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Effect of Drilled Seeding and Nitrogen Rate on Grain Sorghum Yield in Southwest Kansas

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Effect of Drilled Seeding and Nitrogen Rate on Grain Sorghum Yield in Southwest Kansas

Abstract

Drilled sorghum is normally done at the super-high population at row spacing between 7.5 and 10 inches, compared to rows planted at the spacing between 15 and 30 inches. Thompson (1983) growing super-thick sorghum at the Hays Research Station from 1974-1977, found that sorghum planted in narrow rows (12-18 in.) often produced higher yields than when planted in wide rows (24-40 in.). Norwood (1982) in Garden City repeated Thompson's work and also came to the conclusion that yield of high population narrow row sorghum could exceed that of the low population-wide row when subsoil moisture and precipitation were adequate. The conclusion from the work of Thompson and Norwood was that subsoil moisture and precipitation was big drivers for the high population, narrow-row sorghum to equal or exceed the yield of the low population-wide row. Since then, most researchers have found yield response to plant population to be variable depending on the environment. Overall, the general consensus is that under conditions of adequate moisture, the yield of high population sorghum can continue to increase, but can decrease under dry conditions. Today moisture still remains the key for successful dryland sorghum production in southwest Kansas. Thus, the very familiar saying, "moisture and fertility are joined at the hip." Thompson's and Norwood's work did not evaluate narrow row at population under 25,000 seeds/A and at a spacing below 10 in. We hypothesized that drilled sorghum at lower population could make better use of water resources and produce similar yields to drilled sorghum at higher population, and planted sorghum at the same population. Thus, the objective of this study is to evaluate drilled sorghum at different populations ranging from 20,000 to 80,000 seeds/A at a row spacing of 10 in. or less at different nitrogen rates. Furthermore, most farmers in southwest Kansas own both a drill and a planter. Thus, it is not just an agronomic issue, but it is also about getting better value from a single piece of equipment in an already economically challenging wheat-sorghum-fallow production system.

Keywords

grain sorghum, drilled seeding, nitrogen rate, southwest Kansas

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Summary

This study compared drilled planted sorghum at four seeding rates to planted sorghum at three different nitrogen (N) fertility levels at two locations in southwest Kansas (Garden City and Tribune). In 2017, at the Garden City location using a John Deere experimental sorghum drill and at Tribune using a regular John Deere drill, higher yields were produced with drilled seeded sorghum with 60,000 and 80,000 seeds/a at both locations. Likewise, at both locations, there was no difference in yield between the planted and drilled sorghum at the same seeding rate. Nitrogen fertilizer did not interact with seeding rate to affect yield in Garden City, but significantly increased yield with an increased rate of application at the Tribune location. In general, the effect of nitrogen rates and seeding rates on sorghum yield was observed to be influenced by other management and environmental factors. The results of this study suggested that there was no yield penalty for drilling or planting sorghum at the same seeding rate.

Introduction

Drilled sorghum is normally done at the super-high population at row spacing between 7.5 and 10 inches, compared to rows planted at the spacing between 15 and 30 inches. Thompson (1983) growing super-thick sorghum at the Hays Research Station from 1974–1977, found that sorghum planted in narrow rows (12–18 in.) often produced higher yields than when planted in wide rows (24–40 in.). Norwood (1982) in Garden City repeated Thompson’s work also concluded that yield of high population narrow row sorghum could exceed that of the low population-wide row when subsoil moisture and precipitation were adequate. The conclusion from the work of Thompson and Norwood was that subsoil moisture and precipitation were big drivers for the high population, narrow row sorghum to equal or exceed the yield of the low population wide row. Since then, most researchers have found yield response to plant population to be variable depending on the environment. Overall, the consensus is that under conditions of adequate moisture, the yield of high population sorghum can continue to increase but can decrease under dry conditions. Moisture still remains the key for successful dryland sorghum production in southwest Kansas. Thus, the very familiar saying, “moisture and fertility are joined at the hip.” Thompson’s and Norwood’s work did not evaluate narrow row at population under 25,000 seeds/a and at a spacing less than 10 in. We hypothesized that drilled sorghum at lower population could make better use of wa-

ter resources and produce similar yields to drilled sorghum at higher populations, and planted sorghum at the same population. Thus, the objective of this study is to evaluate drilled sorghum at different populations ranging from 20,000 to 80,000 seeds/a at a row spacing of 10 in. or less at different nitrogen rates. Furthermore, most farmers in southwest Kansas own both a drill and a planter. Thus, it is not just an agronomic issue, but it is also about getting better value from a single piece of equipment in an already economically challenging wheat-sorghum-fallow production system.

Procedures

Experiments were conducted under dryland conditions at two locations in western Kansas (Southwest Research-Extension Center in Garden City and Tribune) to determine the interaction of seeding rate and nitrogen rate under narrow row sorghum in southwest Kansas. At the Garden City location, a John Deere sorghum experimental drill was used, while at the Tribune location research plot-sized equipment was used. The experimental design was a split plot design with seeding rate as the main plot and nitrogen rate as the subplot. The main plot size in Garden City was 30-ft wide × 40-ft long and the subplots were 10-ft wide × 40-ft long. In Tribune, the main plot was 60-ft wide × 50-ft long and the subplots were 20-ft wide × 50-ft long.

Planting Dates and Plot Layout

Sorghum variety Dekalb 3707 was planted at both locations, on June 12, 2017, in Garden City and June 6, 2017, in Tribune. A randomized complete block design with a 5 × 3 factorial treatment arrangement with four replications was used at both locations. At Garden City, sorghum was planted on 15 in. row spacing using a 40-ft wide John Deere experimental sorghum no-till drill. The drilled seeding rates were 20,000, 40,000, 60,000, and 80,000 seeds/a and the planted sorghum was seeded at 20,000 seeds/a with a planter at 30 in. row spacing with a John Deere 7300 planter.

At Tribune, sorghum was planted on 7.5 in. row spacing with a John Deere 1590 no-till drill. The drilled seeding rates were 20,000, 40,000, 60,000, and 80,000 seeds/a and the planted sorghum was seeded at 40,000 seeds/a with a planter at 30 in. row spacing with a John Deere 1700 planter. The three factors were three nitrogen rates (0, 50, and 100 lb/a) at both locations.

At both locations, potassium (K) and phosphorus (P) were applied based on the soil test recommendations provided by the Kansas State University Department of Agronomy Soil and Plant Testing Laboratory, Manhattan, KS.

Herbicide management at Garden City was the application of glyphosate at 1.25 qt/a + Harness at 2.5 pt/a + Starane Ultra at 0.75pt/a applied pre-plant on June 1, 2017. At Tribune, Atrazine at 1 lb/a + Rifle at 16 oz /a was applied early on February 16, 2017, followed by 80 oz/a Lumax E2 + 48 oz/a Gramoxone + 0.50% v/v NIS and applied pre-emergence on June 10, 2017.

Data Collection and Analysis

The Garden City location was harvested using a 7.5-ft wide head plot combine and Tribune was harvested with a 5-ft wide head. Crop weights were adjusted to 13% moisture.

Data were analyzed using PROC GLM with SAS 9.4 (SAS Institute, Inc., Cary, NC) and a model statement appropriate for a factorial design. Treatment means were separated by Fisher's projected least significant difference test.

Results

Garden City

Drilled sorghum at the higher populations produced the highest yield, but there was no difference in grain yield between the planted sorghum at 20,000 seeds/a and the drilled sorghum at the same seeding rate (Figure 1). Nitrogen rate did not interact with population or affect sorghum yield independently in the study.

Tribune

Similar to Garden City, higher yield was produced at the higher drilled seeding rate and there was no difference in grain yield between planted sorghum and drilled sorghum at the same seeding rate (Figure 2). Sorghum yield increased with the increased rate of nitrogen fertilizer (Figure 3).

Conclusion

The result observed in the study can be attributed to the influence of planting equipment, planting date, and environmental condition. At the Garden City location, the later planting date and the drier condition at and after planting might have contributed to the low yield obtained. At the Tribune location, the response to nitrogen fertilizer may be attributed to the influence of a hail storm on August 18. These results indicate the complexity of seeding rate with the management and environmental condition. Additionally, these results suggest that there is no yield penalty for drilling or planting sorghum at the same population.

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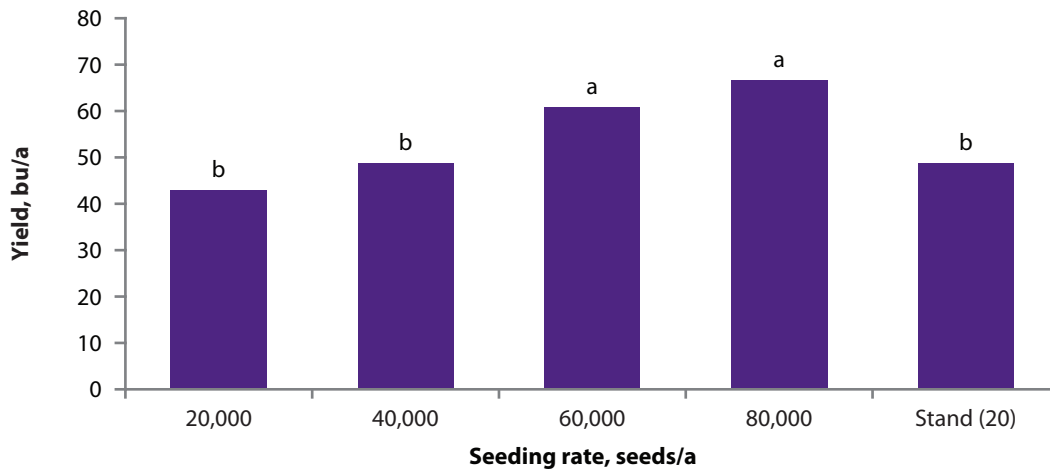


Figure 1. Grain sorghum yield affected by four drilled seeding rates and the standard planting rate (20,000 seeds/a) averaged across three different nitrogen rates at Garden City, KS.

^{ab}Different letters are not significantly different.

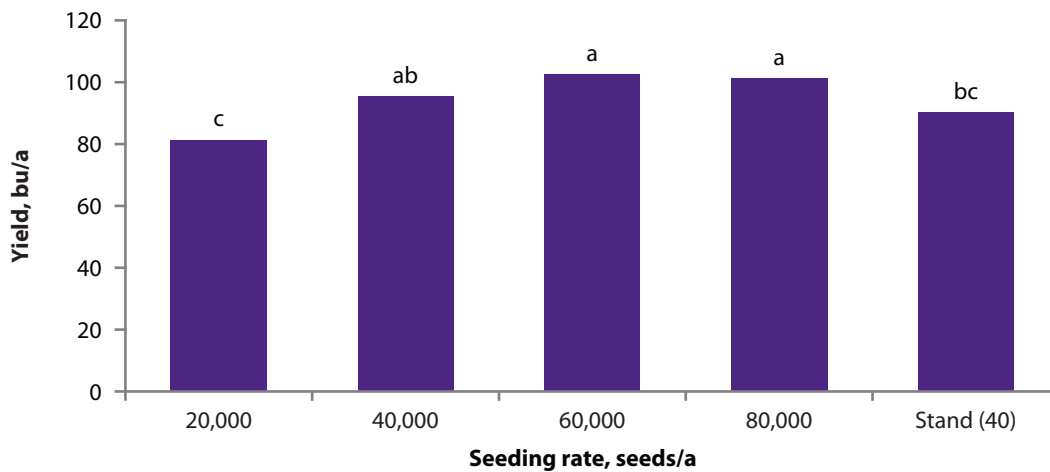


Figure 2. Grain sorghum yield affected by four drilled seeding rates and the standard planting rate (40,000 seeds/a) averaged across three different nitrogen rates at Tribune, KS.

^{abc}Different letters are not significantly different.

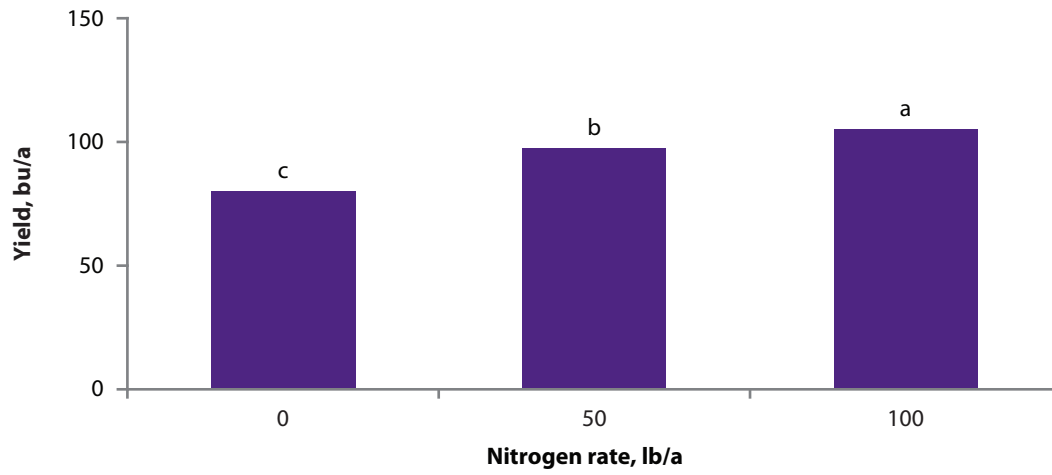


Figure 3. Grain sorghum yield affected by nitrogen rate under four drilled seeding rates and the standard planting rate in Tribune, KS.

^{abc}Different letters are not significantly different.