

Grain Sorghum Yield Response to Water Availability

J. Broeckelman, G. Kluitenberg, K. Roozeboom, and I.A. Ciampitti

Summary

Yield effects of irrigation on sorghum and corn were compared, focusing only on the grain sorghum phase. Average water use for irrigation was 22 in., and dryland sorghum used 17 in. Average yields based on 12.5% grain moisture for dryland and irrigated sorghum were similar, with 138 bu/a for the irrigated and 142 bu/a for the dryland environment. Irrigated sorghum yields were similar, but in dryland, the Pioneer 84G62 hybrid yielded 149 bu/a, a 10 bu/a increase over Pioneer 84Y50 and DKS 53-67 hybrids, which yielded 139 bu/a and 138 bu/a, respectively. Although there was a difference in the yield between the hybrids on the dryland block, there were no significant differences between water use and water use efficiency (WUE).

Introduction

Decreases in available irrigation water and increased water restrictions necessitate exploration of more economical ways to use available irrigation water. Under low-yielding environments (<80 bu/a grain sorghum), sorghum has a yield advantage over corn because of its lower input costs and superior WUE and heat tolerance. Sorghum's yield potential is not as high as corn's, however, so the goal of this study is to determine at what point in available water, both under dryland and irrigation management scenarios, it is better to plant sorghum rather than corn.

Procedures

In a randomized complete block design, grain sorghum was planted in a dryland and a fully irrigated block at the Scandia Unit of the North Central Kansas Experiment Field. Within each block, three treatments of different grain sorghum hybrids were planted (Pioneer 84G62, Pioneer 85Y40, and DKS 53-67) with four replications. The plot size was 10 ft × 45 ft (length), and sorghum was planted in 30-in. rows (four rows per plot). The center two rows were harvested for final grain yield and its components.

Plant populations and fertility were based on yield goals of 160 bu/a for the fully irrigated sorghum and 125 bu/a for the dryland. Grain sorghum was planted on May 22 with seeding rates based on a goal of 90,000 plants/a in the irrigated block and 50,000 plants/a in the dryland block. Fertilizer was applied based on recommendations for corn because sorghum fertilizer recommendations for the target yield were lower, and we wanted to eliminate variables that would cause different yields for corn vs. sorghum.

Nitrogen (N) was applied preplant at 100 lb/a on both dryland and irrigated sorghum and was supplemented with 130 lb/a N on the irrigated block (applied June 11, 2014). Based on soil tests, phosphorus (P) was also applied on June 11 at 30 lb/a on dryland and 35 lb/a on irrigated treatments. Potassium (K) was not applied because of high soil-test potassium levels.

Because this study evaluates crop production under limited irrigation, water usage was measured at diverse growth stages. After emergence, 6-ft aluminum tubes were installed in the center of each plot halfway between the center two rows. These tubes were used to take water content measurements throughout the growing season using a neutron probe at depths of 0.5, 1.5, 2.5, 3.5, and 4.5 ft. The moisture readings were taken at emergence, mid-vegetation, flowering, mid-reproductive, harvest, and 55 days after seed maturity.

Results

Yields for both irrigated and dryland blocks were similar (Tables 1 and 2). This could be owing to several factors, including time of harvest or lodging. A glitch in the new program on the irrigation system also caused dryland sorghum to receive 1.2 in. of water near flowering, which is the most sensitive time for sorghum.

The irrigated sorghum had an average yield of 138 bu/a, and dryland had an average yield of 142 bu/a. Although yields were similar, water use and WUE differed between irrigated and dryland treatments. The mean water use for the irrigated and dryland were 21.9 in. and 17.0 in., respectively. The dryland was more efficient with the water that it used, with WUE of 8.3 bu/in. compared with 6.3 bu/in. for irrigated sorghum.

Irrigated sorghum hybrids did not differ in water use, yield, or WUE, but a significant difference was detected among hybrids in the dryland environment, although not for water use and WUE (using a 95% confidence interval). The Pioneer 84G62 hybrid yielded significantly higher at 149 bu/a, whereas 85Y40 and DKS 53-67 had similar yields of 139 and 138 bu/a, respectively.

Table 1. Sorghum water use, yield (12.5% grain moisture), and water use efficiency (WUE) parameters under the irrigated environment

Irrigated	Means		
Hybrid	Water use, in.	Yield, bu/a	WUE, bu/in.
85Y40	21.8 A ¹	139.4 A	6.4 A
84G62	22.1 A	136.8 A	6.2 A
DKS 53-67	21.7 A	139.3 A	6.4 A
<i>P</i> -value	0.4892	0.8931	0.7221

¹ Values with the same letters are not significantly different ($P > 0.05$).

Table 2. Sorghum water use, yield (12.5% grain moisture), and water use efficiency (WUE) parameters under the dryland environment

Dryland	Means		
Hybrid	Water use, in.	Yield, bu/a	WUE, bu/in.
85Y40	16.8 A ¹	138.9 B	8.3 A
84G62	17.3 A	148.9 A	8.6 A
DKS 53-67	17.0 A	137.9 B	8.1 A
<i>P</i> -value	0.0936	0.0082	0.0715

¹ Values with the same letters are not significantly different ($P > 0.05$).