



Nitrogen fertilization effects on sorghum forage yield and quality

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BACKGROUND

Dairy heifer nutrient requirements are lower than lactating animals, but feeding lower energy diets can be a challenge for some producers that have high quality feeds. Sorghum forages are less expensive to grow, and typically exhibit reduced energy density and greater concentrations of fiber compared to corn silage; therefore they may be very suitable for replacement dairy heifers. In addition, sorghums require less water and nitrogen compared to corn, which also would reduce fertilization needs. However, only minimal research evaluating sorghum growth and nutritive value under variable rates of nitrogen fertilization has been conducted in the Midwestern US.

OBJECTIVES

To evaluate the effect of nitrogen fertilization on yield and quality of photoperiod sensitive (PS), conventional, and brown mid-rib (BMR) forage sorghum and sorghum-sudangrass compared to corn.

MATERIALS & METHODS

- Randomized complete block design with treatments arranged in a 4 x 8 factorial with 3 replicate blocks
- Within each block, N rates (0, 56, 112, 168 kg N/ha) were randomized
- Within each N rate, 7 sorghum varieties and 1 corn hybrid were randomly assigned
- 7 kg N was applied as urea by hand at planting
 - 0 kg N/ha rate did not receive pre-planting N
- Remaining N was applied at the 4-6 leaf stage
- Planting and Harvesting
 - Plots were planted June 3, 2016
 - Corn was planted using a 4 row planter (79,360 seeds/ha) and sorghums were planted with a no till drill
 - Sorghum seed rates: forage sorghum 248,000/ha; sorghum-sudan 22.4 kg/ha; sudangrass 16.8 kg/ha
 - Plot length was 4.57 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. Corn hybrid and 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® |

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

Table 3. DM nutrient values for sorghums and corn using nitrogen rates in WI in 2016

| Variety | NDF | CP | IVTD | IVNDFD | TDN |
|---------------------------------|--------|--------|--------|--------|--------|
| Corn | 42.4 | 5.9 | 79.6 | 51.8 | 69.1 |
| PS forage sorghum ¹ | 63.3 | 4.3 | 71.1 | 54.5 | 58.2 |
| PS sorghum-sudan | 62.9 | 3.6 | 69.7 | 51.8 | 57.4 |
| Forage sorghum | 59.8 | 5.3 | 69.5 | 49.1 | 57.8 |
| Sorghum-sudan | 59.5 | 3.6 | 70.1 | 49.7 | 58.4 |
| BMR forage sorghum ² | 52.4 | 5.6 | 77.9 | 57.8 | 65.6 |
| BMR sorghum-sudan | 59.2 | 6.2 | 74.7 | 57.4 | 63.0 |
| PS BMR sudangrass | 61.2 | 4.9 | 75.6 | 60.0 | 61.0 |
| SEM | 1.13 | 0.28 | 0.82 | 0.97 | 0.82 |
| Nitrogen Rate kg N/ha | | | | | |
| 0 | 58.9 | 4.4 | 75.3 | 57.9 | 62.4 |
| 56 | 57.7 | 4.9 | 73.2 | 53.5 | 61.1 |
| 112 | 56.8 | 5.0 | 72.9 | 52.4 | 60.8 |
| 168 | 56.9 | 5.3 | 73.1 | 52.7 | 61.1 |
| SEM | 0.92 | 0.20 | 0.72 | 0.77 | 0.66 |
| Treatment factors (P =) | | | | | |
| Nitrogen | 0.20 | 0.13 | 0.12 | 0.01 | 0.37 |
| Variety | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| Nitrogen x Variety | 0.82 | 0.09 | 0.57 | 0.32 | 0.59 |

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 using nitrogen rates in WI in 2016

| Variety | Nitrogen Rate (kg/ha) | | | |
|---------------------------------|-----------------------|------|------|------|
| | 0 | 56 | 112 | 168 |
| Corn | 12.4 | 11.5 | 14.1 | 15.7 |
| PS forage sorghum ¹ | 10.0 | 21.4 | 21.9 | 25.1 |
| PS sorghum-sudan | 11.7 | 18.7 | 21.3 | 23.6 |
| Forage sorghum | 13.4 | 20.7 | 19.1 | 20.3 |
| Sorghum-sudan | 13.8 | 17.3 | 15.3 | 20.1 |
| BMR forage sorghum ² | 14.2 | 24.3 | 17.2 | 21.3 |
| BMR sorghum-sudan | 8.6 | 14.9 | 12.6 | 13.3 |
| PS BMR sudangrass | 6.9 | 8.9 | 11.5 | 12.4 |
| SEM | 3.2 | | | |
| Variety x Nitrogen (P=) | 0.67 | | | |

¹PS=photoperiod sensitive; ²BMR= brown mid-rib; nitrogen rate affected yield (P=0.02) when 0 kg N/ha was compared to 56, 112, and 168 kg N/ha. There was no significant difference between N application rates 56, 112, and 168 kg N/ha (P=0.21). Yield was affected by variety (P<0.01).



Picture 1. Plot at harvest.

SUMMARY

DM Yield

- Yield was affected by variety (P< 0.01) with PS varieties, forage sorghum, and BMR forage sorghum having greater yields than BMR sorghum-sudangrass, sudangrass, and corn.
- Nitrogen rate affected yield (P=0.02) with reduced yields for 0 kg N/ha plots compared to all other N rates.
- There were no differences in yield across N rates of 56, 112, and 168 kg N/ha (P>0.21).

Nutrients

- Nitrogen affected IVNDFD (P=0.01) with 0 N rate having the highest digestibility.
- Varieties of sorghums and corn were nutritionally different in NDF, CP, IVTD, IVNDFD, TDN (P< 0.01).
- BMR varieties tended to have lower NDF and higher TDN values compared to the PS sorghums. Concentrations of IVNDFD and IVTD were the highest for the BMR varieties, which agreed with Bean et al. (2013).
- Corn had the greatest nutritive quality (highest TDN, lowest NDF).

CONCLUSIONS

- Nitrogen application had minimal effects on nutritive quality of sorghums.
- Sorghums tend to need less nitrogen than corn with a plateau in yield between 56-112 kg N/ha.
- Based on this study, the nutritive quality of sorghums would meet dairy heifers requirements while requiring less nitrogen input than corn.

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| Variety | NDF | CP | IVTD | IVNDFD | TDN |
|---|--------|--------|--------|--------|--------|
| Corn | | 5.9 | 79.6 | 51.8 | 69.1 |
| PS forage sorghum ¹ | | 4.3 | 71.1 | 54.5 | 58.2 |
| PS sorghum-sudan | | 3.6 | 69.7 | 51.8 | 57.4 |
| Forage sorghum | | 5.3 | 69.5 | 49.1 | 57.8 |
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| PS BMR sudangrass | | 4.9 | 75.6 | 60.0 | 61.0 |
| SEM | | 0.28 | 0.82 | 0.97 | 0.82 |
| Nitrogen Rate kg N/ha | | | | | |
| 0 | 58.9 | 4.4 | 75.3 | 57.9 | 62.4 |
| 56 | 57.7 | 4.9 | 73.2 | 53.5 | 61.1 |
| 112 | 56.8 | 5.0 | 72.9 | 52.4 | 60.8 |
| 168 | 56.9 | 5.3 | 73.1 | 52.7 | 61.1 |
| SEM | 0.92 | 0.20 | 0.72 | 0.77 | 0.66 |
| Treatment factors (<i>P</i> =) | | | | | |
| Nitrogen | 0.20 | 0.13 | 0.12 | 0.01 | 0.37 |
| Variety | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| Nitrogen x Variety | 0.82 | 0.09 | 0.57 | 0.32 | 0.59 |
| ¹ PS=photoperiod sensitive; ² BMR=brown mid-rib; IVNDFD was determined with a 48 hour invitro incubation. | | | | | |

| Variety | NDF | CP | IVTD | IVNDFD | TDN |
|---|--------|----|------|--------|-----|
| Corn | 42.4 | | | | |
| PS forage sorghum ¹ | 63.3 | | | | |
| PS sorghum-sudan | 62.9 | | | | |
| Forage sorghum | 59.8 | | | | |
| Sorghum-sudan | 59.5 | | | | |
| BMR forage sorghum ² | 52.4 | | | | |
| BMR sorghum-sudan | 59.2 | | | | |
| PS BMR sudangrass | 61.2 | | | | |
| SEM | 1.13 | | | | |
| Nitrogen Rate kg N/ha | | | | | |
| 0 | 58.9 | | | | |
| 56 | 57.7 | | | | |
| 112 | 56.8 | | | | |
| 168 | 56.9 | | | | |
| SEM | 0.92 | | | | |
| Treatment factors (<i>P</i> =) | | | | | |
| Nitrogen | 0.20 | | | | |
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