

Environmental Effect on Some Local Grain Sorghum (*Sorghum bicolor*) Cultivars Production Grown in Central Region of Saudi Arabia

Yahya A. Refay

*Department of Plant Production, College of Agriculture, King Saud University,
P.O. Box 2460, Riyadh 11451, Saudi Arabia*

Abstract. A field experiment was conducted at Deirab Agricultural Experiment Station, King Saud University, in the 1990 and 1991 summer growing seasons to evaluate the effect of four planting dates (April 1, 15, May 1 and 15) on grain yield, yield components, and some other agronomic characteristics of three local grain sorghum cultivars (Shahla, White, Red grains).

Planting on April 1, 15 and May 1 produced significantly higher increases in the local sorghum cultivars grain yield. These increases in grain yield might be due to the significant increases in head weight, 500-grain weight, and the nonsignificantly slight increase in tiller number. The Shahla and White Grain sorghum cultivars, beside planting on April 15, took a longer time to reach about 50% bloom. White local grain sorghum and April 1 planting date produced the tallest plants. The highest total dry forage weight was obtained from White and Red Local Grain sorghum cultivars and planting on May 15, suited seed production in the Central Region of Saudi Arabia.

Introduction

Grain sorghum (*Sorghum bicolor* Moench) ranks fifth in acreage production among the world cereals after wheat, rice, corn and barley [1, p 327-385]. Efforts should be made to increase the yield potential and improve the quality of grain by overcoming factors that have major negative effects on its growth and development. Planting date is considered one of the most influential factors that control grain yield and other agronomic characteristics of grain sorghum crop. The effect of planting dates on growth and development of grain sorghum was found to be associated with response to photoperiod and temperature [2-4]. Planting crops in a proper date was found to promote the grain sorghum yield through an increase in tillering [5]. Mirhadi *et al.* [6] attributed the increase in the grain sorghum yield from May plan-

ting date to the increase in plant height, panicle length, leaf number per plant and number of grains per panicle. Alessi and Power [7] obtained a reduction in grain yield of corn when the planting date was delayed from May 17 to June 28. There is a lack of information on grain sorghum production in Saudi Arabia and, particularly, in the Central Region.

This study was an attempt to initiate an investigation of the local grain sorghum cultivars productivity sown on different planting dates, in the Central Region at Riyadh, Saudi Arabia.

Materials and Methods

This study was carried out during the summer seasons of 1990 and 1991 on a loamy sand soil at the Agricultural Experiment Station of King Saud University, College of Agriculture, at Deirab, near Riyadh [24° N, 46° E]. The soil of this location had a pH of 7.6 and low levels of N and P. Three local grain sorghum cultivars (Shahla- pale white-, Red and White) were obtained from the South Region of Saudi Arabia (Gizan). These cultivars were sown on four planting dates; April 1 and 15, May 1 and 15. The P fertilizer (Ca superphosphate 15.5% P₂O₅) was applied during seedbed preparation at the rate of 200 kg N/ha in three equal splits; at planting, one month after planting, and one week before bloom. Flood irrigation was used every 3-5 days. The experimental design was randomized complete block (RCBD) with four replications. This study contained 48 experimental units (3 cultivars × 4 planting dates × 4 replicates). Each experimental unit was 2.7 meters wide and 4 meters long with four rows. All recorded data were statistically analyzed by using the analysis of variance and the L.S.D. test of significance [8, p. 84-107]. Recorded data during the two seasons were the number of days to 50% bloom, plant height (cm), number of tillers per m², total dry forage weight (t/ha), heads weight (g), grain yield (t/ha), and 500-grain weight (g). The total dry forage weight included the whole plant (the main stem plus tillers) in 1990 growing season, whereas in 1991 growing season, only the main stem was included.

The results were presented to indicate the effect of planting date on the mean values of the three cultivars used, whereas the mean values of the four planting dates for each cultivar were compared with those of the other cultivars.

Results and Discussion

The means of days to 50% bloom, plant height, number of tillers, total dry forage weight, head weight, grain yield, and 500-grain weight are presented in the Table.

Table 1. Effect of planting dates and local grain sorghum cultivars on some agronomic characteristics*

Factors	BD	PH	TE	DW	HW	GY	500-GW
1990							
(First season)							
1- Planting dates							
April 1	59.22 b	265.3	21.44	16.82 c	4.140 ab	2.652 a	15.10 a
" 15	63.22 a	266.9	20.78	20.33 b	3.614 bc	2.699 a	15.29 a
May 1	56.33 c	261.3	19.89	18.49 bc	4.922 a	3.352 a	15.92 a
" 15	59.44 b	271.7	18.33	30.61 a	3.185 c	1.559 b	13.42 b
LSD (.05)	1.01	NS	NS	3.31	0.832	0.787	1.28
2- Cultivars							
Shahla Sorghum	61.33 a	268.9	19.67	21.14	3.370 b	2.366	15.02 b
White Sorghum	60.09 b	263.6	20.92	21.46	4.210 a	2.745	13.72 c
Red Sorghum	57.25 c	266.5	19.75	22.14	3.370 a	2.366	16.08 a
LSD (.05)	0.88	NS	NS	NS	0.720	NS	0.98
1991							
(Second season)							
1- Planting dates							
April 1	58.89 c	218.0 c	25.89 a	5.32	2.161	1.713	16.78 a
" 15	62.44 a	231.7 b	22.11 b	7.40	2.221	1.421	15.88 b
May 1	58.33 d	248.4 a	19.44 c	5.84	2.276	1.493	15.99 b
" 15	60.22 b	235.0 b	12.89 d	7.49	2.192	1.403	13.89 c
LSD (.05)	0.40	9.6	2.01	NS	NS	NS	0.43
2- Cultivars							
Shahla Sorghum	60.25 b	226.6 b	20.00 b	4.17 b	2.137	1.453	15.52 b
White Sorghum	60.92 a	241.7 a	22.42 a	8.28 a	2.188	1.463	14.33 c
Red Sorghum	58.75 c	231.6 b	17.33 c	7.09 a	2.313	1.607	17.06 a
LSD (.05)	0.34	8.5	1.74	2.17	NS	NS	0.37

* = Means followed by the same letters are not significantly different at P = .05.

NS = Not significant;

BD = Days to 50% bloom

TE = Total dry forage weight (t/ha);

PH = Plant height (cm);

500-GW = 500-grain weight (g).

HW = Head weight (t/ha);

GY = Grain yield (t/ha);

A) Grain yield and yield components

The significant effect of planting dates on the local sorghum cultivars grain yield was found only in 1990 growing season. The local grain sorghum cultivars did not significantly differ in the grain yield and its mean values ranged approximately between 2.4 to 2.7 t/ha,. The results of 1990 growing season showed that planting on April 1 and 15 and May 1 produced significant increases in grain sorghum yield over May 15 planting date. In the meantime, planting on May 1 nonsignificantly outyielded April dates by about 0.680 t/ha. In 1991, the results showed the same trend, but were not significant. Also, the magnitude of mean values was lower in 1991 than in 1990.

Head weight was significantly influenced by both planting dates and cultivars only in 1990. Hence, planting on April 1 and May 1 produced significantly heavier heads than the last planting date in 1990 growing season. However, planting on either April 15 or May 15 produced nearly the same head weight. Moreover, the head weight of Red and White grain sorghum cultivars was significantly heavier than that of Shahla cultivar in 1990. Again, the mean head weight values were higher in 1990 than in 1991.

Results of 1990 also indicated that there were no significant differences in number of tillers due either to the time of sowing or the local grain sorghum cultivars, although the results showed insignificant increases in tiller number in the cases of planting on April 1, 15 and May 1 over May 15. On the other hand, 1991 results indicated that white grain sorghum cultivar had significantly more tiller number (22-42) than the other cultivars (20.00 and 17.33). The highest significant tiller number was found in plants sown on April 1 (25.89), followed by April 15 (22.11), May 1 (19.44) and 15 May (12.89). The results also indicates that both planting dates and cultivars significantly affected the 500-grain weight in the two seasons. Accordingly, the heaviest grains (500-grain weight) of sorghum cultivars were obtained from the Red grain sorghum cultivar, followed by Shahla, and White grain sorghum cultivars in both seasons. Moreover, sorghums, that were sown on April 1 and 15 and May 1, produced significantly heavier grains than those planted on May 15 in the two seasons. However, the 500-grain weight of April 1 planting was significantly higher than that of April 15 and May 1 in 1991 growing season.

The above results and the other previous studies [6,9 and 10] indicated that planting dates could have different effects on grain sorghum yield and its components because of different genotypes that had been used in those studies and the different environmental conditions that existed during the time of each study. The relationship between grain yield and its components had been studied by many researchers. Refay [11] attributed the higher grain yield of grain sorghum resulted from planting

in early May, to the higher number of tillers. Blum [12] found an increase in grain sorghum yield from early planting (March 20-24) through increased tiller number and 1000-grain weight. In the present study, it appears that the contributing components to the significantly increased grain sorghum yield were mainly the 500-grain weight, head weight and, to some extent, the insignificant increase in tiller number of grain sorghum cultivars that were grown on the first three planting dates of 1990 season. In 1991 season, however, only the higher 500-grain weight and tiller number in these first three dates cause a nonsignificant increase of grain sorghum yield. This might be ascribed to the different environmental conditions in the two seasons.

B) Other agronomic characteristics

The 1990 and 1991 results showed that both planting dates and local grain sorghum cultivars had significant effects on the number of days to about 50% bloom. The Shahla and White grain sorghum cultivars took a longer time (about 60-61 days) to reach 50% bloom than the Red grain sorghum cultivar (about 57-59 days) in the two growing seasons. These differences might suggest an instability in the rate of physiological plant development among the studies cultivars.

In 1990 growing season, there were about four and three days increase in the time to bloom for Shahla and White over Red grain sorghum cultivars, respectively. Furthermore, the results of the second season showed that the differences in time of bloom of Shahla and White compared to Red grain sorghum, were 1.5 and 2.2 days, respectively. The table also reveals that planting grain sorghum cultivars on April 15 in 1990 and 1991 increased the number of days to 50% bloom, while planting on May 1 enhanced blooming. The previous studies of Ben Hummouda [13], Voight *et al.* [14], and Pauli *et al.* [15] indicated that, as the time of planting grain sorghum was delayed from the optimal date, the number of days to approach 50% bloom decreased. Sastry *et al.* [5] attributed the decrease in the number of days till panicle initiation, as the time of planting advanced from January to May, to the increase in temperature and decrease in bright sunshine hours per day. However, the present results did not agree with the previous studies and showed a fluctuating response of grain sorghum cultivar bloom to planting dates, which might be due to the fluctuating temperature and bright sun shine hours per day in each season.

The overall means of planting dates and local cultivars of grain sorghum grown in 1990 season did not significantly influence the plant height, whereas in 1991, both planting dates and local grain sorghum cultivars caused a significant effect on the same parameter. According to the 1991 results, White grain sorghum cultivar was significantly taller than the other local cultivars. It is also indicated that planting on May 1 in 1991 produced the tallest significant plants, followed by May 15, April 15

and April 1 in a descending order. These findings revealed that the greatest plant height might not be associated with early planting and it can occur at any planting date if favorable conditions exist. In this respect, Voigt *et al.* [14] planted grain sorghum in May (early planting) to August (late planting). They obtained the tallest plants from sowing on June 1, neither on early (May) nor late (August) planting.

No significant differences in total dry forage weight were observed among either the local grain sorghum cultivars in 1990 or the planting dates in 1991. On the other hand, considerable differences in total dry forage weight were obtained among the local cultivars in 1991 and the planting dates in 1990. White and Red local grain sorghum cultivars had significantly heavier total dry forage weights than the Shahla cultivar in 1991. Their respective mean values being 8.28, 7.09 and 4.17 t/ha. The maximum significant production of dry forage in 1990 was obtained from the sorghum plants that were sown on May 15 (30.61 t/ha) followed by April 15 (20.33 t/ha), May 1 (18.49 t/ha) and April 1 (16.82 g). In 1991, however, a similar insignificant trend was obtained. Thus suggested that the proper planting date for a high dry forage production of the local grain sorghum cultivars under this study could be May 15. For an increased sorghum grain yield production, one of the first three planting dates might be suitable.

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تأثير الظروف البيئية على إنتاج ثلاثة أصناف محلية من الذرة الرفيعة المزروعة في المنطقة الوسطى من المملكة العربية السعودية

يحيى علي رفاعي

قسم الإنتاج النباتي، كلية الزراعة، جامعة الملك سعود

الرياض، المملكة العربية السعودية

ملخص البحث . أجريت هذه التجربة في محطة التجارب الزراعية بكلية الزراعة - جامعة الملك سعود، خلال موسمي ١٩٩٠م، ١٩٩١م لتقويم تأثير أربعة مواعيد زراعية ١ إبريل، ١٥ إبريل، ١ مايو، ١٥ مايو على الإنتاج وعناصر الإنتاج، وبعض الصفات المحصولية لثلاثة أصناف محلية من الذرة الرفيعة (شهلاء، بيضاء، حمراء). ودلت نتائج التجربة على أن الزراعة في ١ إبريل و ١٥ و ١ مايو، زادت في الإنتاج، كما أسهمت عناصر الإنتاج التالية: وزن الرؤوس ووزن ٥٠٠ حبة والزيادة البسيطة غير المعنوية في عدد الخلفات في تلك الزيادة. ولقد أوضحت نتائج التجربة أن الصنفين شهلاء وحمراء والزراعة في ١٥ إبريل أخذت وقتاً أطول للوصول إلى ٥٠٪ من التزهير. وتشير أيضاً نتائج الدراسة إلى أنه في الوقت الذي أعطى فيه الصنف بيضاء والزراعة في ١ إبريل نباتات أطول، نجد أن الصنفين بيضاء وحمراء والزراعة في ١٥ مايو أعطت أعلى إنتاج من المادة الجافة. كما اتضح أن الزراعة المبكرة بوجه عام أعطت محصولاً عالياً من الحبوب.