# SORGHUM AS A FORAGE IN WISCONSIN[1, 2]

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## Background

Growing of moderate quality forages that meet and not exceed requirements of dairy replacement heifers is not commonly done; however, it would have a positive impact on the dairy industry. It is typical for heifers to gain excessive bodyweight, especially post-puberty which negatively impacts first lactation milk production when fed diets high in energy. Replacement dairy heifers are typically fed high forage diets with a combination of corn silage and alfalfa or grass silage. Corn silage is typically high energy (70 to 75% TDN, DM basis) and exceeds dairy heifer requirements (900 to 1200 lb heifers require 62% TDN, DM) causing excess gain and overconditioning. Use of lower quality forages would reduce heifer over-conditioning. Sorghum and sorghum-sudangrass have a lower nutritive quality (higher fiber, lower starch) than corn silage and would be an alternative to reduce excess heifer weight gains.

New types of sorghum called photoperiod sensitive are now being marketed as both a forage and biofuel crop in various regions across the US including the Midwest. Photoperiod sensitive (PS) sorghum and sorghum-sudangrass plants stay vegetative until the daylight hours reach 12 hours and 20 minutes (mid-September). This allows the plant to accumulate large amounts of forage mass during the growing season. The delay in progression to reproductive stages and senescence can cause challenges with harvesting as the plant has not dried to an adequate moisture level for silage harvest (60 to 70% moisture) so harvest management strategies need to be evaluated for this new forage. Photoperiod sensitive sorghums have been evaluated in Iowa (Salas-Fernandez, 2010) with average yields of 21 tons DM/ha across several hybrids compared to 16 tons DM/ha for conventional forage sorghum hybrids. However, PS sorghum has not been evaluated as a dairy forage source in colder climates such as those in Central Wisconsin.

The objective of this study was to evaluate the yield of PS forage sorghum and sorghum-sudangrass compared to non-PS sorghum, sorghum-sudangrass and corn silage. We chose to conduct the study at the Hancock and Marshfield Agricultural Research Stations due to differences in soil characteristics (silt loam soil at Marshfield and sandy soil at Hancock).

## Methods

Forages evaluated included 1 PS forage sorghum, 1 PS sorghum-sudangrass, 1 forage sorghum, 1 BMR forage sorghum, 1 sorghum-sudangrass, 1 BMR sorghum-sudangrass, and 1 PS sudangrass hybrid. Two management factors were evaluated in a factorial treatment design (planting date and harvest strategy). The two plantings were 1) early June mid-June. Harvest methods were either 1) single harvest in early fall once the forage was at an adequate moisture for forage harvesting or was killed by a frost or 2) multiple harvests with one in early August and

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another in mid-October after a killing frost. The treatments were arranged in a split-plot design such that the harvest methods were in separate randomly assigned halves within each block to avoid shading of the multiple harvest plots by the single harvest plots after the first harvest. Four replications for each planting, harvest, and variety combination were evaluated.

Seeding rates were corn at 32,000 seeds/acre, forage sorghum at 100,000 seed/acre (7 lb/acre), sorghum-sudangrass at 20 lb/acre, and sudangrass at 15 lb/acre. Soil was tilled prior to planting. Starter fertilizer was applied at 20 lb N per acre at planting. Corn was planted using a four-row planter set at 30 inch rows. All others were established using a 5-foot no-till drill set at 15 inch rows. Plot length was 15 feet. Nitrogen fertilizer was applied at approximately the three to four leaf stage with the entire N amount given for the single harvest plots and ½ the allotment for the multiple harvest plots. The remaining N for the multiple harvest plots was applied following the August harvest.

Harvest measurements included height, growth stage and kernel maturity. Plots were harvested using a 3-foot sickle bar mower or by hand using a corn knife at approximately 4 inch cutting height. Harvested forage was weighed using 30 gallon trash cans and then chopped using a gas-powered wood chipper. Chopped forage was analyzed for dry matter content by drying in a forced air oven at 55 °C until no change in weight (typically 4 to 5 days). Forage dry matter yield (tons DM per acre) was calculated based on the forage dry matter amount from the harvest yield data and sample dry matter content (wet forage yield x DM content) and the area harvested (length x width; ex. 2.5 ft x 15 ft). Data presented are means from four replicates of each treatment combination with each site presented separately. Multiple harvest yields were combined to give a total yield for both harvests. Corn harvested during the August harvest did not have any subsequent regrowth.

## Results

Data are presented in Table 1. Planting date generally had a negative impact on yield with lower yields for the later planting date except at the Marshfield site. The early June planting date was followed by heavy rain fall that caused crusting of the soil surface and delayed germination. In addition, planting depth of the sorghums was approximately 1.5 inches which also delayed and drastically reduce germination and likely potential yields. The deep planting depth especially negatively affected the forage sorghum varieties due to the combination of poor germination and low seeding rate resulting in very poor establishment and some plots being removed from the study. It is recommended to plant sorghum at 0.5 to 1 inch in poorly drained soils like those at Marshfield. The deep planting depth had less of an impact at Hancock but emergence was still poor for some of the sorghum plots. Growing conditions were in general normal temperatures during the summer with a stretch of dry, warm weather in mid-August which helped to accelerate sorghum growth.

Forage yields were greater at Hancock compared to Marshfield for all forages and management factors. The soil conditions likely allowed for quicker emergence and growth at the Hancock site while the forages had slow emergence and growth due to wet soils at the Marshfield site. The non-BMR varieties had comparable or better forage yield than corn at the Hancock site with the BMR varieties having lower yields. The non-BMR sorghum-sudangrass had the highest yields at Hancock for both planting dates while the PS sorghum-sudangrass was highest for both dates at Marshfield.

Single harvest yields were two to three times the combined multiple harvest yields at both sites. Forage quality will be assessed later on the forages, but it is expected that the multiple harvest forages will have improved forage quality than single harvest strategies. The first harvest was delayed to early August which may have limited later forage growth during the ideal growing period in late August. As expected, sorghum-sudangrass varieties had the highest yield when using the multiple harvest strategy.

In conclusion, some sorghum varieties are able to produce similar forage yields to corn in Central Wisconsin. These high yielding varieties may be useful to provide significant quantity of moderate quality forage for heifer feeding or other livestock with low nutritive needs such as pregnant beef cows. For high tonnage, it is recommended to use a single cut system. Moisture level at harvest can be challenging as sorghums often are frost-killed before drying down to an adequate moisture. Harvest should be delayed 1 to 2 weeks after a killing frost to dissipate prussic acid levels and allow for drying. Photoperiod sensitive varieties did not lodge in this study after a killing frost which may allow for additional drying time.

Table 1. Forage dry matter yields (tons DM/acre) for various sorghums and corn silage at Hancock and Marshfield Agricultural Research Stations.

| | Hancock | | | | Marshfield | | | |
|---|---|---|---|---|---|---|---|---|
| Planting: | Early June | | Mid-June | | Early June | | Mid-June | |
| Forage / Harvest: | Single | Multi | Single | Multi | Single | Multi | Single | Multi |
| Corn silage | 8.48 | 3.87 | 6.17 | 2.17 | 5.21 | 2.72 | 5.87 | 2.16 |
| PS forage sorghum[1] | 9.40 | 3.42 | 8.19 | 1.65 | 4.23 | 1.25 | 4.89 | 1.19 |
| PS sorghum-sudan | 9.58 | 5.47 | 9.43 | 3.71 | 8.48 | 3.21 | 7.93 | 3.13 |
| Forage sorghum | 8.32 | 4.31 | 7.05 | 2.13 | 4.07 | 1.52 | 4.38 | 1.98 |
| Sorghum-sudan | 12.33 | 4.68 | 10.22 | 4.26 | 6.32 | 3.76 | 6.08 | 3.32 |
| BMR forage sorghum[2] | 6.39 | 3.56 | 4.25 | 1.94 | 3.85 | 1.54 | 3.93 | 1.80 |
| BMR sorghum-sudan | 6.69 | 4.00 | 6.73 | 2.68 | 4.17 | 1.78 | 4.32 | 2.52 |
| BMR sudangrass | 6.08 | 3.45 | 5.70 | 2.59 | 5.29 | 2.69 | 5.16 | 1.36 |

[1] PS = Photoperiod sensitive variety
[2] BMR = Brown mid-rib variety

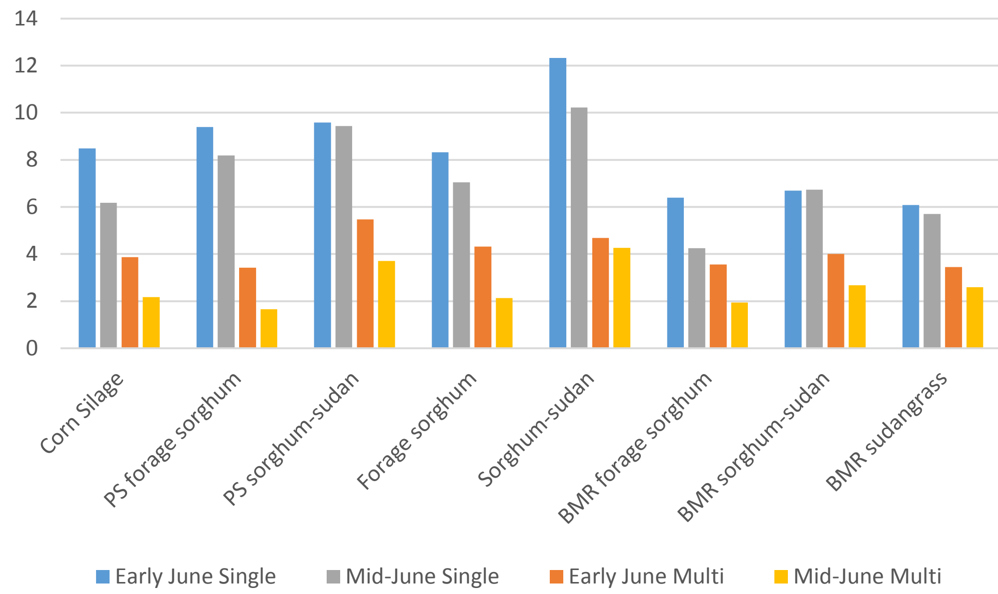


Figure 1. Forage yields at Hancock of corn and sorghum varieties planted at two dates and harvested using a single or multiple cut system

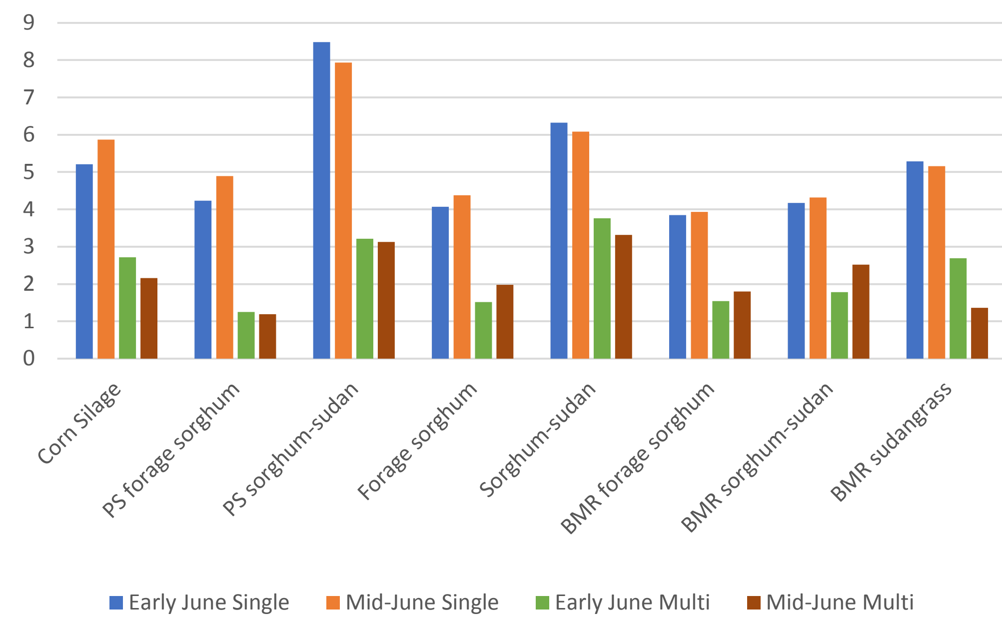


Figure 2. Forage yields at Marshfield of corn and sorghum varieties planted at two dates and harvested using a single or multiple cut system