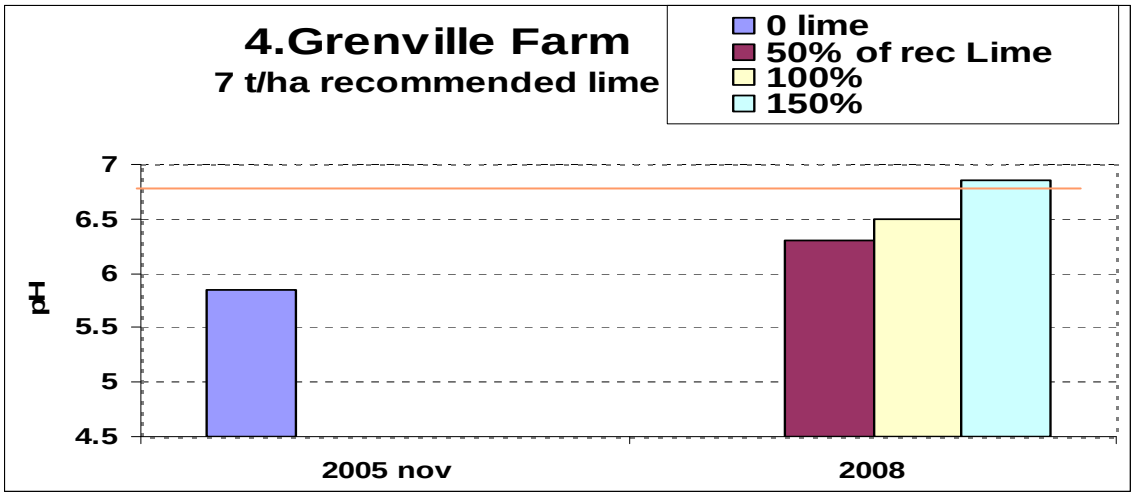
Results:

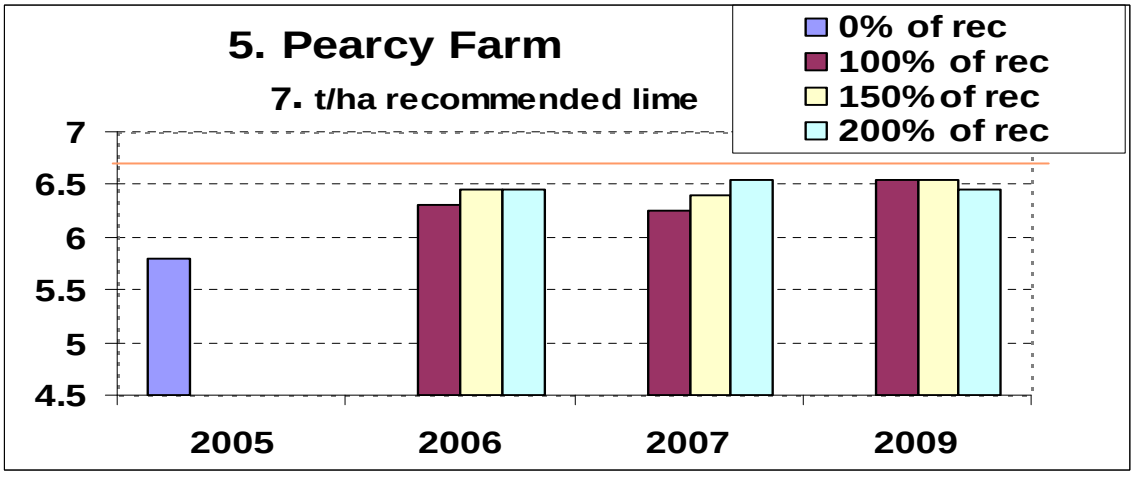
Figures 1-6. Effect of year and lime rate on soil pH at 6 Muskoka farms. .
(Orange line represents approximate target pH)

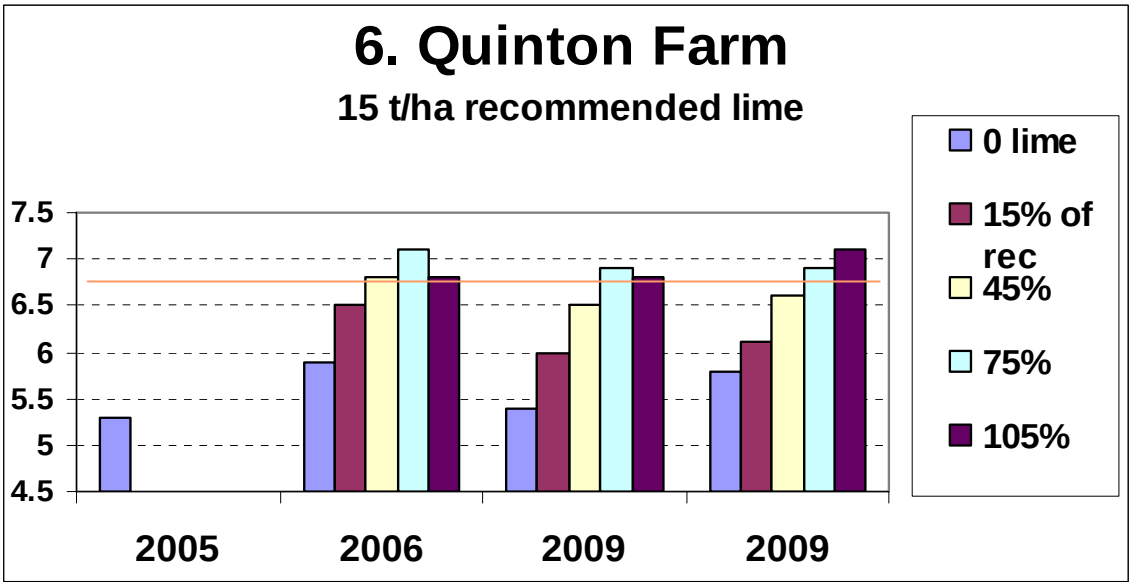





3.Mallard Siding
Rec lime 6 t/ha
0% of Rec
70% Rec.
140% Rec
pH
7
6.5
6
5.5
5
4.5
2005
2005
2006
2008
2009

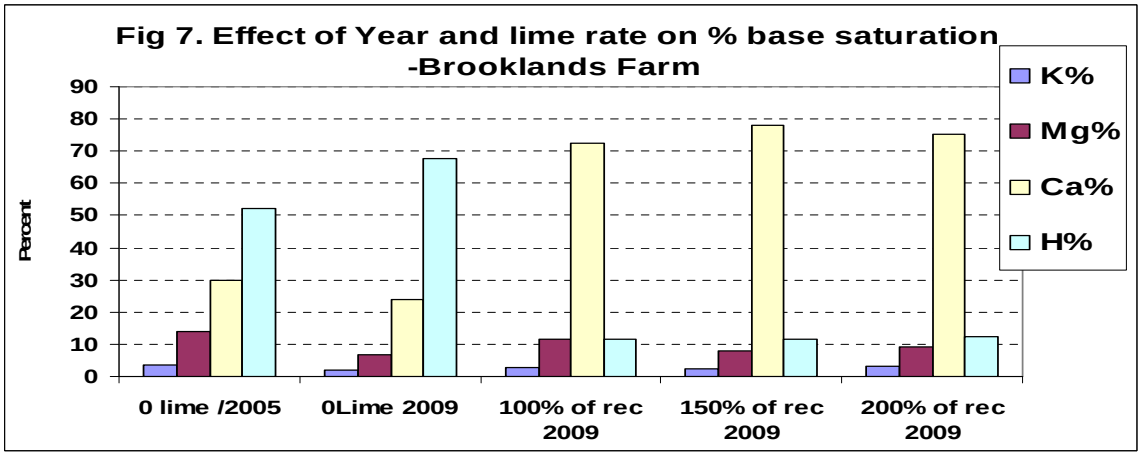

4.Grenville Farm
7 t/ha recommended lime
0 lime
50% of rec Lime
100%
150%
pH
7
6.5
6
5.5
5
4.5
2005 nov
2008

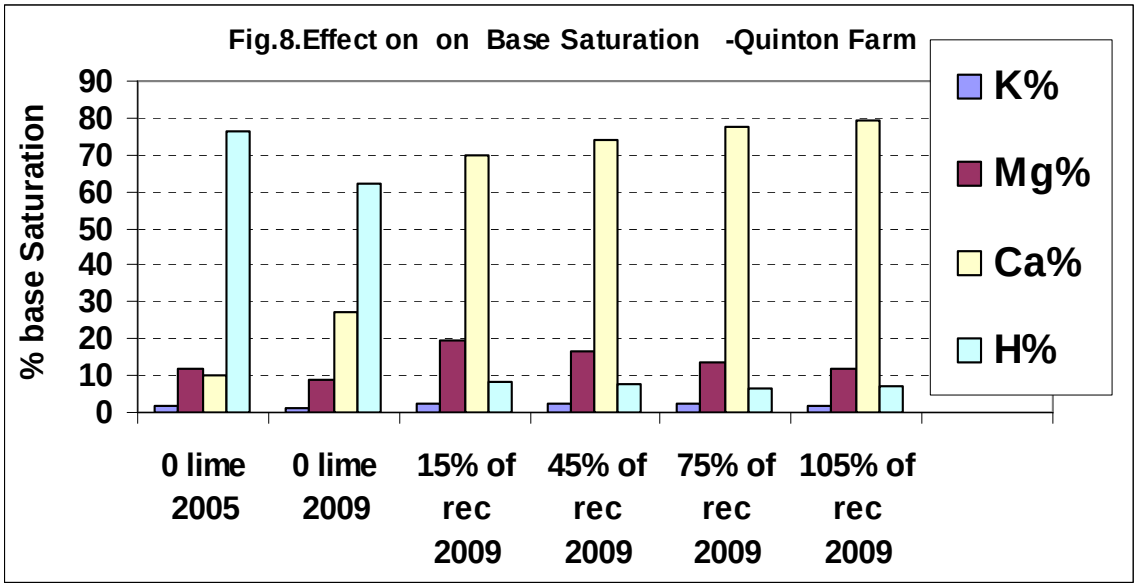

5. Pearcy Farm
7. t/ha recommended lime
0% of rec
100% of rec
150% of rec
200% of rec
7
6.5
6
5.5
5
4.5
2005
2006
2007
2009



1. Effect on pH - As shown in figs 1-6, pH continues to rise for 1-2 years after lime application. After 4 years, pH reached target levels at all sites except Mallard Siding(where lime, even at the higher than recommended rate, did not increase pH to target levels. There is no sign of pH decline at 4 years , even at sandy, low buffered sites (1 and 2). Although the 150% of recommended rate resulted in marginally high pH at sites 1,2,4,and 5, the lower (recommended) rate was equally effective in achieving target pH levels. Results differed at site 6 (high buffered site), where lower rates 50-75% effectively achieved target pH . There was some concern that the recommended rate (100% rate) may have produced excessively high pH levels at this site.

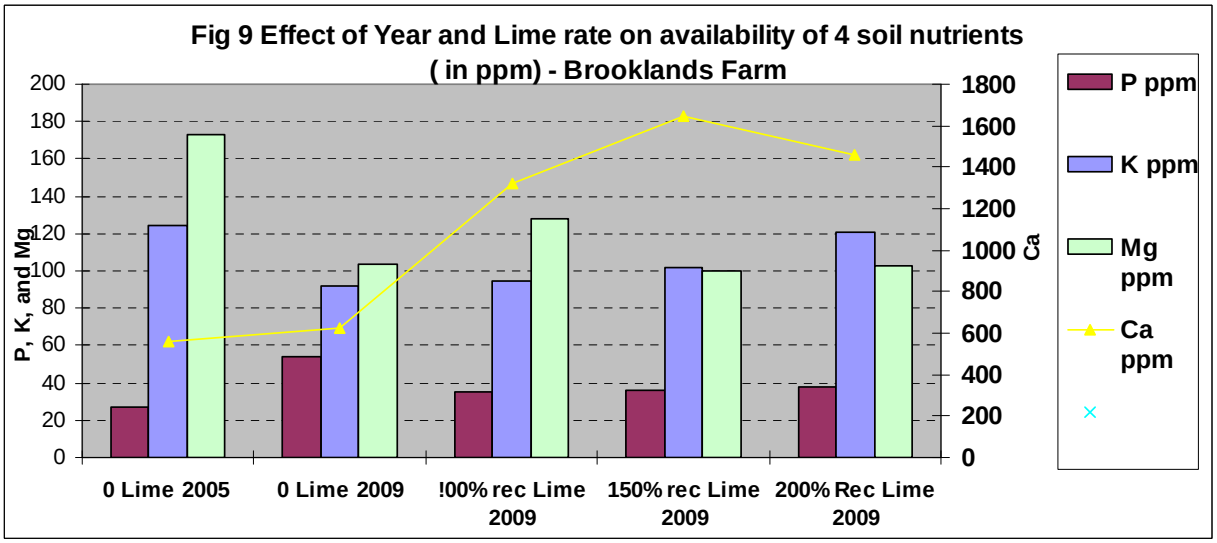
2. Effect on base Saturation Figures 7 and 8

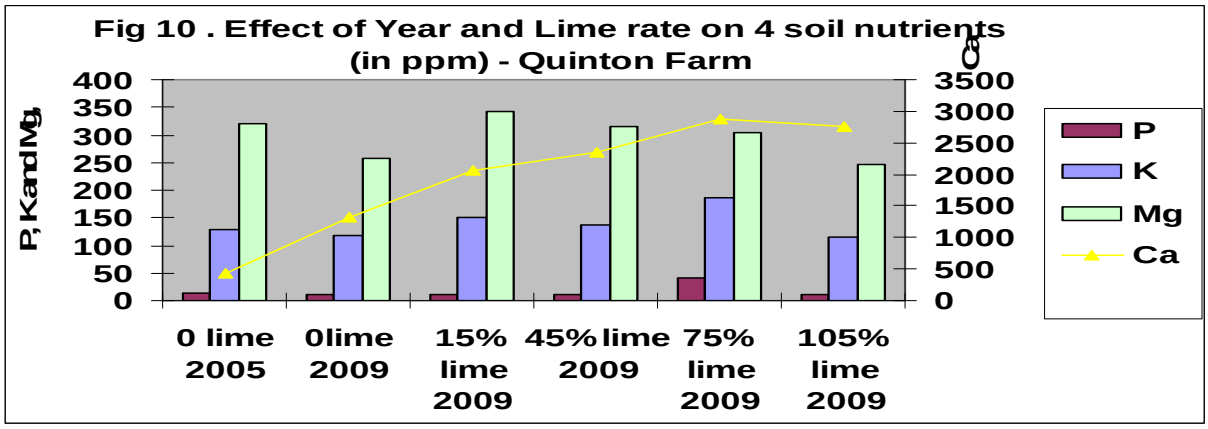


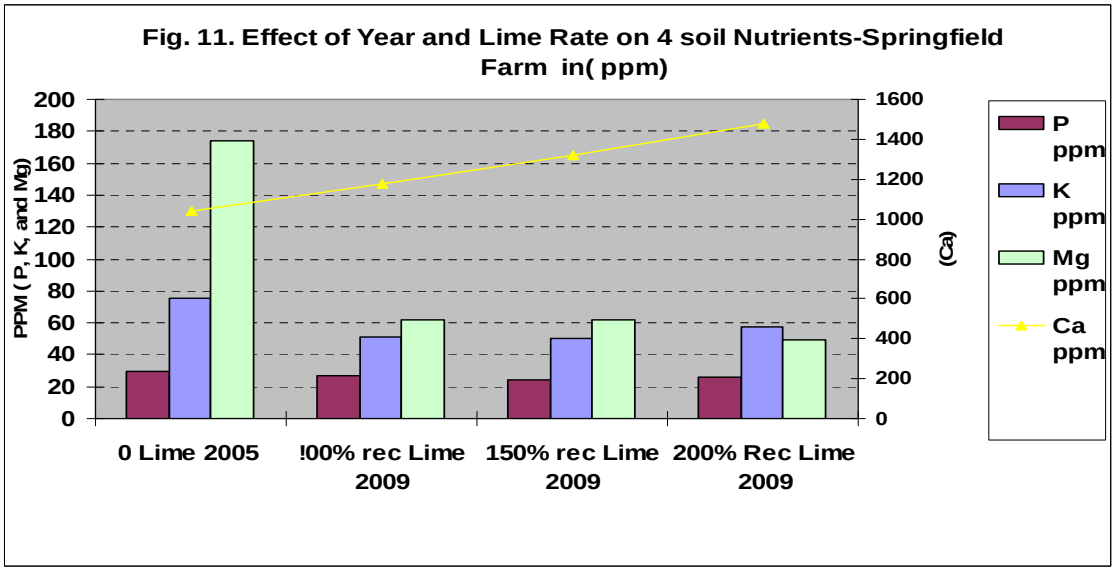


Large changes were found in base saturation 4 years after liming at all sites. The sandy (BrooklandsFarm) and clay (Quinton farm) sites illustrate that without lime, hydrogen occupied most (60- 80%) of the binding sites. With the application of lime, calcium replaced hydrogen (which dropped to about 10-15% saturation) . At the highest lime rates, calcium saturation rose to approximately 80% at both locations. In contrast, saturation of potassium and magnesium declined slightly with lime application.

3. Effect on 4 Soil Nutrients (P, K, Mg, Ca)



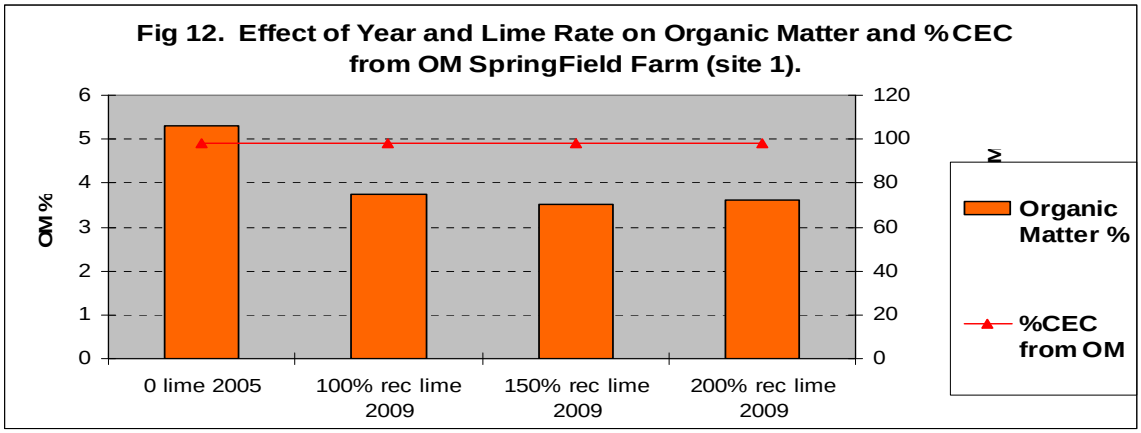


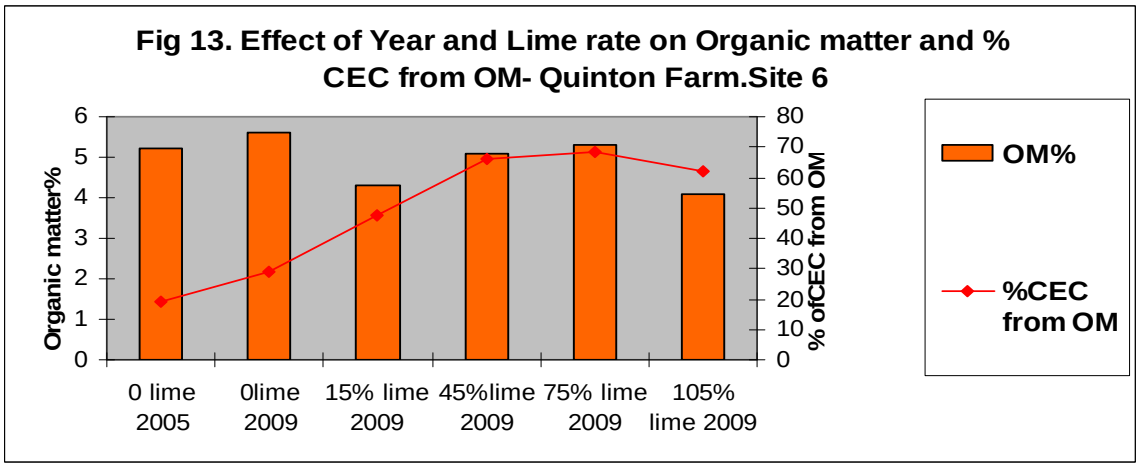


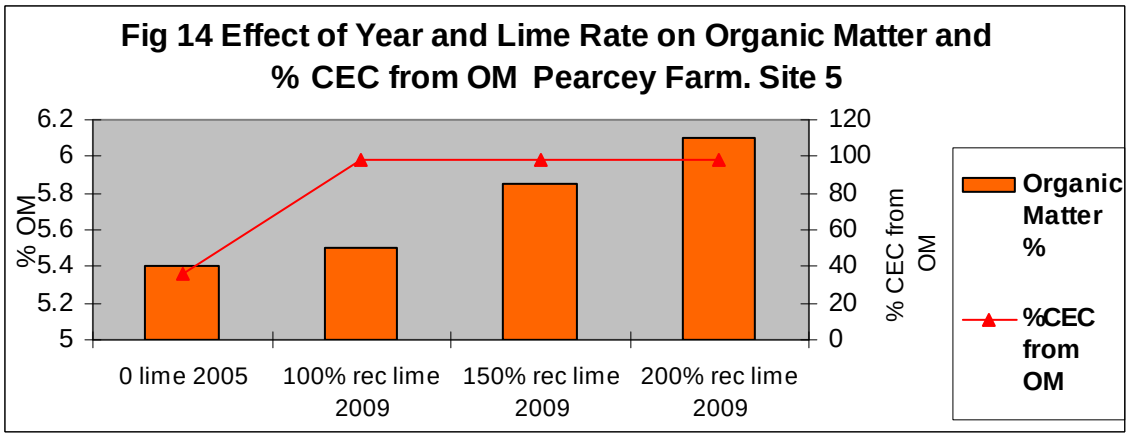
Figures 9, 10 and 11 indicate that change in K, Mg and Ca is closely related to changes in base saturation. Except for Ca, nutrients did not increase with lime rate- at some sites, P,K and Mg were slightly lower at higher lime rates.The drop in nutrient availability was more pronounced at the sandy soil site with low CEC (fig 11). The low Mg found at several sites (1, 2, 5) should have been corrected using dolomitic limestone . As limestone did not increase the low levels of available P and K at sites 2,5,and 6, these sites may need alternative soil amendments or higher rates of manure/ fertilizer, to correct these low nutrient levels values.

Organic matter (OM) was high (3.5 -6%), at all sites. This is expected, as Muskoka farmers have generally found high levels of organic matter in their soils . In comparing organic matter in 2005 with 2009, 4 years after liming, it was found that organic matter had increased slightly at sites 2,3,and 5, but decreased slightly at sites 1 and 6. Cation exchange sites in soils may be supplied by organic matter or clay. It was found that OM was very important in supplying CEC (90-98%) not only

4. Organic matter and % Cation exchange from Organic Matter





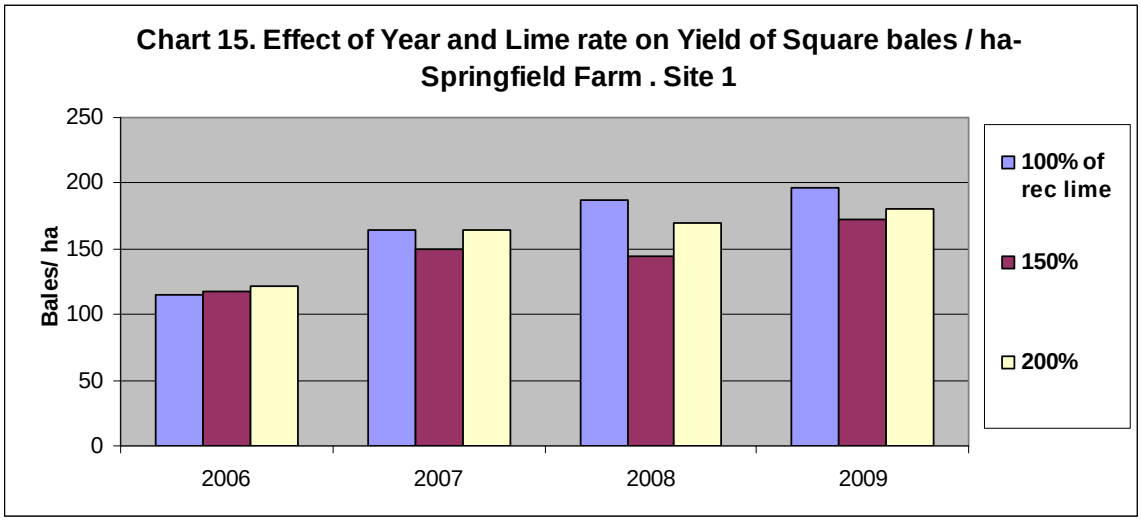


at the low and medium (1,2,3,4, 5)sites, but also at the high clay site (20-70%) . In general , no clear effect due to lime or lime rate on organic matter was found at these sites.

5. Effect of Lime on Yield and Quality

Yield was assessed by visual comparison and counting bales of hay from each plot. Final yield figures from some sites are not yet available. At Brooklands farm a large reduction in strawberry yield and quality was noted visually on the unlimed plot in

2009, when pH had dropped to 5.8 . the yield of square bales of hay from Springfield farm are shown in figure 15 .



While increased yields in each successive year are found, this effect may be due to favourable weather in later years, rather than to the application of lime.

Summary:

Soil test lime recommendation best at all sites, except site 6 (clay with high CEC), where lower rates (50-75%of recommended) are best. Recommended rate can maintain target pH for at least 4 years (at 5 of the 6 sites). Higher than recommended rates resulted in excessive Ca saturation , possibly displacing other soil nutrients. Marginally reduced nutrient levels with lime were found at the sandy soil (low CEC) site. Dolomitic lime with higher Mg content would be more effective to correct both low soil pH and low Mg. Alternative soils amendments , manure or fertilizer may be needed to improve available nutrients. As locally produced wood ash is available in Muskoka , the use of wood ash to correct both soil pH and low nutrient levels should be explored. A final soil test , to be taken 6 years after liming is planned, to examine long term liming effects on Muskoka soils. If funds permit, tissue tests for micronutrient changes will be included .

Next Steps:

The study will be continued.

Acknowledgements:

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