



Effect of irrigation on sorghum forage yield and quality in the central sands region of Wisconsin

Abbey Grisham¹, Matt Akins¹, Elizabeth Remick¹, Huawei Su², Wayne Coblenz³, Robin Ogden³

¹Department of Dairy Science, University of Wisconsin-Madison, Madison, WI.

²College of Animal Science and Technology, China Agricultural University, Beijing, China

³US Dairy Forage Research Center, Marshfield, WI

ADSA 2017- M166



BACKGROUND

The Central Sands Region in Hancock, Wisconsin contains very well drained soil and this leads to the area's need for crop irrigation. Furthermore, sandy soil has low retention of nitrogen requiring multiple fertilization events. Sorghum forages have not been researched in the Central Sands Region under reduced irrigation and these forages may be a useful source, particularly for feeding dairy heifers.

OBJECTIVES

Evaluate the effect of irrigation on yield and quality of photoperiod sensitive (PS) and non-photoperiod sensitive forage sorghum and sorghum-sudangrass compared to corn in central Wisconsin.

MATERIALS & METHODS

- Treatments were arranged in a split-plot randomized complete block design with 3 replications.
- Five irrigation rates (0 %, 25 %, 50 %, 75 %, and 100 % of corn requirements) were applied using a linear irrigation system with each rate applied for a strip of the field.
- Varieties were randomly assigned within irrigation strip for each replicated block.
- The plots receiving 0% irrigation were planted at a different location of the station with a similar soil type.
- Irrigation rates were attained using irrigation nozzles with varying flow rates.
- Planting and Harvesting
 - Plots were planted June 2, 2016.
 - Plots were clean tilled, corn was planted using a 4 row planter (79,360 seeds/ha) and sorghums were planted using a no-till drill.
 - Sorghum seed rates: forage sorghum 248,000 seeds/ha, sorghum-sudan 22.42 kg/ha, sudangrass 16.81 kg/ha.
 - Plot length was 3.1 meters.
 - Plots were hand harvested at 1/3 to 1/2 kernel milk-line for corn, soft to hard-dough for sorghum, or after a killing frost in early October.

RESULTS

Table 1. Sorghum variety information

Treatment	Hybrid/Variety	Company
Forage sorghum	AF8301	Alta Seeds
Sorghum-sudangrass	AS5201	Alta Seeds
PS forage sorghum ¹	4-Ever Green	Walter Moss Seeds
PS sorghum-sudangrass	Mega Green	Walter Moss Seeds
BMR forage sorghum ²	BMR 3411	Croplan®
BMR sorghum-sudangrass	Greentreat® 1731	Croplan®
PS BMR sorghum-sudangrass	Greentreat® Rocket	Croplan®

¹PS = photoperiod sensitive; ²BMR = brown mid-rib

Table 3. DM nutrient values for sorghums and corn with various irrigation rates

Variety	NDF	CP	IVTD	IVNDFD	TDN
Corn	39.0	6.9	81.2	51.6	71.9
PS forage sorghum ¹	59.0	5.8	73.4	54.8	63.1
PS sorghum-sudan	60.8	5.6	67.8	47.0	57.9
Forage sorghum	48.9	8.0	72.7	44.1	63.2
Sorghum-sudan	56.4	6.9	68.1	43.5	58.5
BMR forage sorghum ²	47.5	8.2	77.2	52.0	67.2
BMR sorghum-sudan	55.5	7.0	75.6	56.0	66.0
PS BMR sudangrass	56.3	7.1	75.5	56.6	64.5
SEM	0.79	0.17	0.54	0.98	0.59
Irrigation Rate (%)					
0	53.1	6.6	73.4	49.9	63.5
25	52.2	7.5	75.8	53.6	65.9
50	54.1	6.9	73.5	51.0	63.6
75	51.9	6.7	73.5	49.0	63.6
100	53.2	6.9	73.5	50.1	63.6
SEM	0.73	0.14	0.54	0.77	0.55
Treatment factors (P =)					
Irrigation	0.30	0.02	0.08	0.03	0.07
Variety	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Irrigation x Variety	0.20	0.22	0.05	0.46	0.04

¹PS=photoperiod sensitive; ²BMR=brown mid-rib; IVNDFD was determined with a 48 hour in vitro incubation.

Table 2. DM yields (Mg/ha) for sorghums and corn at various irrigation rates

Variety	Irrigation Rate (%)					Contrasts (P=)		
	0	25	50	75	100	0 vs mean of other rates	Linear effect	Quadratic effect
Corn	15.5	15.1	17.3	19.3	22.5	0.01	<0.01	0.11
PS forage sorghum ¹	20.4	23.5	35.4	39.8	37.4	0.03	<0.01	0.22
PS sorghum-sudan	21.1	26.9	31.7	38.8	44.5	<0.01	<0.01	0.82
Forage sorghum	26.1	24.7	25.2	26.8	31.5	0.82	0.31	0.39
Sorghum-sudan	19.8	19.2	25.1	26.0	21.7	0.06	0.04	0.03
BMR forage sorghum ²	15.9	22.6	21.3	29.8	34.8	<0.01	<0.01	0.28
BMR sorghum-sudan	18.5	18.9	19.4	18.7	24.6	0.51	0.17	0.39
PS BMR sudangrass	21.3	23.3	19.7	28.4	24.6	0.53	0.35	0.69
SEM	3.54							

¹PS=photoperiod sensitive; ²BMR= brown mid-rib; Irrigation rates affected yield (P<0.01). Yield was also affected by variety (P<0.01). There was a variety by irrigation interaction (P=0.04).



Picture 1. Picture of dryland plot (0% irrigation) at harvest.

SUMMARY

DM Yield

- Natural precipitation for the growing period was 62.2 cm.
- Rainfall amounts were above average.
- Irrigation totals were 7.4, 14.9, 22.4, and 29.8 cm for 25, 50, 75, 100% rates respectively.
- There was a variety by irrigation rate interaction (P=0.04).
 - Sorghum yields were similar or greater than corn yields.
 - PS varieties and BMR forage sorghum were the most responsive to increased irrigation.
 - Corn had moderate responsiveness to irrigation.

Nutrients

- Irrigation had minimal effects on forage quality.
- There was an irrigation by variety interaction for IVTD (P=0.04) and TDN (P=0.05).

CONCLUSIONS

- Sorghums can be grown with less irrigation than corn.
- Sorghums can produce similar or increased yields compared to corn

ACKNOWLEDGMENTS

- This project was partially supported by a Midwest Forage Association Research Grant.
- This work is partially supported by the USDA National Institute of Food and Agriculture, Hatch project 1006557.
- The authors thank Scott Fischer and Jason Cavadini of the Marshfield ARS and Paul Sytsma of the Hancock ARS for assistance with the project.

REFERENCES

Bean, B. W., R. L. Baumhardt, F. T. McCollum, and K. C. McCuiston, 2013. Comparison of sorghum classes for grain and forage yield and forage nutritive value. Field Crops Research. 142: 20–26.