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Effects of Soil Temperature at Planting on Corn and Sorghum Silage Yields

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Summary

Long- and short-season hybrids of corn (*Zea mays* L.) and forage sorghum (*Sorghum bicolor* (L.) Moench) were planted at six dates as determined by soil temperature. Hybrids were planted when soil temperatures reached and remained above 50, 55, 60, 65, 70, and 75 °F in 1988 and 1989. Silage yields ranged from 11.7 to 21.2 tons/A. Long-season sorghum yield was greater than short-season corn yield in 1988 and greater than corn and short-season sorghum in 1989. Planting long- and short-season corn or short-season sorghum at 50 °F soil temperature did not reduce yields either year. Long-season sorghum yield increased dramatically in both years by delaying planting until soil temperature reached 65 °F. Environmental conditions such as rainfall distribution, day length, and solar radiation imposed by planting at selected soil temperatures may have influenced yields more than soil temperature did.

Introduction

Corn and sorghum silage production is relatively new to the western Cross Timbers region. Planting corn near the last average freeze date increases the chances of receiving adequate rainfall during mid-April to June 15 and of avoiding high temperatures during pollination. However, the probability of temperatures being 32 °F or below in late March in the Stephenville area is 70%. Corn planted after April 1 matures in mid- to late June and is more likely to encounter insufficient moisture and higher air temperatures during this period when the crop is at or near silking. High temperatures at silking result in poor pollination and grain set. In earlier research at Stephenville, moisture stress reduced corn silage yield to about 4 tons/A, and dryland sorghum planted under average rainfall a month later than corn produced almost double the yields of irrigated corn. Low soil temperatures or other unfavorable soil conditions in early spring may reduce corn and sorghum stands and necessitate replanting. Our objective was to determine the effect of planting date based on soil temperature on silage yields of corn and sorghum.

Procedure

The experiment was conducted during 1988 and 1989 at the Texas A&M University Research and Extension Center, 2 mi north of Stephenville, on Windthorst fine sandy loam soil (fine, mixed, thermic, Udic Paleustalfs). Nitrogen (N) and phosphate (P_2O_5) fertilizer were applied both years at the rate of 250 lb/A of N and 80 lb/A of P_2O_5. Potassium application was 80 lb/A potash (K_2O) in 1988 and 60 lb/A in 1989. Supplemental irrigation was applied in 1988 because of drought; irrigation and rainfall records are given for both years in Table 1. Plots were not irrigated in 1989.

We used a randomized complete-block design with a split-plot arrangement of treatments in four blocks. Hybrids were main plots, and planting dates were subplots. Each subplot was four rows wide (36 in. between rows) and 30 ft long. Long- and short-season hybrids of corn (Pioneer 3165 and 3475, respectively) and forage sorghum (Dekalb-Pfizer FS-25e and FS-5, respectively) were planted at six dates as determined by soil temperature (50, 55, 60, 65, 70, or 75 °F) 6 in. below the top of the beds. Rates of 34,000 and 78,400 seed/A were used for corn and sorghum, respectively. Temperatures were monitored at 8 a.m. daily in 1989 and 5 days per week in 1988. All hybrids were planted the same day after the soil temperature reached or exceeded the target temperature for 5 days. However, in 1989 some planting dates were less than 5 days apart (Table 2).

The plots were harvested when sorghum grain reached soft dough or when corn grain was in medium dent. We cut 10 ft by hand from the center of the two middle rows, 3 to 4 in. above ground, for yield determination. Subsamples were dried at 140 °F for 48 hours to determine dry matter percentages.

Results

Silage yields ranged from 7.4 to 30.3 tons/A (Table 2). Long-season sorghum produced greater yield than did short-season corn in 1988 and greater yield than all other hybrids in 1989.

Keywords: corn silage / forage sorghum / soil temperature / planting dates.

Table 1. Rainfall (RF) and irrigation (I) received by corn and sorghum during 2 years at Stephenville.

Planting temp.	Corn: Long season RF	Corn: Long season I	Corn: Short season RF	Corn: Short season I	Sorghum: Long season RF	Sorghum: Long season I	Sorghum: Short season RF	Sorghum: Short season I
(°F)	inches							
	1988							
50	12.9	8.4	10.3	6.6	12.9	10.2	12.9	9.3
55	12.5	6.4	10.3	6.4	12.5	6.4	12.5	7.3
60	12.3	7.3	12.3	7.3	12.3	8.2	12.3	8.2
65	10.4	9.0	10.4	6.4	11.2	10.8	11.2	9.9
70	10.3	10.7	9.5	7.2	13.5	10.7	10.3	8.1
75	4.4	9.0	4.4	8.1	7.7	10.7	4.4	9.0
	1989							
50	19.4		19.4		19.4		19.4	
55	19.4		19.4		19.4		19.4	
60	19.4		19.4		19.4		19.4	
65	18.1		18.0		19.3		19.0	
70	12.1		12.1		15.3		12.1	
75	12.1		12.1		15.3		12.1	

Table 2. Silage yield (tons of 35% dry matter silage/A) of long- and short-season hybrids of corn and forage sorghum planted at six dates as determined by soil temperatures at Stephenville (1988 and 1989).

Soil temp.	Planting date 1988	Planting date 1989	Corn† Long-season 1988	Corn† Long-season 1989	Corn† Short-season 1988	Corn† Short-season 1989	Sorghum† Long-season 1988	Sorghum† Long-season 1989	Sorghum† Short-season 1988	Sorghum† Short-season 1989
°F										
50	3/11	3/14	17.7*	15.7	14.3	14.3	17.4	16.0	18.6	15.4
55	3/28	3/17	17.1	16.6	14.6	12.9	15.7	16.0	17.7	14.3
60	4/08	3/20	21.1	16.3	14.6	14.9	17.7	15.7	18.6	17.4
65	5/11	4/25	18.8	10.6	19.1	11.7	28.6	30.3	18.0	13.4
70	5/30	5/25	17.7	8.9	16.6	9.1	23.4	17.4	14.6	10.0
75	6/09	5/26	17.1	8.3	13.1	7.4	24.3	15.3	14.6	10.3
Hybrid mean			18.2	12.6	15.4	11.7	21.2	18.5	17.0	13.5

*LSD (0.05) for comparing any two means = 5.67 tons/A for 1988 or 3.07 tons/A for 1989. LSD (0.05) for comparing any two hybrid means = 4.55 tons/A for 1988 or 1.94 tons/A for 1989.

†Long-season corn = Pioneer 3165; short-season corn = Pioneer 3475; long-season sorghum = DeKalb-Pfizer FS-25e; short-season sorghum = DeKalb-Pfizer FS-5.

Yields of long- and short-season corn were reduced significantly in 1989 when planted at a soil temperature of 65 °F compared with planting at 60 °F. The same effect occurred for long-season corn in 1988, but the reduction was not statistically significant. It is unlikely that small differences in total water received (less than 1.5 in.) could account for such large decreases in yield. Planting long- or short-season corn at 50 °F soil temperature did not significantly reduce yields either year. Yield of long-season corn planted at different soil temperatures in 1988 did not differ.

Sorghum yield response to planting date depended on hybrid. Yields of short-season sorghum were not reduced by planting at a soil temperature of 50 °F either year. Long-season sorghum yield, however, increased dramatically each year when planting was delayed until soil temperature reached 65 °F. This increase was apparently not due to moisture differences (Table 1).

Days for corn to reach dent stage decreased as planting date was delayed. When planted at a 50 °F soil temperature (mid-March), long-season corn matured in 118 days, but when planted at 75 °F, it matured in 88 days. Short-season corn planted at 50 and 75 °F reached dent at 108 and 80 days, respectively.

Short-season sorghum also required fewer days to maturity as planting date was delayed: 124 days when planted at 50 °F and 88 days at 75 °F. Long-season sorghum matured in 127 days when planted at a 50 °F soil temperature, 108 days when planted at 60 °F, and 124 days when planted at 70 °F. Factors such as amount and timing of rainfall, differing day lengths, and intensity of solar radiation probably contributed to differences in time to reach maturity.

These data indicate that corn may be planted when soil temperature reaches and remains above 50 °F, or about mid-March in north central Texas, without sacrificing yield. Corn may be planted as late as mid-April; however, rainfall is normally low the last half of June and in July, increasing the chance of stress during pollination. Sorghum should be planted when soil temperature reaches and remains above 65 °F (about mid-April) and may be planted as late as mid-May to June 1.