

Optimal N & P fertilizer rates for irrigated corn and grain sorghum--Part 2

Have you ever wondered what happens to the nitrogen that isn't used by row crops?

A long-term study at the Southwest Research & Extension Center at Tribune helps answer this question. The study site was established in 1961 on an Ulysses silt loam soil. Fertilizer treatments were a combination of nitrogen rates that included 0, 40, 80, 120, 160, and 200 lb N/a without P₂O₅ and K₂O; and with 40 lb P₂O₅/a and 0 K₂O/a; and with 40 lb P₂O₅/a and 40 lb K₂O/a. The fertilizer was broadcast by hand and incorporated.

As previously mentioned in Agronomy Research Briefs #8 Part 1, the optimal nitrogen and P₂O₅ rates for irrigated corn was 160 lb N and 40 lb P₂O₅/a and 80 lb N and 40 lb P₂O₅/a for grain sorghum, but an equally important aspect of this study was the results from the profile nitrogen testing that was done after 30 years of the study. Soil sampling was done incrementally down to 10 feet and nitrate-nitrogen levels were determined.

The least amount of nitrate-nitrogen in the total 10 feet of the soil profile was at the 0 lb N/a rates for corn (15 lb nitrate) and nitrate levels increased to 224 lb in the profile as nitrogen rates increased to the highest levels. By adding 40 lb P₂O₅/a with the nitrogen fertilizer less nitrate was accumulated in the profile. Nitrate levels ranged from 15 lb with no nitrogen fertilizer to 166 lb nitrate at the highest nitrogen rates. At the optimal 160 lb N and 40 P₂O₅/a rate, there was 78 % less nitrate (48 lb nitrate) in the 10 feet profile than with the 160 lb N and 0 lb P₂O₅ rate (224 lb nitrate) and 71 % less nitrate than the 200 lb N and 40 lb P₂O₅/a rate (166 lb nitrate).

Grain sorghum accumulated more nitrate-nitrogen in the 10 feet soil profile with increasing nitrogen fertilizer rates than did corn. This would indicate that grain sorghum is less responsive than corn to applied nitrogen. The lower nitrogen fertilizer rates resulted in less than 20 lb nitrate in the ten feet profile, and nitrate levels went as high as 750 lb nitrate with the higher nitrogen fertilizer rates. By adding 40 lb P₂O₅/a with the nitrogen fertilizer, soil nitrate levels did not increase to the same levels (which means added phosphorus helps the nitrogen to be used more efficiently by the crop). For example, soil profile nitrate levels were in the 12 to 14 lb nitrate range using the lowest nitrogen fertilizer rates with 40 lb P₂O₅/a and increased to 260 lb nitrate with the highest nitrogen fertilizer rate. At the optimal 80 lb N and 40 lb P₂O₅/a rate there was 25 lb nitrate in the 10 feet profile, while with 80 lb N and 0 lb P₂O₅/a there was 118 lb nitrate.

What's the bottom line?

Nitrogen is mobile in the soil and moves with the downward movement of water. Nitrogen not used by the crop moves below the root zone and has the potential of entering the water table. Excessive nitrogen fertilizer applications are costly and not environmentally sound. Phosphorus applications allows the crop to use nitrogen more efficiently. Profile soil testing should be conducted to determine fertilizer needs.

For more details about this study see:

Kansas Fertilizer Research 1991. P. 30-36. K-State Res & Ext Report of Progress 647.

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