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Effects of hybrid maturity and growth stage on yield and composition of forage and grain sorghums when harvested as silage

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Effects of Hybrid Maturity and Growth Stage on Yield and Composition of Forage and Grain Sorghums when Harvested as Silage

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Summary

Thirteen sorghum hybrids chosen to represent a range of sorghum types were evaluated in two separate trials. Each was harvested at three stages of grain development: milk to early-dough, late-dough, and hard-grain.

Among the forage sorghums, there was a 26-day range in days to half bloom from early to late maturing varieties. Harvest date did not affect crude protein content. However, whole-plant DM yield was significantly lower at the last harvest for the three latest maturing varieties. Grain yield increased over time in the early and intermediate hybrids. Lodging increased significantly over time for all varieties except DeKalb FS-25E.

Among the grain sorghums, there was only a 4-day range in days to half bloom and very little difference in plant height. The forage sorghum was later maturing and taller. Whole-plant DM yields for the grain sorghums were highest at late-dough. Grain yields and grain to forage ratios generally increased with maturity, except when there were losses due to birds. Grain sorghums started to lodge by the hard-grain stage.

Introduction

Sorghum's importance as a feed grain and silage crop has increased steadily in the High Plains region during the past 25 years. In recent years, more acres and tons of sorghum were harvested, stored, and fed as silage in Kansas than corn. Today, improved sorghum hybrids often give DM yields comparable to corn with lower production costs. But, there are often large variations among sorghum hybrids. Research in Texas indicates that whole-plant grain sorghum harvested and fed as silage produces about one-third more cattle gain per acre than harvesting and feeding only the grain portion.

Our objective was to determine how sorghum hybrids with different characteristics are affected by stage of development at harvest.

Experimental Procedures

Two separate experiments were conducted under dryland conditions during the summer of 1984. The forage sorghum trial included two early, two intermediate, and two late maturing hybrids. Included in the grain sorghum trial were two early, two intermediate, and one late maturing hybrids. A forage sorghum, intermediate in maturity, also was included in the grain sorghum trial for

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comparison purposes. Hybrids were chosen to represent a range of sorghum pedigrees, which included variations in maturity, plant height, and grain and forage yields. Each variety was harvested at three stages of grain development; milk to early-dough, late-dough, and hard-grain. Treatments were arranged in a split-plot design with stages of harvest as main plots and varieties as sub-plots with four replications.

About 90 lb per acre of anhydrous ammonia and a broadcast pre-emergence herbicide spray (Ramrod-atrazine) were applied before planting. Soil tests indicated that phosphorus and potassium were adequate. All plots were planted June 1, but heavy rains during emergence ruined stands on the forage sorghum plots, so they were replanted on June 25. The grain sorghum stands were a little thin in spots, but acceptable. Furadan insecticide was placed in the furrows at planting and Cygon insecticide spray was applied July 31 for greenbug control. Each plot consisted of six rows, 30-inches apart and 30 ft in length. Two to three weeks after emergence, the plots were thinned to 34,848 plants per acre (six inches between plants).

Agronomic data collected on each plot included days to half bloom, plant height, lodging, whole-plant DM, and grain yields. Days to half bloom measured maturity, and is defined as number of days between the planting date and the date half of the main heads had some florets in bloom. Plant height was measured to the tallest point of the head immediately prior to harvest. Whole-plant yields for each plot were determined by harvesting a 20 ft length from each of the two center rows with a modified one-row forage harvester. Chopped forage from each plot was weighed, sampled for DM, and collected for silage-making. Silage was made from each plot in a 5-gallon capacity plastic laboratory silo. Grain yields were determined by hand clipping the heads from 20 ft of one of the remaining rows. Then, the heads were dried and threshed in a stationary thresher.

Results and Discussion

Forage Sorghum Trial. Shown in Table 23.1 are days to half bloom and plant height of the six varieties of forage sorghum. There was a 26-day range in days to half bloom from early to late maturing varieties. Unexpectedly, plant height was highest for the earlier maturing varieties and lowest for the intermediate maturing varieties. The relatively late planting date (June 25) and an early freeze (September 27) probably were responsible for this unusual relationship.

The data for yield and composition by variety are also shown in Table 23.1. An early freeze damaged the late maturing DeKalb FS-25E and resulted in a much lower grain yield and grain to forage ratio than in the other five varieties. Forage DM content was significantly higher at the third harvest for all varieties, except DeKalb FS-25E. No significant differences in whole-plant crude protein (CP) due to harvest date were observed in any variety. Forage DM yield was significantly lower for the three latest maturing hybrids (Silomaker, Cow Vittles, and DeKalb FS-25E) at the hard-grain stage. Grain yield was highest ($P<.05$) for the late-dough and hard-grain harvests in the early and intermediate varieties. Grain to forage ratios were numerically lowest at the milk to early-dough stage for all varieties. Lodging percents were significantly higher at the last harvest date for all varieties, except DeKalb FS-25E.

Grain Sorghum Trial. The earliest and latest maturing grain sorghum varieties differed by only 4 days to half bloom (Table 23.2). Likewise, plant heights were similar for all grain sorghums. The forage sorghum (Pioneer 947) was later maturing and significantly taller than the grain sorghums.

The data for yield and composition by variety are also presented in Table 23.2. Whole-plant DM content for the grain sorghums was significantly higher at each successive harvest, while Pioneer 947 remained constant after the first harvest. About 10 days elapsed between each successive harvest stage. The effect of harvest stage on CP content was significant for only one variety (TX 2752 x TX 430), however there was a trend for CP content to decrease with maturity for all varieties except Asgrow Colt. A1though differences were not statistically significant, all grain sorghum varieties produced their highest DM yields at the late-dough stage of development, while the forage sorghum declined in DM yield at each successive harvest. Grain yields and grain to forage ratios generally increased with maturity, but due to severe damage by birds in some plots, grain yields were reduced at the third harvest for three of the grain sorghum varieties. Lodging increased significantly at the third harvest for four of the five grain sorghums. The forage sorghum also lodged more as maturity progressed, however these values were likely inflated since it was not surrounded by a crop of similar height.

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Sorghum Performance Tests

Sorghum Performance Tests are conducted annually by the Kansas Agricultural Experiment Station to provide farmers, Extension workers, and private research and sales personnel with unbiased agronomic information on many sorghum hybrids marketed in Kansas. Cooperating seed firms nominate test entries, select test sites, and pay entry fees to cover part of the test costs. Because the program is voluntary, not all hybrids grown in the state are included in tests, and hybrids are not grown uniformly at all locations.

Results of the 1984 Sorghum Performance Tests are summarized in Report of Progress 465. It can be obtained through Extension personnel, or the Kansas Agricultural Experiment Station.

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Table 23.1. Yield and Composition of the Six Forage Sorghum Varieties Harvested at Three Stages of Maturity

Variety	Harvest[1]	Whole-plant DM %	Whole-plant CP[2] %	Yield/Acre Whole-plant tons[2]	Yield/Acre Grain bu[3]	Grain: Forage Ratio	Lodging %
Early Maturity							
Buffalo Canex	1	27.2[b]	7.1	5.4[c]	35.3[b]	.20	0.0[c]
(55[4], 86[5])	2	25.8[c]	5.7	5.9[a b]	54.7[a]	.30	7.5[a b]
	3	29.2[a]	6.8	6.2[a]	55.1[a]	.28	11.5[a]
Warner Sweet-Bee	1	24.8[c]	6.9	5.5[b]	45.8[b]	.26	15.8[b]
(62, 93)	2	26.8[b]	6.8	6.1[a]	58.6[ab]	.31	34.3[a b]
	3	30.4[a]	6.7	6.6[a]	64.3[a]	.31	44.0[a]
Intermediate Maturity							
Pioneer 947	1	30.5[b]	9.1	5.6	49.0[b]	.28[b]	.8[b]
(68, 81)	2	31.7[b]	8.7	6.1	82.5[a]	.51[a]	2.8[ab]
	3	41.9[a]	9.1	6.4	77.1[a]	.44[a]	7.3[a]
Golden Acres T-E	1	27.0[b]	8.2	6.2[a b]	41.3[b]	.20	3.0[a b]
Silomaker	2	30.5[a]	8.5	6.6[a]	61.5[a b]	.30	2.0[b]
(76, 71)	3	30.1[a]	8.6	5.8[b]	49.9	.28	12.3[a]
Late Maturity							
Conlee Cow Vittles	1	24.5[b]	8.1	6.3[a]	23.3	.10[b]	6.0
(79, 84)	2	26.0[a]	7.7	6.2[a]	35.5	.16[a b]	10.8
	3	25.8[a]	7.7	5.6[b]	41.9	.24[a]	28.5
De Kalb FS-25 E	1	26.9[a]	8.3	6.7[a]	9.6	.04	0
(81, 82)	2	24.7[b]	7.9	6.3[ab]	11.6	.05	0
	3	24.7[b]	8.1	6.2[b]	10.6	.04	0

[1] Harvest 1, milk to early-dough; harvest 2, late-dough; harvest 3, hard-grain.

[2] 100% dry matter basis.

[3] Adjusted to 12.5% moisture.

[4] Days to half bloom.

[5] Plant height, inches.

[a b c] Means within a variety with same letter are not different (P<.05).

Table 23.2. Yield and Composition of the Sorghums in the Grain Sorghum Trial

Variety	Harvest[1]	Whole-plant DM %	Whole-plant CP[2] %	Yield/Acre Whole-plant tons[2]	Yield/Acre Grain bu[3]	Grain: Forage Ratio	Lodging-%
Early Maturity							
DeKalb DK-42Y	1	32.2[a]	10.9	5.1	70.6	.51[a]	0.0
(61[4], 43[5])	2	41.9[b]	10.5	5.5	96.0	.76[a]	0.0
	3	50.9[c]	10.1	5.3	85.5	.65[a b]	2.2
Northrup-King 2778	1	31.4[a]	10.7	4.8	64.2[b]	.51[b]	0.0[a]
(61, 43)	2	41.5[b]	10.5	5.4	101.0[a]	.86[a]	0.0[a]
	3	49.9[c]	9.4	5.0	86.7[a b]	.76[a b]	6.2[b]
Intermediate Maturity							
TX 2752 x TX 430	1	35.1[a]	10.8[a]	5.5	72.6[b]	.49[b]	0.0[a]
(62, 43)	2	42.9[b]	10.5[a]	5.9	107.4[a]	.84[a b]	0.0[a]
	3	53.1[c]	9.3[b]	5.3	107.5[a]	1.05[a]	15.0[b]
Funk's G-522DR	1	34.2[a]	10.5	5.4[b]	70.5[b]	.49[b]	0.0[a]
(63, 42)	2	43.8[b]	10.3	6.2[a]	102.9[a]	.71[a b]	0.0[a]
	3	55.1[c]	9.8	5.6[a b]	103.9[a]	.83[a]	11.5[b]
Late Maturity							
Asgrow Colt	1	31.4[a]	10.0	5.2	63.0	.41	0.0[a]
(65, 44)	2	39.2[b]	10.0	5.9	102.2	.76	0.0[a]
	3	47.6[c]	10.0	4.8	85.3	.79	11.7[b]
Pioneer 947 (forage)	1	39.1[a]	9.4	6.2	83.4	.50	47.6[a]
(72, 78)	2	45.2[b]	8.8	6.1	85.5	.53	62.9[a]
	3	45.5[b]	8.5	5.8	91.2	.62	70.0[b]

[1] Harvest 1, milk to early-dough; harvest 2, late-dough; harvest 3, hard-grain.

[2] 100% dry matter basis.

[3] Adjusted to 12.5% moisture.

[4] Days to half bloom.

[5] Plant height, inches.

[a b c] Means within a variety with same letter are not different (P<.05).