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Grain Sorghum Response to Planting Date

Shawn P. Conley and **William J. Wiebold,** Department of Agronomy, University of Missouri, Columbia 65211

Corresponding author: William J. Wiebold. wieboldw@missouri.edu

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Abstract

Determining an optimal planting date for grain sorghum [*Sorghum bicolor* (L.) Moench] is critical to maximize yield and economics of production. Therefore, research was conducted to quantify the response of grain sorghum yield to planting date and hybrid maturity and to develop an optimal planting date window for Missouri growers. Six grain sorghum hybrids were planted on five dates in 1992 and 1994 and four dates in 1993. Two hybrids were selected from each of three maturity classes (early, medium, and late) based on production conditions in central Missouri. The experimental design was a randomized complete block in a split-plot arrangement with four replications. The main plots were planting dates and the sub-plots were hybrids. Results indicate that planting date had a small but inconsistent effect on grain sorghum yield. The effects on yield of planting earlier or later than mid-May were small and inconsistent among years, and we believe a rather wide planting date window exists for grain sorghum production in Missouri. We found no evidence that Missouri growers should switch to early-maturing hybrids if planting is delayed into mid-June.

The optimal temperature for grain sorghum [*Sorghum bicolor* (L.) Moench] seed germination is 86°F. However, adverse weather may mandate planting into an unfavorable soil environment which may lead to poor stand establishment or replanting (4,6). Planting may be delayed long enough that choosing an early-maturity hybrid may be warranted. Therefore, it is critical to quantify the effect of planting date and hybrid maturity on grain sorghum yield in order to maximize economic return.

Several studies have assessed grain sorghum yield response to planting date and hybrid maturity in dry-land production systems (1,2,3,5,7). However, some inconsistency in conclusions has been reported. M'Khaitir and Vanderlip (8) reported that planting date had no consistent effect on grain sorghum yield in a study conducted in Kansas. Martin and Vanderlip (7) also conducted research in Kansas, but found an optimal planting period for consistent grain sorghum yield of 25 May to 5 June. Francis et al. (3) reported that across several hybrids, grain sorghum yield in Nebraska was consistently 8% greater, when planted in early- to mid-May versus early to mid-June.

Research conducted in Arkansas resulted in a greater grain sorghum yield response to planting date (2,5). Bryant et al. (2) reported that grain sorghum yield decreased 22% on 19 March, 25% on 20 May, and 49% on 21 June compared to a 19 April planting date. Similarly, Johnson et al. (5) reported that grain sorghum yield decreased in the early June and July planting dates by 25% and 65%, respectively, versus early May and April planting dates.

Few experiments have studied the possible interaction between grain sorghum yield and hybrid maturity. Martin and Vanderlip (7) reported that, except for extreme planting dates (April or July), hybrid maturity did not affect yield.

The variability in yield response to planting date and environment indicates that additional research is required to develop recommendations for Missouri production systems. The objectives of this experiment were to quantify the response of grain sorghum yield to planting date and hybrid maturity and to determine if an optimal planting date exists for Missouri growers.

Grain Sorghum Hybrids

Six grain sorghum hybrids were planted on five dates in 1992 and 1994 and four dates in 1993. Two hybrids were selected from each of three maturity

classes based on production conditions in central Missouri. Early-season hybrids (60 days to 50% anthesis) were Dekalb brand 28E and Pioneer brand 8855. Mid-season hybrids (65 days to 50% anthesis) were Asgrow brand Seneca and Golden Harvest brand H388W. Late-season hybrids (70 days to 50% anthesis) were Asgrow brand Topaz and Pioneer brand 8379. Planting dates varied among years and are listed in Tables 1, 2, and 3. The treatment design was a split plot with whole plots arranged in a randomized complete block and replicated four times. Planting dates were the whole plots and the six hybrids were the split plots.

Table 1. Flowering dates for six grain sorghum hybrids planted on five dates in 1992.

	Planting date					
Hybrid	**14 April**	**28 April**	**18 May**	**2 June**	**16 June**	**Mean†**
28E	6 July	10 July	22 July	1 August	13 August	23 July b
8855	6 July	9 July	23 July	30 July	14 August	22 July a
Seneca	13 July	16 July	28 July	9 August	19 August	29 July c
H388W	12 July	16 July	29 July	9 August	18 August	29 July c
Topaz	21 July	21 July	4 August	13 August	23 August	4 August e
8379	18 July	19 July	31 July	9 August	20 August	31 July d
Mean†	12 July a	15 July b	28 July c	6 August d	18 August e	

† Means within a column or row followed by the same letter are different (LSD = 0.05).

Table 2. Flowering dates for six grain sorghum hybrids planted on four dates in 1993.

	Planting date				
Hybrid	**30 April**	**15 May**	**25 May**	**2 June**	**Mean†**
28E	14 July	20 July	22 July	2 August	21 July a
8855	13 July	20 July	23 July	1 August	22 July a
Seneca	21 July	24 July	28 July	9 August	28 July b
H388W	18 July	25 July	29 July	9 August	27 July b
Topaz	25 July	28 July	30 July	10 August	31 July c
8379	20 July	25 July	30 July	8 August	28 July b
Mean†	18 July a	24 July b	27 July c	6 August d	

† Means within a column or row followed by the same letter are different (LSD = 0.05).

Table 3. Flowering dates for six grain sorghum hybrids planted on five dates in 1994.

	Planting date					
Hybrid	**20 April**	**5 May**	**20 May**	**7 June**	**21 June**	**Mean†**
28E	8 July	11 July	17 July	2 August	12 August	22 July a
8855	9 July	9 July	16 July	3 August	13 August	22 July a
Seneca	14 July	17 July	24 July	9 August	17 August	29 July b
H388W	14 July	18 July	25 July	9 August	19 August	29 July b
Topaz	21 July	21 July	29 July	12 August	23 August	2 August d
8379	16 July	18 July	26 July	10 August	21 August	30 July c
Mean†	14 July a	16 July b	23 July c	7 August d	17 August e	

† Means within a column or row followed by the same letter are different (LSD = 0.05).

The experiment was planted on a Mexico silt loam soil at the Bradford Research and Extension Center near Columbia, Missouri. In 1992, the plot area was chisel plowed and field cultivated in spring. Plots were planted without tillage in 1993 and 1994. The previous crop was soybean [*Glycine max* (L.)

Merr.] for all three years. Seeding rate was 100,000 seeds per acre. Plots were four rows wide and 25 feet long. Inter-row spacing was 30 inches.

Weed control was accomplished with preemergence application of ramrod and atrazine. Prior to planting, 200 pounds of nitrogen as ammonium nitrate were surface applied. Phosphorus and potassium were applied according to soil test recommendations provided by the University of Missouri Soil and Plant Testing Laboratory.

The date of 50% flowering was recorded for all plots. A net was placed over all four rows of each plot shortly after flowering to reduce damage from bird feeding. At maturity, plots were end-trimmed to a length of 20 feet and the center two rows harvested with a plot combine. Yield was corrected to 15% moisture.

Yield Response to Planting Date

The six hybrids exhibited flowering dates similar to what we predicted except 8379, which was several days earlier than expected (Tables 1, 2, 3). The range from earliest to latest flowering hybrid did not change much among May and June planting dates; however the spread was greater for the April planting dates. The number of days between planting and flowering decreased as planting was delayed. On average, the six hybrids planted in April required more than 80 days, whereas hybrids planted in June required less than 65 days. This effect probably resulted from slower emergence and less rapid accumulation of heat units for early planting dates. These results agree with Martin and Vanderlip (7).

Hybrids flowered in mid-July when planted in April and in August when planted in June. August tends to be drier than July, but the last two weeks of July are typically the hottest weeks of the year. Regardless of planting date, all six hybrids matured before first frost.

In 1992, yield averaged over all hybrids was highest for the 18 May planting date and lowest for the 14 April planting date, however there was a hybrid by planting date interaction (Table 4). Yield for the two early-season hybrids followed this trend, but there were no differences among planting dates for yield of the two mid-season hybrids. The lowest yield for the two late-season hybrids occurred on the 16 June planting date. This suggests that cool temperatures may have limited grain filling and may have decreased test weight late in the season (7).

Table 4. Yield for six grain sorghum hybrids planted on five dates in 1992.

Hybrid	Planting date					Mean
	14 April	28 April	18 May	2 June	16 June	
	(bushels/acre)					
28E	69†	94	126	112	96	99b‡
8855	69	75	122	119	105	98b
Seneca	125	126	136	117	129	127a
H388W	114	128	132	123	123	124a
Topaz	127	149	137	134	105	130a
8379	135	131	151	115	119	130a
Mean	106c	117b	134a	120b	113b	

† LSD(0.05) to compare planting date means within a hybrid is 24.1 bushels/acre.

‡ Means within a column or row followed by the same letter are different (LSD = 0.05).

In 1993, the lowest yield occurred on the latest planting date (Table 5). The weather in 1993 was extremely wet and these conditions affected plant growth, nitrogen availability, and weed control. These effects were maximized for the last planting date. There was no planting date by hybrid interaction in 1993.

Table 5. Yield for six grain sorghum hybrids planted on four dates in 1993.

Hybrid	Planting date				Mean
	30 April	15 May	25 May	2 June	
	(bushels/acre)				
28E	56†	59	77	64	64b‡
8855	52	63	85	54	64b
Seneca	80	84	98	80	86a
H388W	91	74	90	80	84a
Topaz	89	94	103	79	91a
8379	82	87	105	78	88a
Mean	75ab	77ab	93a	72b	

† LSD(0.05) to compare planting date means within a hybrid is 18.3 bushels/acre.
‡ Means within a column or row followed by the same letter are different (LSD = 0.05).

In 1994, planting dates did not differ for yield, but there was a significant planting date by hybrid interaction (Table 6). Lowest yield for the early-season hybrids occurred on the 20 April planting date. Low yields were recorded for the 20 May planting date of the mid-season hybrids. It is not obvious why this occurred. Of the two late-season hybrids, Topaz yield was unaffected by planting date and 8379 exhibited its highest yield on the 7 June planting date.

Hybrids differed for yield in all three years. In each year, the early-season hybrids were often lower yielding than the mid- or late-season hybrids. There was never a yield advantage to planting early-season hybrids even on our latest planting dates.

Table 6. Yield for six grain sorghum hybrids planted on five dates in 1994.

Hybrid	Planting date					Mean
	20 April	5 May	20 May	7 June	21 June	
	(bushels/acre)					
28E	96†	102	120	110	118	109c‡
8855	70	90	102	94	107	93d
Seneca	112	125	107	126	110	116abc
H388W	106	117	104	121	119	113bc
Topaz	116	117	116	127	117	119ab
8379	111	119	123	131	125	122a
Mean	102a	112a	112a	118a	116a	

† LSD(0.05) to compare planting date means within a hybrid is 16.3 bushels/acre.
‡ Means within a column or row followed by the same letter are different (LSD 0.05).

We conclude that planting date has a small effect on grain sorghum yield. Planting dates differed for yield in two of the three years and for those two years the best planting date appears to be in mid-May. However, the effects of planting earlier or later than mid-May on yield were small and inconsistent among years, and we believe a rather wide planting date window exists for grain sorghum production in Missouri. We found no evidence that Missouri growers should switch to early maturing hybrids if planting is delayed into mid-June.

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Literature Cited

1. Allen, R. R., and Musick, J. T. 1993. Planting date, water management, and maturity length relations for irrigated grain sorghum. Trans. ASAE. 36:1123-1129.
2. Bryant, H. H., Touchton, J. T., and Moore, D. P. 1986. Narrow rows and early planting produce top grain sorghum yields. Highlights Agric. Res. Al., Ag. Exp. Sta. 33:5.
3. Francis, C. A., Moomaw, R. S., Rajewski, J. F., and Saeed, M. 1986. Grain sorghum hybrid interactions with tillage system and planting dates. Crop Sci. 26:191-193.
4. Heiniger, R. W., Vanderlip, R. L., and Welch, S. M. 1997. Developing guidelines for replanting grain sorghum: I. validation and sensitivity analysis of the SORKAM sorghum growth model. Agron. J. 89:75-83.
5. Johnson, W. C., Williams, E. D., Touchton, J. T., Eason, J. T., and Ruf, M. E. 1984. Planting dates and plant population affect grain sorghum production. Highlights Agric. Res. Al., Ag. Exp. Sta. 31:8.
6. Larson, E. J., and Vanderlip, R. L. 1994. Grain sorghum yield response to nonuniform stand reductions. Agron. J. 86:475-477.
7. Martin, V. L., and Vanderlip, R. L. 1997. Sorghum hybrid selection and planting management under moisture limiting conditions. J. Prod. Agric. 10:157-163.
8. M'Khaitir, Y. O., and Vanderlip, R. L. 1992. Grain sorghum and pearl millet response to date and rate of planting. Agron. J. 84:579-582.