Balanced Fertilization and the Environment

Dr. Mike Stewart
Great Plains Director, Potash & Phosphate Institute (PPI)

THE WORLDWIDE per capita land base for agricultural production has declined dramatically over the past few decades and is expected to continue to decrease. For example, it's estimated that by the year 2025 the land in production per person will be 56 percent less than it was in 1965. This continued reduction will, of course, demand further increases in yield. These yield increases will in turn require greater nutrient inputs. It's also reasonable to assume that the impact of agriculture on the environment will be increasingly scrutinized since the public's influence over production is growing. The question that naturally follows is, "Are the fertilizer inputs necessary to produce high yields Earth friendly?" To answer this question we must consider some of the consequences of adequate and balanced fertilization.

Balanced fertility results in increased nutrient use efficiency and therefore less likelihood of nutrient loss to the environment due to leaching and/or runoff. This effect has been demonstrated in a long-term irrigated corn study in western Kansas. The research site, established in 1961, has been in continuous irrigated corn with treatments receiving six nitrogen (N) rates ranging from 0 to 200 lb/A and two phosphorus (P) rates, 0 and 40 lb P_2O_5/A. Over the first 30 years of the study, P fertilization resulted in an increase in average fertilizer N use efficiency of 40 percent. Consequently, there was much less residual N in the soil where P was applied (**Figure 1**), thus less chance of N entering ground or surface water.

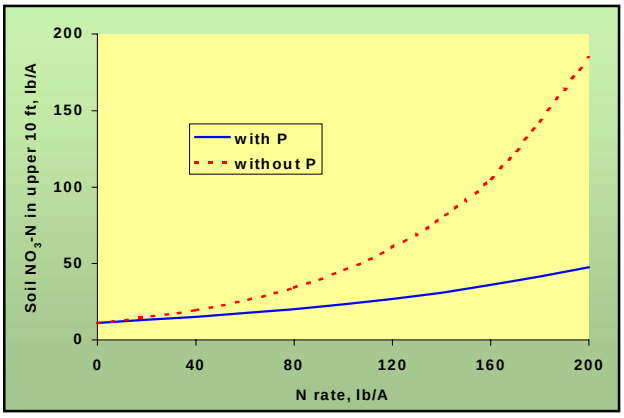

Figure 1. Effect of N and P fertilization on residual nitrate-N in the upper 10 feet after 30 years of irrigated corn production (Kansas).

The effect of balanced fertilization on nutrient use efficiency was also demonstrated in a long-term dryland corn study in Maryland. Corn production from the application of 160 lb N/A per year was compared to production where 160 lb each of N, P_2O_5, and K_2O were applied each year. In the beginning of the study, yield differences between the two treatments were slight. However, by the third year of the study, yield where balanced fertilization was employed was over 40 bu/A higher than where N alone was applied. The differences continued to increase throughout the study, reaching a high of 159 bu/A in the ninth year. This can be attributed to the depletion of soil P and K over time where no P or K fertilizer was applied. The same trend is seen in N use efficiency (**Figure 2**). Nitrogen use efficiency where no P and K fertilizer was applied dramatically decreased as the study progressed. Where the more balanced fertilization program was employed, N use efficiency was maintained and even slightly increased over the 10-year period.

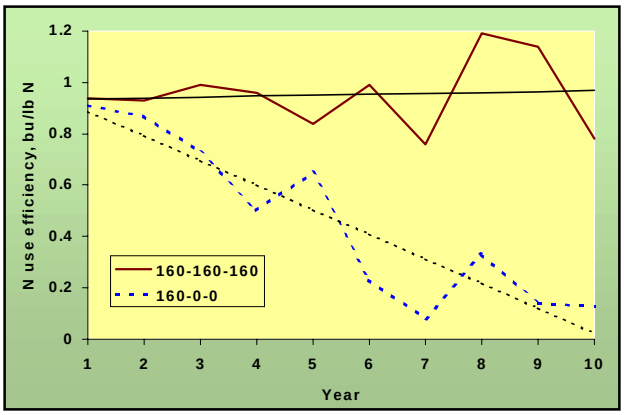

Figure 2. Fertilizer N use efficiency from NPK fertilization versus N alone in dryland corn production over 10 years (Maryland).

Crop water use efficiency (WUE) is improved with adequate and balanced fertility since more yield can be produced with the same amount of water. A well-fed crop produces a healthier and more extensive root system that is capable of extracting water and nutrients more efficiently than a nutrient deficient crop. The effect of fertilization on WUE was clearly shown in a recent southwest Texas irrigated ryegrass study. This study was conducted in an area where there is increasing competition between major urban centers and agriculture for limited ground water resources. Nitrogen fertilization alone increased WUE by as much as 90 percent, but where N and P fertilization was balanced, WUE was increased by over 200

percent (**Figure 3**). The long-term benefits of balanced fertilization to the urban population, not to mention the producer, are obvious.

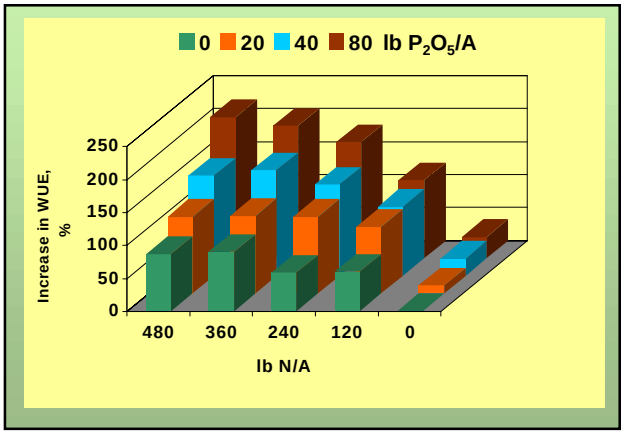

Figure 3. Percent increase in water use efficiency of ryegrass due to N and P fertilization (Texas, one year).

Good fertility management also results in reduced potential for erosion by producing a more healthy and vigorous crop that closes the canopy and covers the soil more rapidly. More biomass is produced with adequate and balanced fertilization. In conservation tillage this generally results in more surface residue and reduced potential for erosion and nutrient runoff into surface water.

Global warming is another familiar environmental issue that fertilization can influence. Agricultural soils may act as significant carbon (C) sinks as well as sources. Increasing levels of soil organic C can help mitigate the greenhouse effect on the environment by reducing atmospheric enrichment of the greenhouse gas carbon dioxide (CO_2). Balanced fertility management, as well as other best management practices (BMPs), can play a major positive role in increasing C sequestration from the atmosphere by crops and storage of C in soils primarily through its effect on crop yields. See accompanying article, "Agricultural Nutrients and Climate Change", for more information on this topic.

High yield production and the fertilizer inputs it requires reduce the total number of acres necessary for agriculture, thus releasing more land for recreational purposes and wildlife habitat. This benefit becomes increasingly important as world population grows.

While adequate and balanced fertilization has distinct environmental protection benefits, it's important to remember that misuse of nutrients can lead to impairment of the environment. Best management practices such as soil testing and proper fertilizer placement and application timing are necessary to maximize the benefits and minimize the potential for damage. ■

For more information, contact:

Dr. W.M. (Mike) Stewart
Great Plains Director
Potash & Phosphate Institute (PPI)
P.O. Box 6827
Lubbock, TX 79493
Phone: (806) 795-3252
Fax: (806) 795-5997
E-mail: mstewart@ppi-far.org