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Can increasing forage sorghum berry size improve berry processing and starch digestibility?

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As dairy cattle inventory in the southern Ogallala Aquifer region continues to increase, farmers are seeking drought tolerant, quality forages to continue meeting forage demands. Corn silage has historically been the silage of choice, but forage sorghum adoption has increased in recent years (USDA NASS 2001-22; Fig. 1). However, variable berry sizes results in poor berry processing, digestibility and starch availability. Recently, the starch digestibility of forage sorghum was evaluated on a commercial West Texas dairy under center pivot irrigation. The objective was to assess the effect of forage sorghum berry size on berry processing score and in situ starch digestibility. This article will provide a summary of preliminary results of this ongoing study and future directions to increase forage sorghum yield and quality.

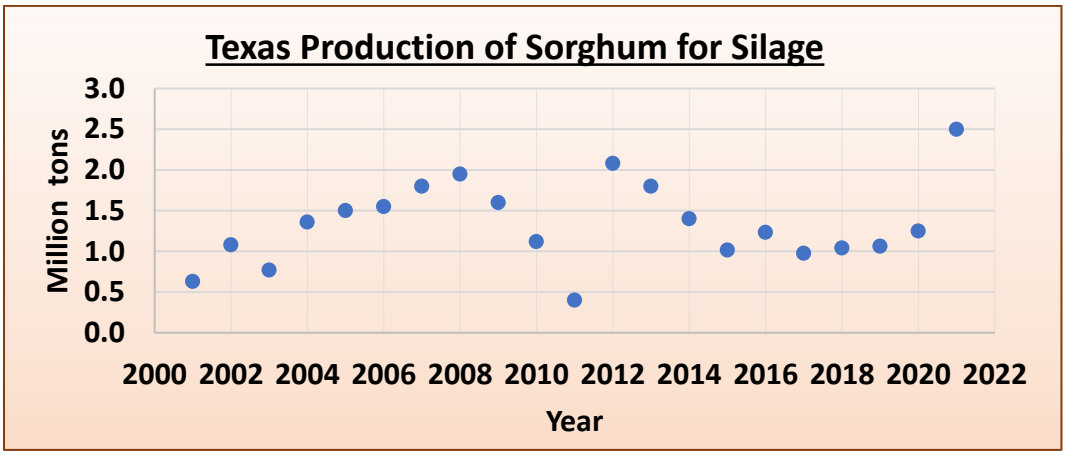

Figure 1. Texas production of sorghum for silage duplicated from 2020 to 2021.

Corn and two forage sorghum hybrids were evaluated: 1) F24, larger berry size and 2) F10, smaller berry size (Fig. 2). Plots were blocked by irrigation section, and sorghum hybrids were randomly allocated within blocks and replicated five times (Fig. 3). Forage sorghum hybrids were harvested at soft dough stage, 30% dry matter and using kernel processors set 2 mm apart. Whole plant and chopped (processed) samples were obtained the day before and at harvest, respectively. Whole and processed grain samples were screened to determine particle size distribution.

Figure 2. The berry processing score and in situ starch digestibility of forage sorghum hybrid F10 (smaller berry size, left) and F24 (larger berry size, right) were compared. Picture courtesy of Diego Druetto.

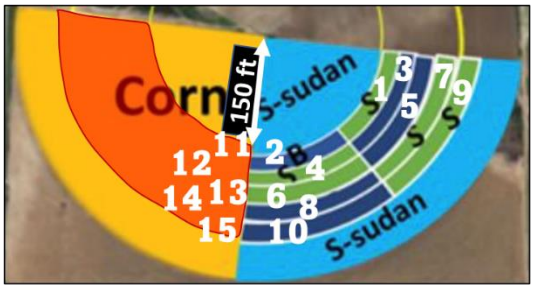

Figure 3. Corn and sorghum crops were randomly allocated to be planted on the west or east side. Then sorghum hybrids F10 (**light green**) and F24 (**dark blue**) plots were randomly allocated within blocks and replicated five times. Sorghum hybrids were seeded on 05/24/21 and harvested 09/03/21.

Three important questions were answered with this study:

1) Were berries from forage sorghum F24 bigger than F10? Yes, we did a particle size separation of the intact berries (obtained one day before harvest) with two consecutive sieves (4 mm and 3.35 mm) and a pan. Before harvest, F24 had less intact berries passing the 3.35 mm sieve compared to F10, validating the larger berry size on F24.

Intact sorghum berry particle size distribution			
Berry size	**F10**	**F24**	***P*-value**
>4mm, %	0^{a} (± 2.7)	41^{b} (± 2.7)	<0.01
>3.35, %	42 (± 3.9)	49 (± 3.9)	0.24
<3.35, %	58^{a} (± 4.5)	10^{b} (± 4.5)	<0.05

Table 1. Intact berry particle size distribution from panicles obtained the day prior to harvest for silage. ^{a,b} Means within the same row with different superscripts are significantly different.

2) Did berry processing score of F24 and F10 differ? There was very little difference in favor of F10. Two different sieves were used: 1) 2.36 mm sieve: more starch from processed berries from F10 passed the sieve compared to F24; 2) 1.7 mm sieve: no difference. Considering the initial size of the F24 berry was significantly bigger and starch from processed berries passing the 1.7 mm screen did not differ between hybrids, this could indicate potentially more F24 berries were broken compared to F10.

Processed berry particle size distribution	F10	F24	*P*-value
Starch above 2.36 mm screen, %	68[a] (± 1.6)	75[b] (± 1.6)	<0.001
Starch passing 2.36 mm screen, %	32[a] (± 1.6)	25[b] (± 1.6)	<0.001
Starch above 1.7 mm screen, %	84 (± 0.9)	83 (± 0.9)	0.34
Starch passing 1.7 mm screen, %	16 (± 0.9)	17 (± 0.9)	0.34

Table 2. Processed berry particle size distribution from samples obtained at harvest for silage. [a,b] Means within the same row with different superscripts are significantly different.

3) Did F24 have better starch digestibility than F10, and how do they compare with corn?
There was no difference in starch digestibility between F24 and F10. Corn had better starch digestibility compared to both forage sorghum hybrids.

Crop	Sorghum (F10)	Sorghum (F24)	Corn	*P*-value
In-situ starch digestibility, % starch	59.5[a] (± 3.03)	59.3[a] (± 3.03)	74.8[b] (± 3.03)	0.001

Table 3. In-situ rumen starch digestibility (7 h) of forage sorghum hybrids F10 and F24 and corn. [a,b] Means within the same row with different superscripts are significantly different.

Discussion and Future Directions

Results from this study suggest that increasing sorghum berry size, at least for the size difference of the two forage sorghum hybrids compared, might not increase in situ starch digestibility. Future research should evaluate the effect of using hybrids with larger berry size than F24. In addition, the ratio of the panicle to vegetative parts (leaves + stems) of sorghum vs. corn was very different (30:70 vs. 45:55), and this might have affected berry processing. Hence, future research should also assess the value of using a sorghum hybrid with a 45:55 panicle to vegetative parts ratio on starch digestibility.

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References

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[1] J.M. Piñeiro, J. Bell, L.F. Ferraretto, D. Druetto, J. Goeser, E. Coons, A. Hart. 2022. The effects of increased sorghum berry size on berry processing score and starch digestibility. J. Dairy Sci. (accepted for publication)