Are Present-Day Wheat Varieties More Sensitive to Phosphorus Deficiency?

By Paul E. Rasmussen

The title was to get your attention. The question is but one of many being asked in agricultural circles today. Can we answer it?

THERE ARE SEVERAL valid reasons why phosphorus (P) deficiency should be occurring more frequently in wheat fields today. They are:

1. Wheat yields are nearly double what they were 30 years ago, removing twice as much P per acre.
2. Newly-developed semidwarf wheats have less winter dormancy than their earlier counterparts. They begin growth earlier in the spring when soils are colder, which restricts root growth and decreases access to needed nutrients.
3. Newly-developed spring wheat varieties are less day-length sensitive. Again, this results in earlier growth in cooler soils.
4. New varieties tend to rely more on high tillering capability for high yield potential. Any early season nutrient stress will negatively impact tiller formation and has the potential to limit yield.
5. The increasing trend towards conservation tillage means wheat seedlings grow in a cooler environment. There is often greater pressure from soil-borne pathogens which prune the seedling root system. And rows are often wider for trash clearance, requiring better individual plant performance.

Is P deficiency occurring more frequently in modern wheat varieties? More importantly, are we conducting research to determine if it is? We can no longer merely apply fertilizer, take pictures, and determine grain yield. Too many things happen when the plant is growing. Did it tiller well? Was the root system damaged by plant pathogens? Was disease present? Did fertilizer application affect disease level? Did we utilize the correct rate of nitrogen (N), because N response often dominates all other nutrient responses? Were any other nutrients deficient? And what about dual placement of P and N? Was it so close to the seed that it caused plant damage? Was it close enough to the seed so that young seedlings had access to fertilizer? What was the water status throughout crop growth? Did drought stress occur at flowering?

The following figures illustrate some of the problems with defining nutrient needs of present-day varieties. **Figure 1** shows early growth response patterns in cereals. Cereals will not respond to nitrogen when sulfur (S) is deficient. And both N and S must be adequate for P response to occur. Phosphorus response in cereals generally appears only as greater growth and darker green color, without other visual deficiency symptoms. Correct identification of P deficiency requires proper analytical techniques.

Figure 2 illustrates the need to have optimum N fertility in order for P response to be expressed as increased grain yield. Phosphorus response did not occur until optimum rates of N and S were applied. It would have been easy to miss this response in an abbreviated soil fertility trial if the N rate was not correct . . . or if S had been omitted.

Back to the Important Question

During the past 25 years, there has been a steady decline in state and federal research dedicated to soil fertility. This

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Figure 1. Wheat response to N,S and P at tillering. **(Oregon)**

has not always been replaced by increased industry support. Most of the decline in numbers of researchers was from outlying locations where they concentrated on field research. Fewer researchers mean fewer field trials and more trials that are not always fertilized and seeded when they should be.

With fewer people in research, those remaining are concentrating on greenhouse and growth chamber experiments. But these types of studies will not tell us if P response is more prevalent now than in the past. That requires a wide array of multi-year field research trials encompassing the major soil types. And if we are changing tillage systems, we need 3 to 5 years in the new system before valid results are obtained. How do we evaluate yield level if P response is dependent on yield level? Do we throw out results obtained when drought stress limits yield? Drought is a normal part of many dryland wheat growing regions. Are the Bray and Olsen soil tests as reliable today as in the past? Or do they need recalibration?

Is the continuing loss of soil fertility research decreasing our ability to solve environmental problems? Is the shift towards greater percentage of support coming from industry resulting in more or less effective communication between researchers and farmers? At a time when means of communications are advancing by leaps and bounds, are we getting the answers to the problems to the right people?

If it is important to U.S. agriculture to solve problems such as this, do we need a new, cooperative, innovative federal/state/private industry effort? Who will be responsible for taking the lead?

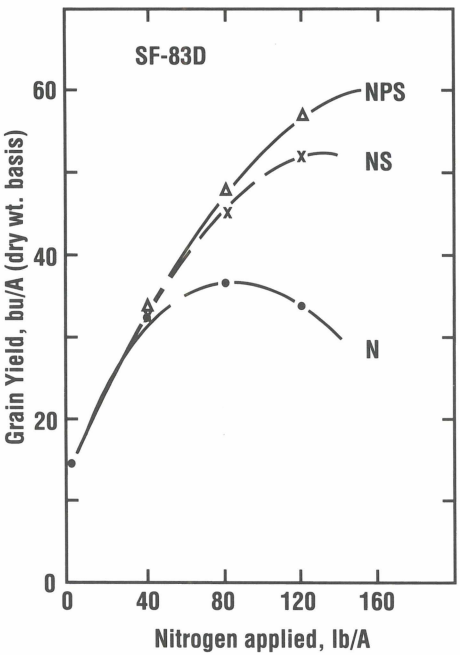

Figure 2. Wheat yield responses to N, N+S, and N+P+S emphasize the importance of meeting all nutrient needs. Adequate amounts of N (98 lb/A) and S (18 lb/A) were required for P response to occur. (Oregon)

Are present-day wheat varieties more sensitive to P deficiency? The answer is probably "yes", but we do not know for sure because the definitive research has not been done. A higher level of continued soil fertility research is essential to be able to provide updated information and recommendations for modern production systems. ■