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FACT SHEET

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ENERGY EFFICIENT FERTILIZATION PRACTICES

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With the continuing increase in energy costs to produce, transport and apply fertilizers, there is a need to evaluate the impact of fertilization practices on energy usage. A major factor linking energy and fertilizer is the use of natural gas to produce anhydrous ammonia. From 35,000 to 40,000 cubic feet of gas are needed to produce a ton of anhydrous ammonia. With gas prices from $2 to $4 per 1,000 cubic feet, it costs from $70 to $160 per ton of anhydrous just to produce the hydrogen needed for ammonia production.

Figure 1 shows that other nitrogen fertilizers originate from anhydrous ammonia. These processes also require energy and add to the cost per unit of nitrogen. A special effort is needed to maximize efficient use of all fertilizers, especially nitrogen.

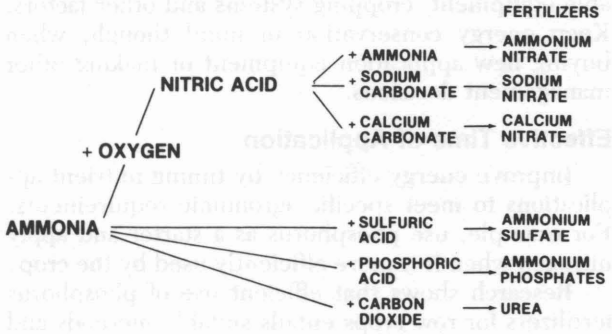

Figure 1. More than 90 percent of all nitrogenous fertilizers consist of ammonia or fertilizers made from ammonia. Source: Fertilizer Salesman's Handbook, National Plant Food Institute.

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Consider these factors to make fertilization more efficient and conserve energy:

- Soil testing
- Maintaining acceptable pH
- Using high analysis
- Efficient application methods
- Effective time of application
- Maximizing the use of legumes
- Using wastes where economically profitable

Soil Testing

A fundamental requirement for efficient and profitable use of fertilizers is maximizing soil nutrients. Soil tests have been developed to show the level of available soil nutrients.

To fully utilize soil tests, each agricultural producer should develop a plan for sampling each field at 2- to 4-year intervals. This plan can vary from sampling one-fourth to one-half the number of fields each year to sampling all fields every 2 to 4 years.

As the cost of fertilizer nutrients increases, the value of soil nutrients also increases. Counting soil nutrients toward the nutrient requirement of a crop is economical as well as energy efficient.

Maintaining Acceptable pH

Soil pH affects the availability of several plant nutrients as well as microbial activity. Therefore, liming acid soils makes the use of applied nutrients and soil nutrients more efficient.

Figure 2 is a generalized presentation of the effects of soil pH on the availability of essential plant nutrients. For most soils and crops, a pH between 6.0 and 7.5 is acceptable. However, for some soils the pH

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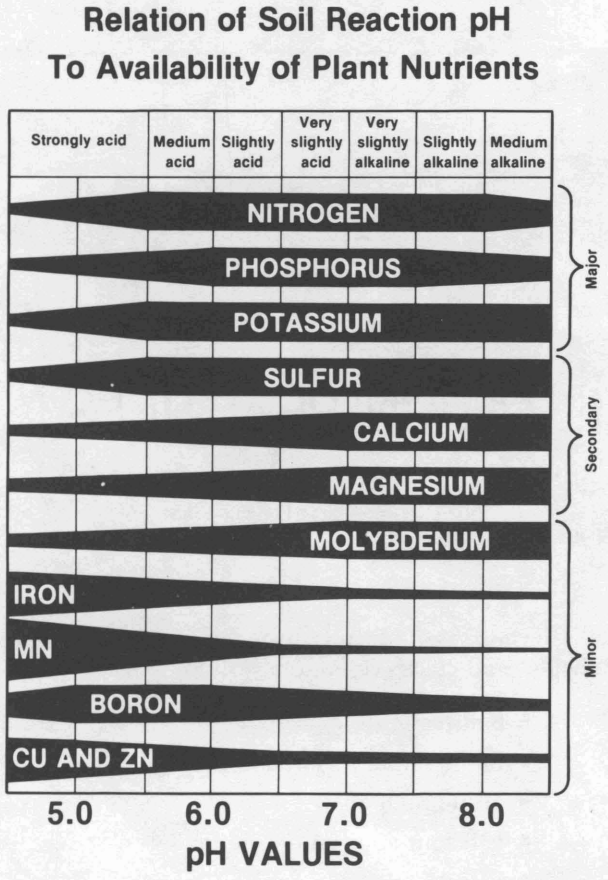

Figure 2. Soil pH affects the availability of most plant nutrients as indicated by the width of the band.

can be below or above this range and not adversely affect the availability of plant nutrients.

Soils that are too acid can be limed to bring pH into the acceptable range. It generally is uneconomical to reduce the pH of alkaline soils under field scale operations.

Using High Analysis

Using fertilizer materials rich in necessary nutrients provides major savings in transportation, storage and handling. For example, ammonium sulfate (21 percent) contains about two-thirds as much nitrogen (N) as ammonium nitrate (34 percent). However, the freight and other shipping and handling costs are about the same. If the only nutrient needed is nitrogen, ammonium nitrate would be more "energy efficient" than ammonium sulfate.

Similar comparisons can be made between formulated fertilizers such as a 5-10-5 versus a 10-20-10 or a 17-17-17 versus a 12-12-12. If these fertilizers are formulated from the same materials, then the lower analysis has more "filler" to make the desired weight. This is illustrated in table 1.

Table 1. Comparison of ingredients in three 1:2:1 ratio fertilizers.

Ingredient	5-10-15	10-20-10	15-30-15
18-46-0	435	870	1,305
34-0-0	65	130	190
0-0-60	166	333	498
Filler	1,334	667	07
Total	2,000	2,000	2,000

With the three ingredients (ammonium phosphate, ammonium nitrate and muriate of potash), over half of a 5-10-5 fertilizer and one-third of a 10-20-10 is filler. This means the cost of mixing, transporting and spreading is more than that for a 15-30-15 formulation, which is the same ratio of ingredients without the filler. Applying a 30-60-30 per acre requires 300 pounds of a 10-20-10 and 200 pounds of a 15-30-15. Therefore, a 4-ton spreader could fertilize only 26⅔ acres using a 10-20-10 and 40 acres with a 15-30-15.

The energy savings are apparent, making the use of high analysis fertilizers one of the most effective methods of conserving energy in fertilizer usage.

Efficient Application Methods

Fertilizers must be applied uniformly to be most effective. This is just as important for row or band applications as for broadcasting. Save energy by applying fertilizer during other tillage operations. For example, try the cold-flo method for applying anhydrous ammonia while disking or apply a "starter" fertilizer at planting. Sidedressing row crops while cultivating also reduces the energy requirements of fertilization.

How much can be accomplished depends on available equipment, cropping systems and other factors. Keep energy conservation in mind though, when buying new application equipment or making other management decisions.

Effective Time of Application

Improve energy efficiency by timing nutrient applications to meet specific agronomic requirements. For example, use phosphorus as a starter and apply nitrogen when it is more efficiently used by the crop.

Research shows that efficient use of phosphorus fertilizers for row crops entails suitable methods and proper timing and rates to meet early seedling requirements. Banding phosphorus 3 to 4 inches to the side and 1 to 2 inches below the seed has been effective. Rates of 20 to 30 pounds of P_2O_5 per acre are adequate on soils with a medium or better level of phosphorus. Higher rates of phosphorus are needed for fields that have lower phosphorus levels. Apply limited amounts of high phosphorus fertilizers such as 18-46-0 and 10-34-0 in the seed row, especially for

drilled crops, if the rate is kept below 100 pounds per acre. For conventional 30- to 40-inch row spacing limit the nitrogen and/or potash application to 8 to 10 pounds per acre (seed row fertilizer applications are not recommended if salinity is a problem).

The time of application affects nitrogen utilization. Apply nitrogen so it reaches the root zone just before the crop needs it. Research indicates this produces the best results. Moisture, crop characteristics and other factors may alter this general guide. Consider split applications of nitrogen for sidedressing and topdressing, at the appropriate time, to improve the efficient use of nitrogen fertilizers.

Maximizing Use of Legumes

Research data and experience prove that high-yielding, non-legume crops cannot be grown without adequate nitrogen and that most soils are low in nitrogen. Legume crops often restore some nitrogen to the soil and can be rotated with other crops to reduce the need for nitrogen fertilization. As fertilizer costs rise, adopting management practices that favor legumes will become increasingly important.

Using Waste Where Profitable

A serious limitation in the use of animal wastes is the cost of hauling and spreading. Fuel costs have increased more rapidly than the value of nutrients in animal manures, feedlot waste, etc. Therefore, the distance these materials can be moved economically has decreased. For example, a 10-ton truckload of feedlot waste valued at $50 could not be moved more than 10 miles from the source because of hauling costs.

Fully utilize animal wastes and other materials that can be applied to the soil to supply plant nutrients. However, first evaluate the amount of energy used compared to the energy savings from the reduction in commercial fertilizer and other benefits.

Summary

Even though the amount of energy used to produce fertilizer is small compared to total energy consumption, conservation is important. Agricultural producers have many opportunities to make efficient use of fertilizers. Management practices such as using soil tests, liming acid soils, using high analysis fertilizer, using efficient application methods, timing applications and using legumes and waste materials not only maximize the utilization of fertilizers, but improve profits from crop production.

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