Soil pH and pasture productivity

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Soil acidity is a universal problem for crop production in humid or high rainfall environments. Agricultural production practices such as addition of ammonium-N fertilizer adds to soil acidity. Reduction of soil acidity is achieved with the application of lime, calcium carbonate. Cropping systems differ in the reason soil acidity limits growth, ability to apply lime in crop sequence, and economics or return from lime application. The need for lime and benefit from application has been measured in coastal pastures research plots for more than a half century. The research work demonstrated that lime applied to soil with pH of 5.5 or lower will increase forage yield and increase longevity of orchardgrass, perennial ryegrass and white clover in pastures.

The half century of research has not satisfied Coastal Oregon pasture managers. They continue to question the need to apply lime and the benefit from its application. The primary questions are economics and yield often expressed as “how much does liming cost?” and “what do I get from applying lime?” Coastal Oregon forage producers pay a relatively high price for lime that produces a modest yield increase. Lime costs more on the coast than in the Willamette Valley, typically 25 to 30 % more/ton. Forage grass yield increase from lime application varies, from 250 to1750 lb/a.

It is generally understood in the scientific community and in commercial farming industries that soil pH plays an important role in crop productivity. Research has shown for many crops that low soil pH can significantly reduce plant productivity. For years, it’s been common for farmers to soil test their soils and use these analysis to determine how low their pH has dropped and typically the lab estimates the quantity of lime or calcium carbonate needed to bring soils up to desirable levels.

The pH of a liming material is not the criteria for effectiveness. The material must be able to form a compound with the hydrogen. Formation a compound with hydrogen, removes hydrogen from soil solution, which in turn reduces acidity. The compound formed by reaction of most agricultural liming materials with hydrogen is water. The amount of lime used to change soil pH, generally ranges from one to 5 tons per acre. This amount of lime is expected to change the pH in approximately 2 million pounds of soil. A single pH unit is a ten-fold change in hydrogen ion concentration. The goal of liming is not to neutralize all hydrogen or raise the pH to 7, rather reduce acidity to tolerable level.

Since most our pastures on the coast range from 4.8 to 6.0 in pH, it has generally been believed that we need to lime our pastures to increase productivity. I think this has been especially true of soils in the lower half of the range (4.8 to 5.4). Two years ago I set out

to conduct some local research to help us better understand the economics of liming coastal pastures. In describing my results, I will use some assumptions that you may or may not agree with, but the data still remains the same.

The project was conducted on two sites that had initial soil pH values at 5.1 and 5.3. I planted a total of 24 plots at each site to perennial ryegrass and used liming treatment rates of 0, 1 ton, 2 ton and 4 tons per acre equivalent. Half the treatments were applied and incorporated while tilling before planting and the other half the plots received lime as a top dress application during the first winter. Plots were harvested six times a year for two years. Yield and quality data were recorded and the data was statistically analyzed.

Lime treatments increased soil pH significantly as well as slight increases in yield. Differences in yield from the control plots to the highest lime application plots were significant. However, the total increase was only around 1000 pounds of forage (less than 10% increase) per acre per year. If we value this feed at 8 cents a pound, we increased the value of forage by $80 acre. The four ton treatment of lime could cost $240 - $280 acre, making the economic return questionable. One main question that is not answered yet, is how long this increase will last? Typically, we would estimate liming working for 5-7 years.

These results were a little surprising, because we have always been lead to believe pH was the limiting factor to forage productivity. We speculate the high organic matter soils found on the coast influenced the differences seen. Another way to say this is these soils that are acidic and high in organic matter are less toxic to ryegrass than a soil with the same pH and lower organic matter. Again, I am only speculating, but this data are similar to some work done in the 1960's at the research station in Clatsop County. It's important to note, these soils started at 5.2 and were increased to 6 at the highest treatment. Other crops besides ryegrass could respond differently.

The results of this project do make me question the economics of liming coastal pastures. I am not saying that low pH is not an issue or that in some cases liming may not be warranted. But I do think we have enough data to question the cost effectiveness of liming coastal ryegrass pastures.