

# Amelioration of Agriculturally Induced Acidity

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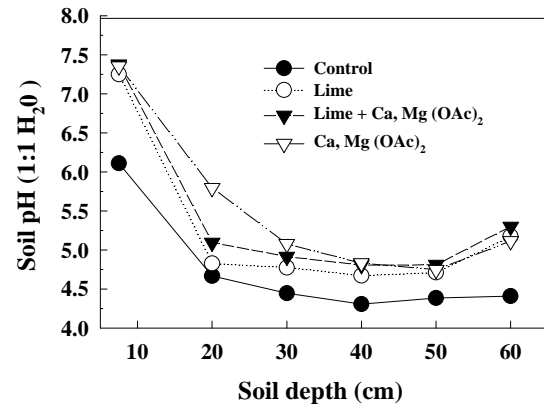
During the past year we examined methods to ameliorate the acidic soil conditions resulting from the use of ammonium sulfate and urea fertilizers. Fertilizer application in and around drip basins has resulted in very acidic soils beneath the emitters. Lime or calcium carbonate is the traditional source of material to increase soil pH and “sweeten” the soil. Unfortunately, lime applied to the surface does not dissolve and move into the soil to any appreciable extent. This is especially problematic at the Nickels site because the soil is most acidic in the subsoil (below 8-10 inches).

We examined the effectiveness of mixing lime with the soil to a depth of 18 inches, applying lime to the surface and using calcium-magnesium acetate as a liming agent. Mixing lime with the emitter basin soil to a depth of 18 inches increased pH and raised Ca levels in the mixed zone as well as below the mixed areas, while lime applied to the surface only increased soil pH in the surface. Where pH and calcium were increased there was a reduction in levels of extractable aluminum. Extractable aluminum had reached high levels in the acidic soil zones. While mixing lime with the soil can alleviate the acidic

soil conditions, this technique is not practical. As an alternative, we examined the ability of a calcium-magnesium acetate to work as a liming agent. Calcium-magnesium acetate is used as a deicing salt for roads and is commercially available. In this material the calcium to magnesium ratio is 3 to 7, which is not ideal. Nonetheless, if the material were to work, the details of applications and formulations could be addressed later.

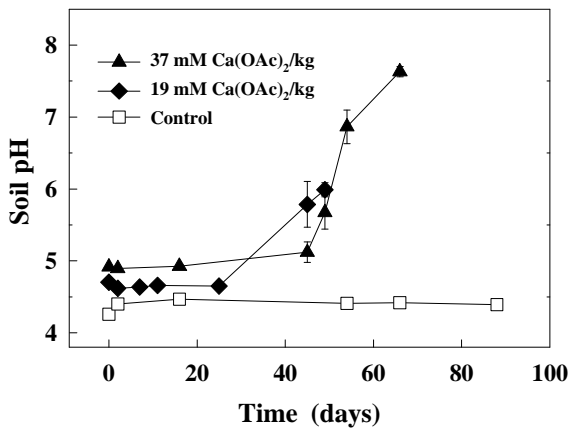
Field trials of calcium-magnesium acetate were established to investigate the utility of applying this material as a liming agent. Calcium-magnesium acetate works because soil microbes release bicarbonate ions as they metabolize the acetate. A release of bicarbonate ions raises pH. Application rates appropriate to the total acidity in the subsoil were mixed with the upper 6 inches of soil in May of 1999. Samples were taken periodically and in April 2000. Figure 1 shows the change in pH in relation to soil depth after 10 months in the field. After 10 months, soil pH did not increase as much as expected. A smaller pH response was probably found because the material was leached before microbial degradation occurred and additional acidity was generated by continued nitrogen fertilization. In the surface where the treatments were mixed with the soil, all treatments increased pH.

Figure 1. Soil pH in treatments after 10 months. The materials were applied in May 1999 and sampled in April 2000.



However, in the next depth increment only calcium-magnesium acetate raised pH above 5.5. Large variations among the three replications made data analysis difficult. One of the control replications was eliminated from the data presented in Figure 1.

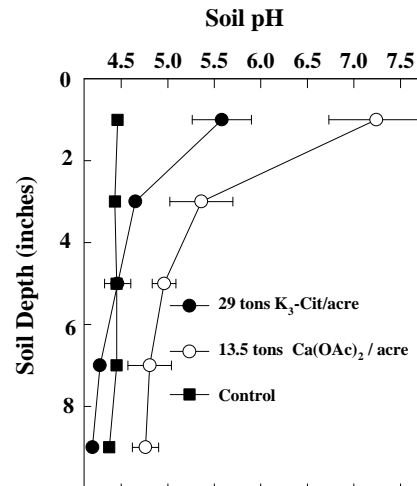
Studies in the laboratory using the acidified soil from the Nickels orchard demonstrated that calcium acetate and potassium citrate both increase soil pH and could work as liming agents. Figure 2 shows the data for batch studies using calcium acetate as a liming material.



**Figure 2.** Effects of calcium acetate on soil pH over time in batch studies maintained at 70 °F.

Note that it took about a month and a half before the effects of the acetate treatment were realized. Since it takes a while for the material to be metabolized, the acetate could have been leached from the soil in the field study before it had time to be utilized completely. If this were the case, smaller, more frequent doses would be a better application method in the field. Whether calcium acetate was being leached in the field is not known. Studies in the laboratory were conducted to examine the extent of leaching and the changes in pH that could be generated in columns of Arbuckle soil. Calcium acetate and potassium citrate were applied to soil columns and reacted for 10 weeks. The results are shown in Figure 3. Calcium acetate and potassium citrate increased

soil pH in the surface and were able to increase soil pH at lower depths suggesting that they could be used to correct acidic conditions in subsoils. In this particular case the materials were applied at rates that were very high on a per acre basis, but only about 2% of the surface is covered by drip basins. Correcting for the area involved gives rate of about 0.27 and 0.6 tons/acre for the calcium acetate and potassium citrate respectively. Both of these materials could be applied in fertigation systems; however the methods would need to be worked out. Application in the irrigation systems would be a useful since potassium and calcium fertilization may be need in some acidic and highly leached orchards.



**Figure 3.** Soil pH in relation to depth for applications of calcium acetate and potassium citrate to acidic Arbuckle gravelly loam subsoil .

Further testing is needed to determine the best methods for application, timing of application, and the dosing rates.