

Have you ever wondered how nitrogen rate, source, and placement and tillage affects continuous grain sorghum yields?

A 23-year study was established in 1982 at the North Agronomy Farm near Manhattan, KS to address this question. The research site was a Smolan silty clay loam soil in continuous sorghum. Nitrogen rates included 0, 30, 60, and 120 pounds N per acre. For the first 13 years of the study, nitrogen source/placement combinations were ammonium nitrate broadcast applied and urea-ammonium nitrate applied broadcast or knifed below the soil surface. For the next 10 years, the N placement variable was dropped and three nitrogen sources, ammonium nitrate, urea, and a polymer-coated urea or a slow release urea treatment were used. The two tillage treatments were no-till and conventionally tilled, which consisted of one chisel and one disking operation between harvest and fertilizer application, plus one disking or field cultivator operation after fertilizer application.

For the first 13 years of the study, grain sorghum yields averaged over nitrogen rates, sources and placement for conventional tillage were 2.6 bushels per acre greater than for no-till yields (78.9 vs 76.3 bu/a). These differences were more pronounced at the lower nitrogen rates, likely due to the slower breakdown of crop residue, and resulting slower release of N to the crop in no-till. At the 30 pounds N per acre rate conventional sorghum yields were 5.8 bushels per acre greater than no-till yields (68.6 vs 62.8 bu/a), and at the 60 pounds N per acre rate conventional sorghum yields were 4.8 bushels per acre greater than no-till yields (84.8 vs 80.0 bu/a), but at the 120 pounds N per acre rate yields for conventional sorghum (94.7 bu/a) and no-till sorghum (95.3) were essentially the same. Yields for both no-till and conventional sorghum increased similarly with each incremental increase in nitrogen rate. As the nitrogen rate increased from 30 to 60 pounds N per acre there was about a 27 percent yield increase for no-till sorghum (62.8 vs 80.0 bu/a) and a 24 percent yield increase for conventional sorghum (68.6 vs 84.8 bu/a). As the nitrogen rate increased from 60 to 120 pounds N per acre there was 19 percent yield increase for no-till sorghum (80.0 vs 95.3 bu/a) and about a 12 percent yield increase for conventional sorghum (84.8 vs 94.7 bu/a). The yield for the check or 0 N rate for no-till and conventional sorghum was 49.0 and 45.1 bushels per acre, respectively.

Probably the most interesting aspect of this research is the nitrogen source component. For no-till sorghum, yields for the broadcast ammonium nitrate, broadcast urea-ammonium nitrate, and knifed urea-ammonium nitrate were 82.9, 76.3, and 78.9 bushels per acre, respectively, while for conventional sorghum yields were 84.5, 81.8, and 81.9 bushels per acre for the same three treatments.

For the second part of the study, grain sorghum yields averaged over nitrogen rates and sources for conventional tillage were about 5.5 bushels per acre greater than for no-till yields (69.3 vs 63.8 bu/a). Again, these differences were more pronounced at the lower nitrogen rates. For example, at the 30 pounds N per acre rate conventional sorghum yields were 7.7 bushels per acre greater than no-till yields (56.3 vs 48.6 bu/a) and at the 60 pounds N per acre rate conventional sorghum yields were 10.4 bushels per acre greater than no-till yields (78.7 vs 68.3 bu/a), while at the 120 pounds N per acre rate yields for conventional (86.8 bu/a) and no-till sorghum (87.4) were virtually the same. As the nitrogen rate increased from 30 to 60 pounds N per acre there was about a 41 percent yield increase for no-till sorghum (48.6 vs 68.3 bu/a) and about a 40 percent yield increase for conventional sorghum (56.3 vs 78.7 bu/a). As the nitrogen rate increased from 60 to 120 pounds N per acre there was about a 28 percent yield increase for no-till sorghum (68.3 vs 87.4 bu/a) and a 10 percent yield increase for conventional sorghum (78.7 vs 86.8 bu/a). The yield for the check or 0 N rate for no-till and conventional sorghum was 25.3 and 27.8 bushels per acre. No-till sorghum yields for the three nitrogen sources, ammonium nitrate, coated urea, and urea, which were broadcast applied, were 71.4, 76.4, and 65.4 bushels per acre, respectively, while yields for conventional sorghum for the three nitrogen source treatments, which were broadcast applied and incorporated, were virtually the same, 73.6, 73.6, and 74.5 bushels per acre.

What's the bottom line?

While overall yields of conventionally planted sorghum were slightly higher than no-till yields at low N rates, no-till and conventional sorghum yields were virtually the same at the recommended nitrogen rates. These data indicate that 60 pounds N per acre isn't enough for sorghum in eastern Kansas. Also, this study indicates that for no-till, broadcast nitrogen applications, especially N sources that tend to volatilize, such as urea or urea-ammonium nitrate solutions, may cause yield losses. However, for conventional sorghum, if nitrogen is broadcast applied and incorporated, the nitrogen source is not that important.

For more details about this research see:

Kansas Fertilizer Research 1982-2004. K-State Research and Extension. Report of Progress 443, 462, 488, 509, 531, 561, 587, 618, 647, 670, 697, 719, 749, 778, 800, 829, 847, 868, 885, 903, 921, 939.

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