TECHNICAL NOTES

UNITED STATES DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE
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AGRONOMY TECHNICAL NOTE NO. 91

LIME MAKES FERTILIZER WORK

AGRONOMIC BENEFITS

Lime does much more than "sweeten" the soil. There are many agronomic benefits of lime.

LIME:

- Improves the physical condition of the soil
- Stimulates microbial activity
- Supplies calcium and magnesium for plants
- Improves symbiotic nitrogen fixation by legumes
- Increases availability of several nutrients, particularly phosphorus and molybdenum, and most importantly
- Makes fertilizer work by raising the pH of the soil. As soil reaction becomes less acid, fertilizer efficiency increases

The environment also benefits from the judicious use of lime. In a well-limed soil, nutrients are more available for plant uptake and less likely to runoff or leach. Critically eroding areas are more quickly established to permanent cover. Nutrients, in the form of manure and other organic by-products, are more readily utilized and less likely to be exported off site. Forage quality and palatability are improved resulting in more efficient ruminant livestock production. Stimulated plant growth increases the sequestration of atmospheric carbon in crops and soils.

Essential plant nutrients, with the exception of iron, manganese, and molybdenum, are most readily available in soils with a pH between 5.5 and 7.5. Iron and manganese are most available at lower (more acid) pH while molybdenum is more available at higher (more alkaline) pH.

Research performed by the University of Minnesota more than a decade ago clearly illustrates how lime makes fertilizer work. Table 1 shows how the efficiency in use of nitrogen, phosphate, and potash increase as pH rises from Extremely Acid (pH 4.5) to Neutral (pH 7.0). At pH 4.5, fertilizer efficiency is 30% for nitrogen, 23% for phosphate, and 33% for potash and $92.75 worth of applied fertilizer was wasted. Whereas, at pH 7.0, virtually 100% of applied fertilizer was available for plant uptake and no fertilizer dollars were wasted.

Each year, millions of dollars worth of fertilizer is applied to Louisiana's crop and pasture lands without regard for soil reaction or lime requirement. Reasons vary, but the effect is poor fertilizer efficiency leading to wasted production inputs, lower yields, less profit, and potential environmental degradation. For example, a soil test on a field where corn is to be grown

indicates the following:

- pH – 5.0 (very strongly acid)
- phosphorus – 15 ppm (low)
- potassium – 80 ppm (low)
- soil texture – silt
- lime – 3,000 lbs/ac expected to raise pH to 6.8
- Recommendations based on corn 125 bu/ac yield
- nitrogen – 150 lbs/ac
- phosphorus – 80 lbs/ac (P_2O_5)
- potassium – 80 lbs/ac (K_2O)

The producer chooses to apply the fertilizer as recommended but decides against applying the lime. Therefore, according to the efficiency figures in Table 1, only 53% of the nitrogen, 34% of the phosphate, and 52% of the potash applied can be utilized by the corn crop. At today's fertilizer prices of $0.51/lb nitrogen, $0.49/lb phosphate, and $0.26/lb potash, $67.59/ac in fertilizer was wasted. Additionally, yield was reduced 40 bu/ac resulting in $140.00/ac less income based on corn priced at $3.50/bu. Had the producer chosen to apply lime at 1.5 tons/ac, the costs would have been $58.50/ac ($39/ton, spread) but losses from waste and lower yield would have been eliminated.

Application of lime would have resulted in a net return of $149.09 ($207.59 - $58.00 = $149.09)

Table 1. Effects of lime relative to fertilizer efficiency

Soil Acidity	Nitrogen	Phosphate	Potash	Cost of Fertilizer Wasted*
Extremely Acid 4.5 pH	**30%**	**23%**	**33%**	**$92.75**
Very Strong Acid 5.0 pH	**53%**	**34%**	**52%**	**$67.59**
Strongly Acid 5.5 pH	**77%**	**48%**	**77%**	**$39.44**
Medium Acid 6.0 pH	**89%**	**52%**	**100%**	**$24.19**
Neutral 7.0 pH	**100%**	**100%**	**100%**	

*Based on information developed by University of Minnesota.

Although, the scenario at the top of this page is contrived, the information presented in Table 1 is timeless. Even during times of low market prices for commodities and livestock and tight profit margins, there are still some things that should not be neglected. There is more to nutrient management than simply making sure that nutrients are not over applied. NRCS personnel can help producers plan nutrient management on farms to help them understand the economic as well as the agronomic and environmental impacts of their decisions.

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