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Summer 2009, No. 2

HIGHER YIELDS AND THE NEED TO ADJUST NUTRIENT APPLICATIONS

Yield levels have increased over time. At some winter meetings, I have heard people ask: "Why is it necessary to add supplemental nutrients in the form of fertilizer, because in the early days my Grandpa or Great Grandpa never used fertilizer and grew nice crops." In answering, it is useful to understand what has occurred in our soils and cropping systems over time. A recent summary by researchers at the Dickinson Research Extension Center in North Dakota showed the mean yield for a couple of crops over time. In the 1940s, the average yields for spring wheat and barley were 21 and 33 bu/A, respectively. But by the 1990s, these average yields increased about 100%, to 40 and 76 bu/A, respectively. The standard for what is considered an adequate yielding crop has increased. Yield improvements can be attributed to a combination of developments in agronomic practices.

Higher yields put a greater demand on the limited supply of mineral nutrients coming from soils. In the 1940s, under a crop-fallow rotation, wheat yield responded only occasionally to N fertilizer. Today, additions of fertilizers containing N, P, K, S, and occasionally some other nutrients are important to achieving higher yields. In the 1940s crop-fallow rotations, the N required for crop growth came from mineralization of soil organic matter during the year of cultivated fallow and the year of cropping. Soil organic matter mineralization can only release a certain amount of N over time. By the 1950s in much of the Northern Great Plains (NGP), the organic matter content in soils was half of the original level present when the grassland soils were plowed and brought into annual small grain cereal production. This first loss of organic matter came primarily from the most easily decomposed portion and released considerable N. The remaining portion of the soil organic matter is more resistant to decomposition, and releases smaller amounts of N.

Fertilizers can be used to supplement the supply of nutrients available from soil. It was fortunate that as cropping continued on the NGP soils that had been depleted of soil organic matter, and the original easily used portion of nutrient pools, the availability of nutrients in the form of commercial fertilizers (primarily N, P, K, and S) increased. The adequate use of fertilizers, along with larger yield potentials, enabled growers to increase yields and gradually rebuild some of the lost soil organic matter.

Determining which nutrients are required and how to best apply them is important to a successful crop management program. Applying sufficient but not excessive amounts is important to achieving desired yields, while avoiding adverse environmental effects. Ideally, each field and even portions of fields can be managed to maximize net economic returns per acre. Year to year nutrient management is a process of first estimating what the soil will supply, shown primarily through soil sampling and analysis. Secondly, assess how much of the various nutrients are needed based on realistic and yet progressive yield targets. Lastly, supply nutrients in effective forms at right rates, timing, and placement to optimize crop uptake and utilization (4R stewardship).

Improved crop yield potentials increase the need for supplemental nutrient sources. Usually, the higher the potential yield target, the higher the required amount of supplemental nutrients. Using the mean wheat yields from the North Dakota work mentioned above, the average nutrient removals in the harvested grain for N, P_2O_5, K_2O, and S for the 20 bu/A crop of 1940 were approximately 30, 10, 7, and 4, respectively. Compare this to removals of 60, 20, 14, and 8, respectively, for the 40 bu/A crop of 2007. The increase in potential crop yields puts more demand on the nutrient supplying capacity of the soil. Fortunately, well planned additions of nutrients in the form of fertilizers helps soils to meet this increased demand.

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Abbreviations: N = nitrogen; P = phosphorus; K = potassium; S = sulfur.

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