NEWS & VIEWS

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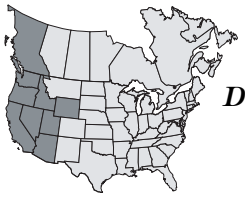

Dr. Robert L. Mikkelsen, West Region Director

October 2004

Balanced Crop Nutrition—Nurture the Crop and the Soil

THERE are six external factors that contribute to the growth of healthy plants:

- **Nutrients**
- **Mechanical support**
- **Air**
- **Heat**
- **Water**
- **Light**

Of these factors, five are directly related to soil conditions. In promoting agricultural productivity, it is essential that the role of soil be acknowledged and its important functions be valued and protected.

Both crop productivity and harvest quality are clearly influenced by having the correct balance of essential nutrients present in the soil. Scientific trials going back for hundreds of years have repeatedly demonstrated that when any plant nutrient is lacking, crop growth and quality will be adversely impacted. When fertilizers are properly used in combination with locally available manures or cover crops, nutrient deficiencies and imbalances are corrected.

Fertilizers come from natural products and contain the essential nutrients for the growth of healthy plants…plants that are used directly for human consumption, feed for animals, supplying fiber, producing biofuels, or growing timber. Human and animal survival depends on the growth of healthy plants.

Fertilizers are currently used in two ways:

1) To improve unfavorable conditions for plant growth by overcoming pre-existing deficiencies (commonly called **build up** of soil fertility reserves).
2) To replace the quantity of nutrients removed in crop harvest (commonly called **maintenance** of soil fertility reserves).

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As an example, where soil improvement through phosphorus (P) fertilization has been practiced for a number of years, it may not be necessary to apply more nutrient than is removed in the harvested crop. However, in many soils of the world, it is still necessary to build and improve their nutrient status so they can reach their potential to support healthy plant growth. In such conditions, additions larger than crop removal are required to build the nutrient reservoir in the soil. Soil testing is essential for knowing what scenario is most appropriate for each specific field.

As shown in **Figure 1**, nitrogen (N) fertilizer consumption in the U.S. has increased more rapidly than P or potassium (K) in the last 40 years. This relative increase in the use of N has resulted from a variety of economic and technical factors…in addition to short-term risk considerations. Nitrogen fertilizer is often seen as a relatively low-cost input that provides a rapid crop response. Where

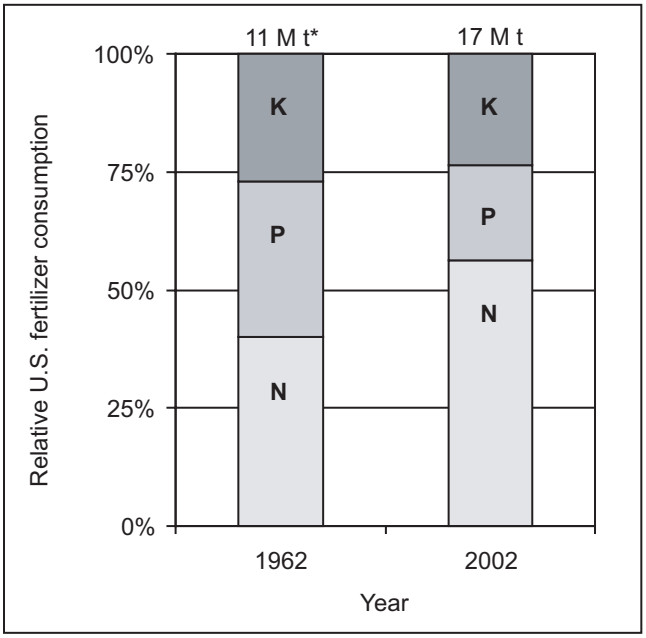

Figure 1. Changes in the relative proportion of N, P, and K consumption in the U.S. in 1962 and 2002. Increases in N consumption have outpaced the consumption of P and K (FAO, 2004). *M t = million metric tons

financial resources are limited or land leases are short, this nutrient is often incorrectly perceived as a risk-reducing factor. There also may be fields that no longer require the **build up** rates of fertilizer and thus are receiving only maintenance rates of some nutrients. Better utilization of manure-derived nutrients may also contribute to this shift in nutrient inputs.

In many regions, we observe that high levels of N fertilization without appropriate inputs of other essential nutrients have a negative effect on both crop production and the environment (**Figure 2**). Nitrogen fertilization where P or K are lacking typically results in enhanced nitrate leaching losses and denitrification (**Figure 3**). Crops without balanced nutrition may suffer from excessive lodging, unfavorable weed and pest competition, lower yields, and reduced harvest quality.

Much of the early research on crop nutrition focused on the plant's need for each single nutrient. Although modern research is more complicated, we now recognize that more emphasis should be given to the interactions between nutrients. Ensuring the efficient use of plant nutrients requires that **all** essential elements are present at the optimal concentration to meet times of peak nutrient demand.

Balanced crop nutrition requires the proper supply of N, P, and K…plus other nutrients such as magnesium, calcium, sulfur, and micronutrients...as determined by soil and crop analysis.

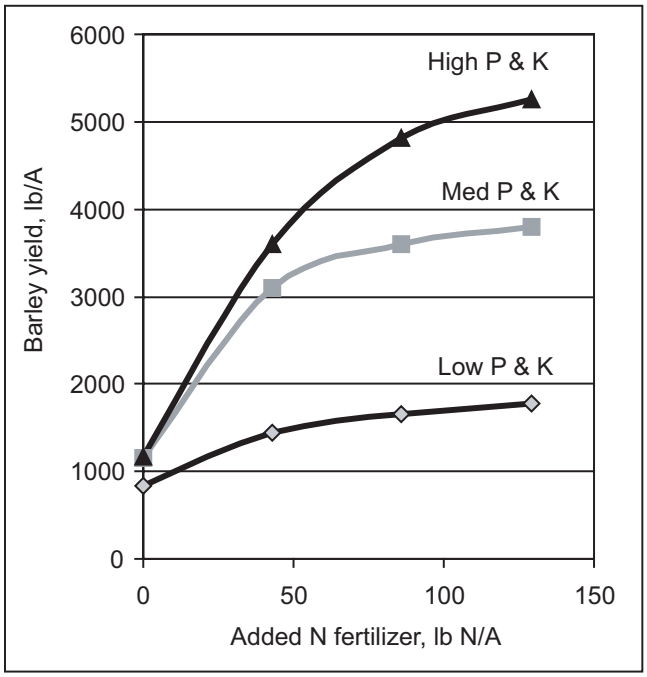

Figure 2. Barley grain yields in soils with low, medium, or high P and K at four rates of N fertilization. Poor yields result in low fertilizer N recovery and the potential for elevated N loss (Johnston, 2001).

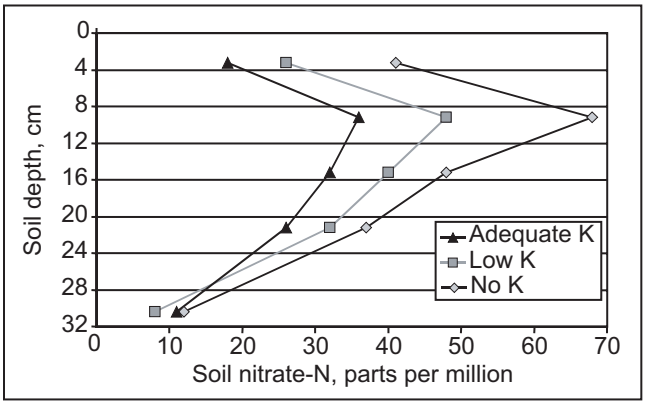

Figure 3. Application of recommended K fertilizer rates for 14 years of cropping results in less nitrate leaching below a corn crop than sub-optimal K application or no K application (Mikkelsen and Kamprath, 2003).

There are very few "ideal" soils in the world; that is, soils that contain all of the essential nutrients in the proper balance required by crops. Overcoming these pre-existing deficiencies is the goal of the fertilizer industry. Animal manures are excellent at providing many of the essential nutrients for crops, but their composition is rarely in balance with what the soil requires to adequately supply the plant's needs. Similarly, legume cover crops are especially good as a N source for subsequent crops, but provide no other additional nutrients that were not already in the soil.

The concept of balanced plant nutrition is certainly not a new one, but it is still not adequately understood and practiced. It is time to move beyond the concept of managing single nutrients.

There is no alternative to providing balanced crop nutrition for producing foods of high nutritional quality with sustainable economic and environmental yield levels. ■

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