

Part 1

Have you ever wondered what the optimum nitrogen and phosphorus rates are for flood irrigated corn and sorghum?

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.

The 31-year average corn yield without any fertilizer (check treatment) was 70 bu/a. There was a yield increase with the incremental nitrogen rates without P₂O₅. The yield was 107 bu/a with 40 lb N/a, and with the 80 lb N/a and 120 lb N/a rates the 31-year average yields were 121 bu/a and 124 bu/a, respectively. Yields for the 160 and 200 lb N/a rates were 131 bu/a and 132 bu/a, respectively. But added phosphorus showed a tremendous yield boost. Averaged over all nitrogen treatments, there was a 24 bu/a yield response with the added 40 lb P₂O₅/a (138 bu/a) compared to the 0 P₂O₅/a rate (114 bu/a). There was an average 21 % increase in yield with each incremental nitrogen rate increase plus the 40 lb P₂O₅/a over the same nitrogen rate increase with the 0 lb P₂O₅/a treatment. At the 160 lb N/a and 0 P₂O₅ rate the yield was 131 bu/a, but by adding 40 lb P₂O₅/a the yield was 169 bu/a (a 29 % yield increase). Thus, the optimal nitrogen rate for corn was 160 lb N/a with 40 lb P₂O₅/a.

In 1992, the K₂O treatment was dropped because there was no yield response, but an 80 lb P₂O₅/a rate was added. Averaged over all nitrogen treatments, there was only a 2 bu/a advantage for the 80 lb P₂O₅ rate over the 40 lb P₂O₅ rate. But the 80 lb P₂O₅ and 160 lb N/a rate (175 bu/a) yielded 6 bu/a more than the 40 lb P₂O₅ and 160 lb N/a rate (169 bu/a). The cost of the extra 40 lb P₂O₅/a (up to 80 lb P₂O₅/a) would be about \$10/a and with the current corn prices, a 2 bu/a yield increase would not be sufficient to cover the additional fertilizer costs, but anything over 5 bu/a would cover expenses.

For grain sorghum, the 31-year yield average without fertilizer was 72 bu/a, but by adding 40 lb N/a the yield was 93 bu/a. The yields for the 80, 120, 160, and 200 lb N/a rates were 103 to 105 bu/a. By adding 40 lb P₂O₅/a there was an overall 12 % yield increase. The optimum combination rate for grain sorghum on this soil was 80 lb N/a with 40 lb P₂O₅/a. Over the 31-year period there was a 3 % yield increase for 120 lb N/a over the 80 lb N/a rate with 40 lb P₂O₅/a. But since 1992, yields for the 80 lb N/a and 120 lb N/a rates have been virtually the same. Potassium did not provide a yield response.

What's the bottom line?

Efficient use of fertilizers (N and P₂O₅) for irrigated corn and grain sorghum is important, so that if a little is adequate, more is NOT better. Results from this study show that phosphorus fertilizer can allow the nitrogen to be used more efficiently. Optimal nitrogen rates for corn was higher than that for grain sorghum. The optimal fertilizer rate for corn on this soil was 160 lb N/a with 40 lb P₂O₅/a and for grain sorghum the optimal fertilizer rate was 80 lb N/a with 40 lb P₂O₅/a. Soil testing should be used to identify fields requiring additional fertilizer P and fields with high residual N levels. The next question is, "where did the nitrogen go that wasn't used by the crops?"

For details about this research see:

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

Field Day 2001, Southwest Research & Extension Center. P. 17-19. K-State Res & Ext Report of Progress 877

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