Effect of Surface Broadcast Vs. Incorporated Lime on Soil pH

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Report to PPIC, February 2000

Introduction

This project was initiated in the fall of 1997 with the support of The Fertilizer Institute of Ontario (TFIO), The Canadian Fertilizer Institute (CFI), the Phosphate and Potash Institute (PPI), A&L Laboratories, East, Stratford Agri-analysis, Agri-Food Laboratories Ltd. and Agriculture and Agri-food Canada.

The objectives of the study are to:

a) determine the efficacy of surface applied lime compared to incorporated lime.
b) observe the rate of change of soil pH with time
c) observe the rate of change of soil pH with depth
d) determine the effects of lime on starter fertilizer
e) compare pelletized lime with dolomitic limestone

Materials and Methods

Sites

The project has three sites all located in southwestern Ontario. The Woodslee site is on a soil classified as a Brookston clay. The site is level and showed evidence of low pH affecting crop growth before the beginning of the experiment.

The Thamesville site is located on a Berrien sandy loam soil. The site is on the top of a knoll and has been affected by wind erosion in the past.

The Melbourne site is located east of Melbourne on a Bookton sandy loam soil. The site is on the top of a knoll and part of a complex slope.

Treatments

Tillage: Spring Disced - twice
No-till - two coulters and trashwheels in front of seed opener

Lime: No lime
Dolomitic lime at 5 t/ha
Pelletized lime at 5 t/ha

Starter Fertilizer: None
0 kg/ha N, 30 kg/ha P_2O_5, 70 kg/ha K_2O
0 kg/ha N, 30 kg/ha P_2O_5, 70 kg/ha K_2O, Mn foliar applied at 8 kg $MnSO_4$/ha at flowering (1998)
0 kg/ha N, 20 kg/ha P_2O_5, 70 kg/ha K_2O, Zn foliar applied at 8 kg $MnSO_4$/ha at 8 leaf stage (1999)

Experimental Design: Split-split plot factorial design with tillage as main plot, lime a split plot on tillage and starter fertilizer a split plot on lime

Plot Data

Planted: Woodslee - May 11, 1999
Thamesville - May 12, 1999
Melbourne - May 12, 1999

Harvest Dates: Woodslee - October 7, 1999
Thamesville - October 4, 1999
Melbourne - October 12, 1999

Soil pH sampling dates:

Woodslee -	May 3, 1999
	June 7, 1999
	June 30, 1999
	October 28, 1999
Thamesville -	May 11, 1999
	June 9, 1999
	June 28, 1999
Melbourne -	May 10, 1999
	June 8, 1999
	July 5, 1999
	October 26, 1999

Sampling depths: 0-2.5 cm*
2.5-5 cm
5-10 cm
10-20 cm

* cores were taken with a probe containing an acetate sleeve. The soil in the sleeve was then separated into the different depth increments for analysis. Ten cores were taken per plot, the cores were sectioned and the individual depths were mixed and boxed for analysis.

Sample analysis: Analysis was done by the soil test laboratories cooperating in the study. The Woodslee samples were analyzed by Stratford Agri-Analysis, the Thamesville samples were analyzed by A&L Laboratories East and the Melbourne samples were analyzed by Agri-Food Laboratories Ltd.

Results and Discussion

Each of the sites will be discussed separately in this section.

Woodslee

The Woodslee site was the finest textured site of the three studied. The initial pH ranged from 5.0 to 5.3. The sodium bicarbonate phosphorus soil test level averaged 13 and the ammonium acetate potassium soil test level averaged 83 at the beginning of the experiment.

There was not an abundance of rainfall at the Woodslee site in 1999. The area received about 50% of the average rainfall during the growing season, which led to a shortage of moisture in the soil and drought stress symptoms on the crop during the growing season.

The sampling date vs. pH graph for each depth to the 5-10 cm depth and each tillage system are shown in Figures 1-6. There was no effect of liming below the 5-10 cm depth so the graphs have not been included.

Soil pH response to pelletized lime was the same as the response to dolomitic lime at the Woodslee site. The two lime sources appeared to react with the same speed and the pH change was of the same magnitude for each depth studied.

Soil pH changed quite rapidly with lime application at the 0-2.5 and 2.5-5 cm depths in the tilled treatment. At the 5-10 cm depth the pH did not change in the year of application, however, in the 1999 season there was an increase in soil pH at the 5-10 cm depth. This was probably the result of the second disking which occurred in the spring of 1999. The tillage incorporated the lime deeper into the profile, increasing the soil pH at the deeper depth.

Thamesville

The graph for soil pH over the sampling dates for the four depths are found in figure 7. There was a stratified pH of the soil when the experiment started at the Thamesville site, however there was a small response to lime at Thamesville.

Soil pH tended to increase with time. There was not a difference in soil pH between the two sources of lime. They both increased soil pH the same amount. The pH change at this site was relatively small. More details will be given in the final report.

There were no corn growth or yield differences among any of the treatments at this site in 1999.

Melbourne

The soil pH values for the Melbourne site are shown in Figures 8-15 for the different tillage systems and depths.

The soil pH values followed many of the same trends at this site as was observed at the Woodslee site. Lime increased the soil pH rapidly at the beginning of the experiment. The differences in pH were maintained throughout the remaining sampling dates.

There was no difference in soil pH response between dolomitic and pelletized lime at this site. There was also no effect of starter fertilizer on soil pH. There was a tillage effect on soil pH at some depths. At the surface, there was no difference in soil pH between the two tillage treatments in the limed plots. At the 2.5-5 cm depth the tilled treatment had a greater increase in soil pH due to lime than the same depth in no-till. The 5-10 cm depth in the tilled plots had an increase in the soil pH. Lime did not affect the soil pH at the 5-10 cm depth in no-till over the duration of the project. There was no effect of liming at the 10-20 cm depth for either tillage treatment.

Conclusions

Liming of the soil altered the pH very rapidly. pH changes occured within 2-4 weeks of lime application. After the initial change in pH from the lime application, further changes in pH were not the result of the lime that was used. The exception was the 5-10 cm depth in the tilled treatment at Woodslee. At this depth a change in pH was observed in 1999, likely due to the tillage that was conducted in the spring of 1999.

There were no differences in soil pH due to the source of lime. The dolomitic lime and the pelletized lime were equally effective.

Starter fertilizer did not have an effect on the soil pH, however it did increase yields at the Woodslee site were the soil K values were in the mid 80's.

Fig. 1 Woodslee Soil pH Tilled - 0-2.5 cm 1998-1999

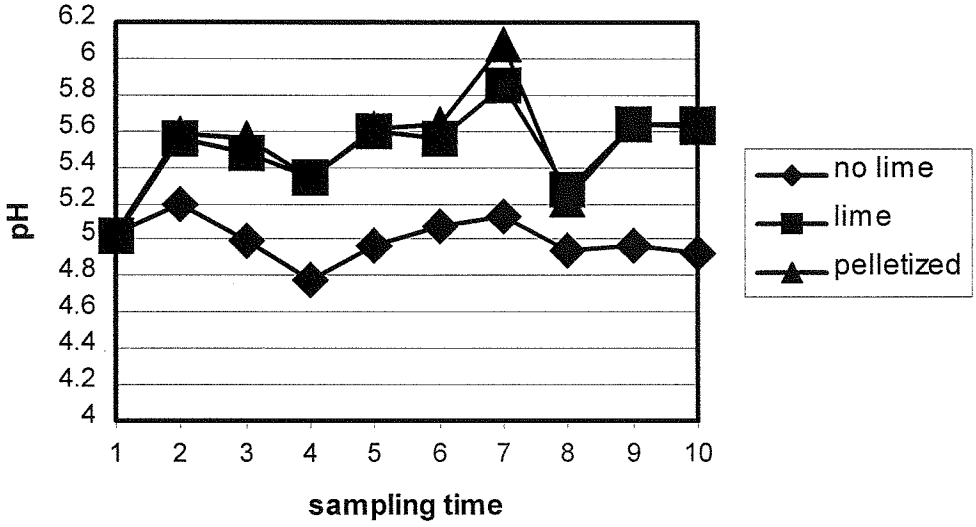

Figure 2. Woodslee Soil pH Tilled - 2.5-5 cm 1998-1999

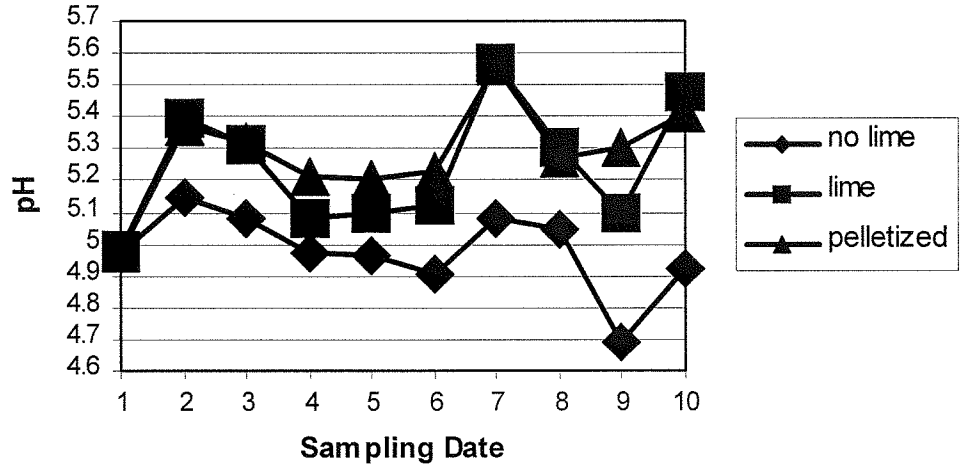

Figure 3. Woodslee Soil pH Tilled - 5-10 cm 1998-1999

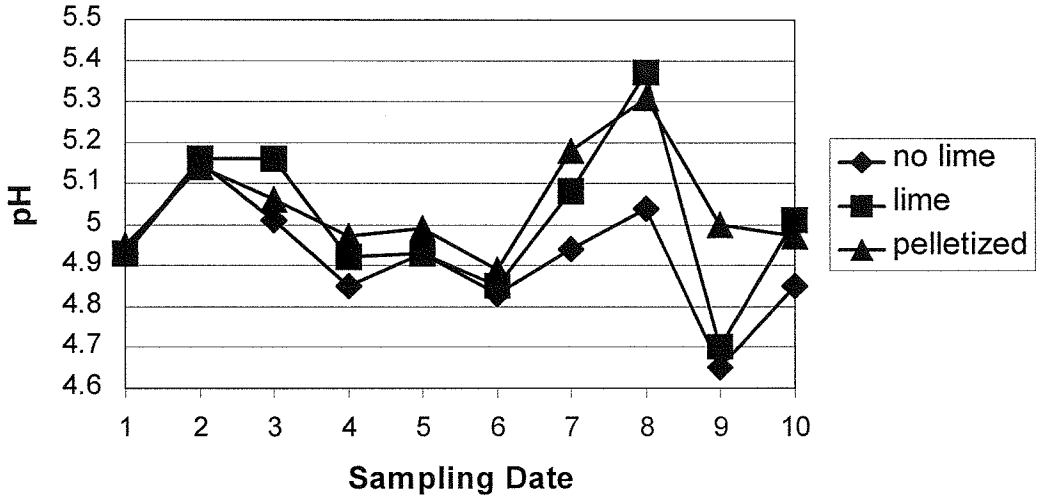

Figure 4. Woodslee Soil pH No-till - 0-2.5 cm 1998-1999

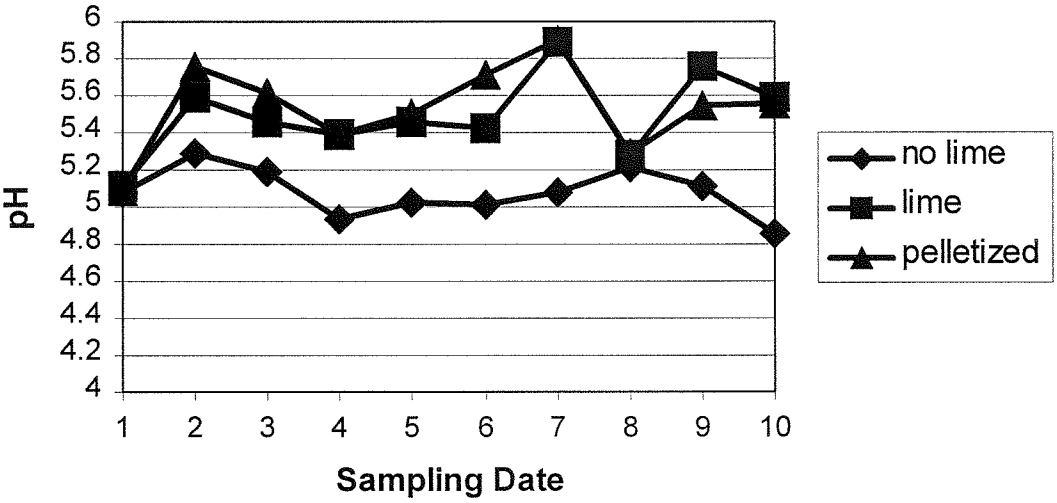

Figure 5. Woodslee Soil pH No-till - 2.5-5 cm 1998-1999

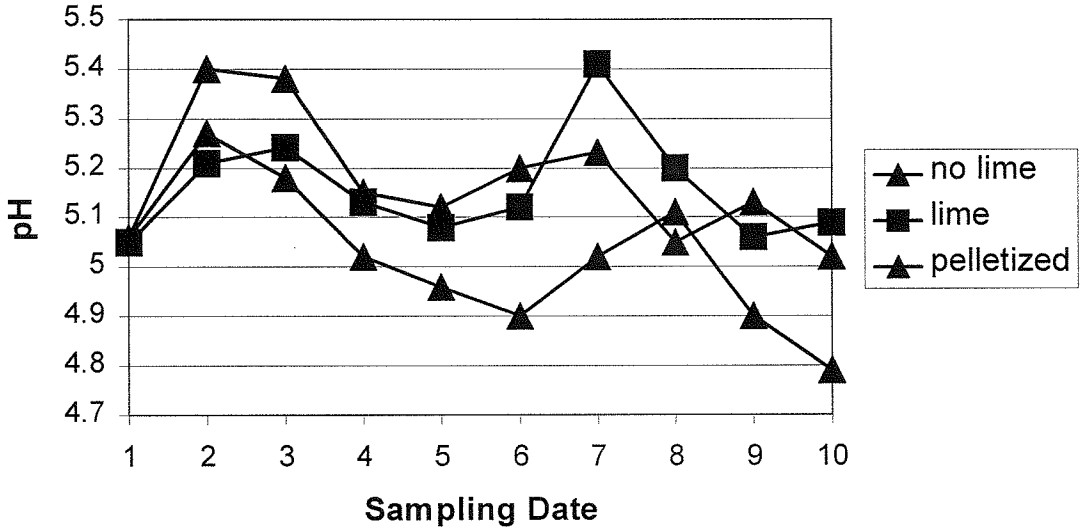

Figure 6. Woodslee Soil pH No-till - 5-10 cm 1998-1999

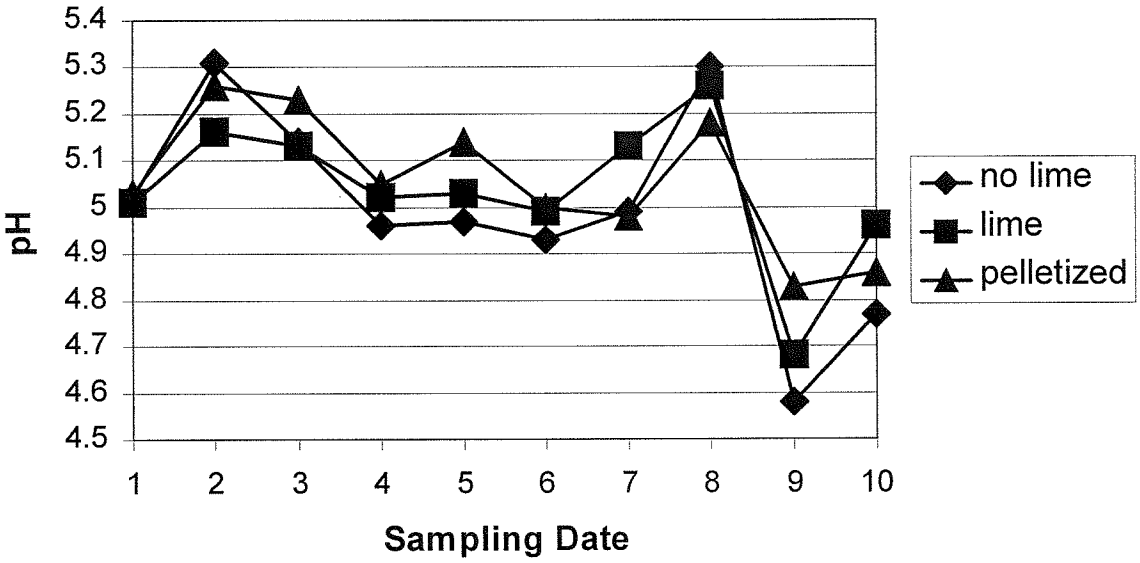

Figure 7. Thamesville pH Depth vs. Time 1998-1999

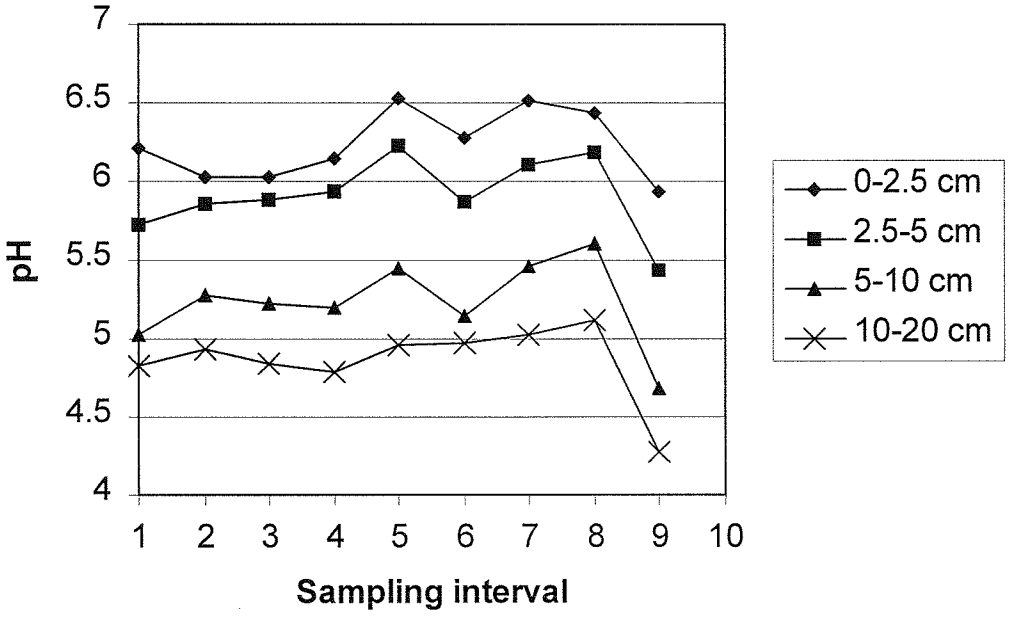

Figure 8. Melbourne Soil pH Tilled - 0-2.5 cm 1998-1999

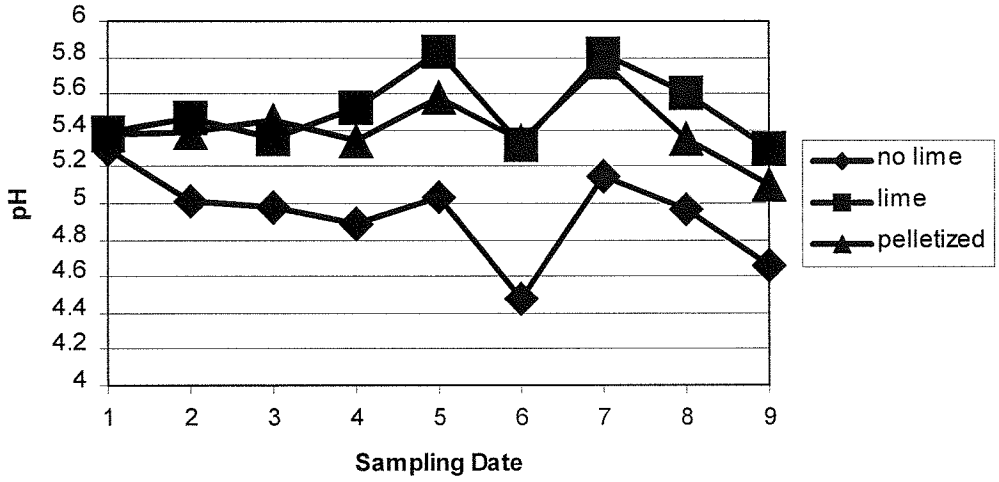

Figure 9. Melbourne Soil pH Tilled - 2.5-5 cm 1998-1999

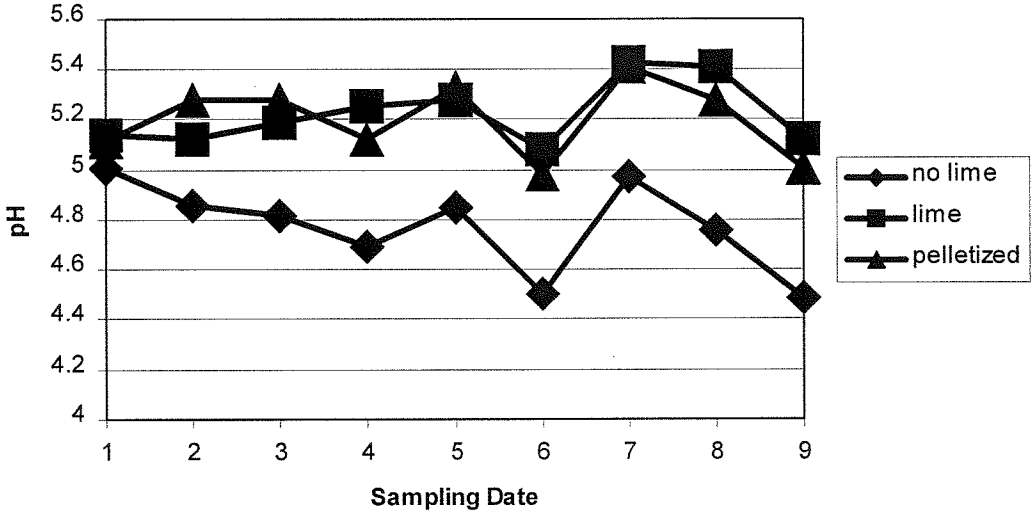

Figure 10. Melbourne Soil pH Tilled - 5-10 cm 1998-1999

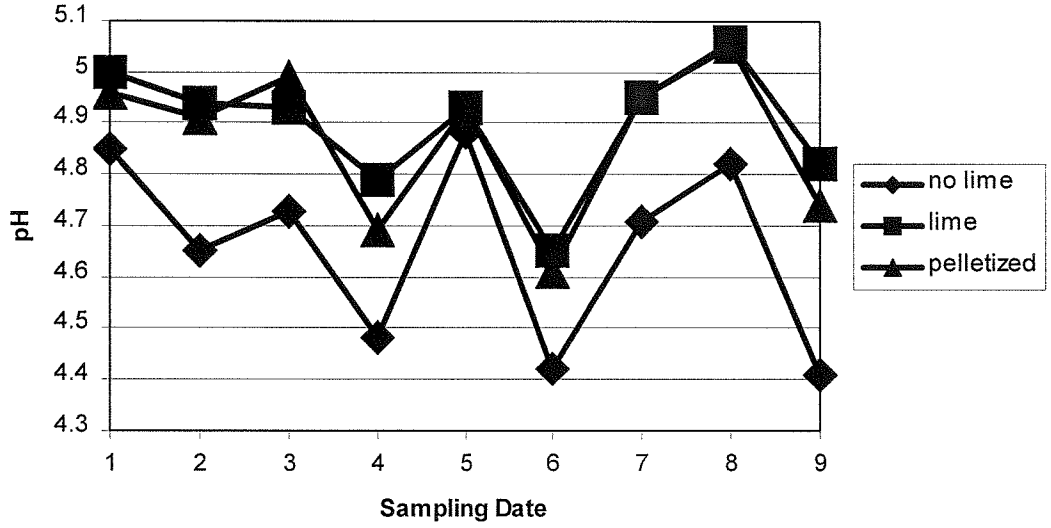

Figure 11. Melbourne Soil pH Tilled - 10-20 cm 1998-1999

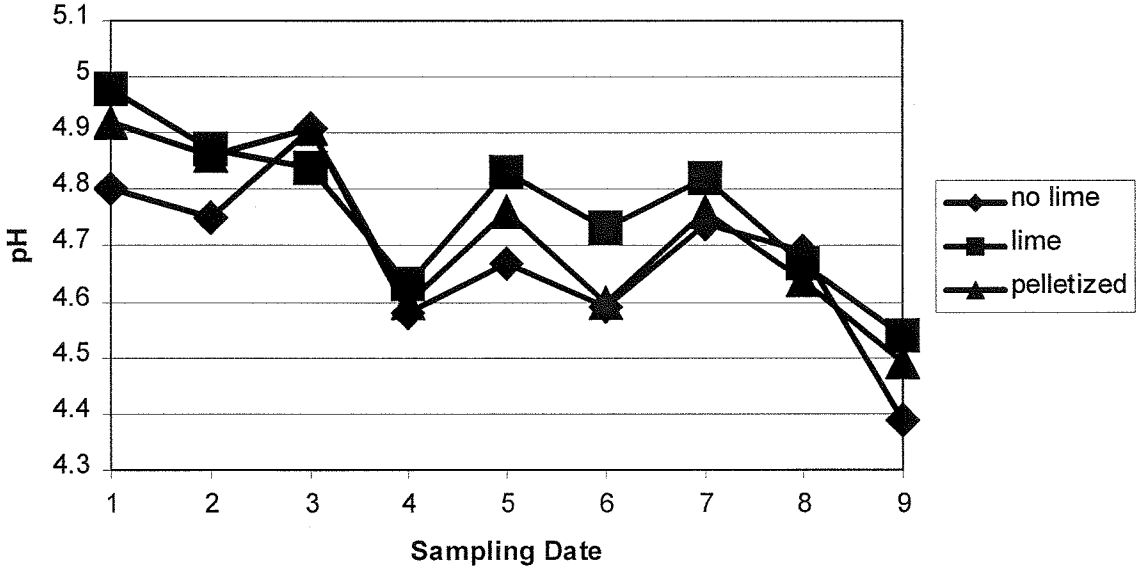

Figure 12. Melbourne Soil pH No-till - 0-2.5 cm 1998-1999

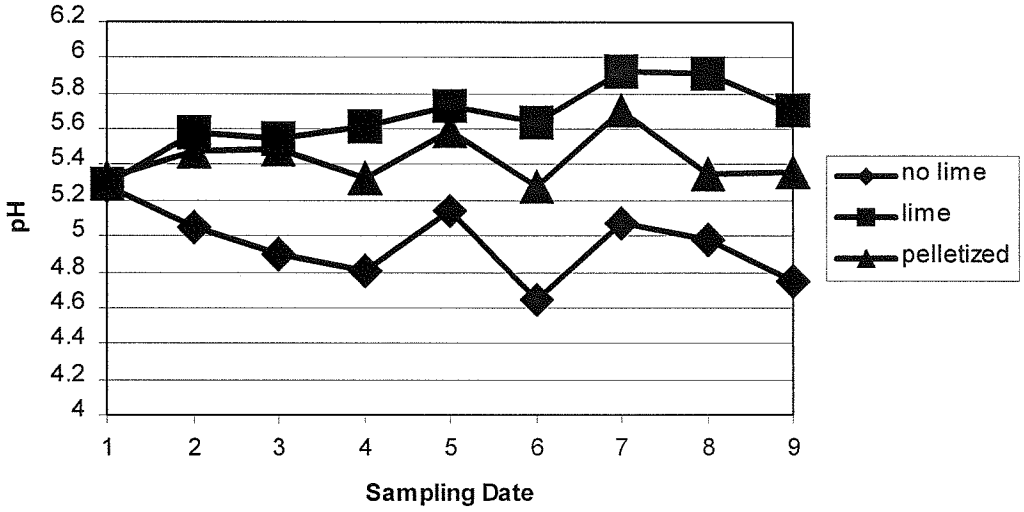

Figure 13. Melbourne Soil pH No-till - 2.5-5 cm 1998-1999

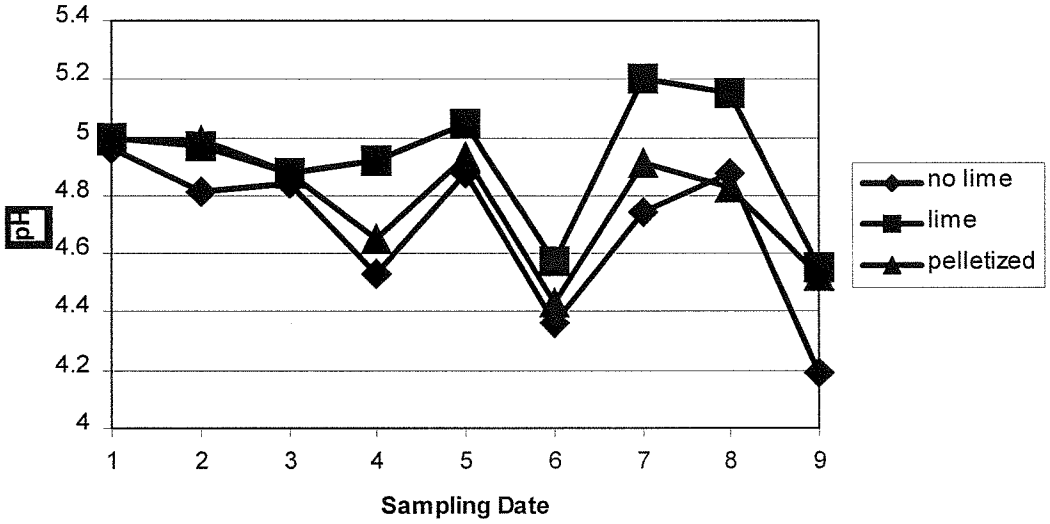

Figure 14. Melbourne Soil ph No-till - 5-10 cm 1998-1999

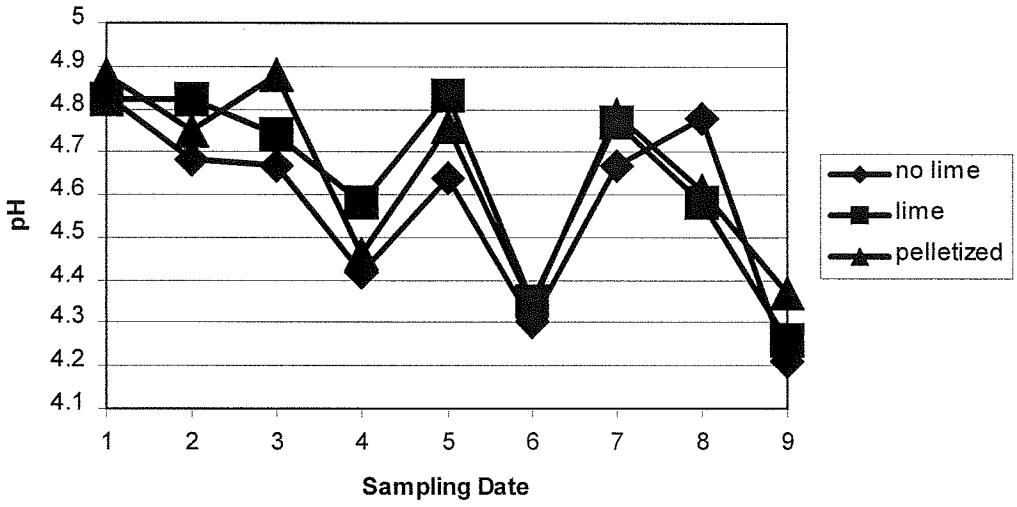

Figure 15. Melbourne Soil pH No-till - 10-20 cm 1998-1999