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Grain Sorghum Production in the Texas Rolling Plains

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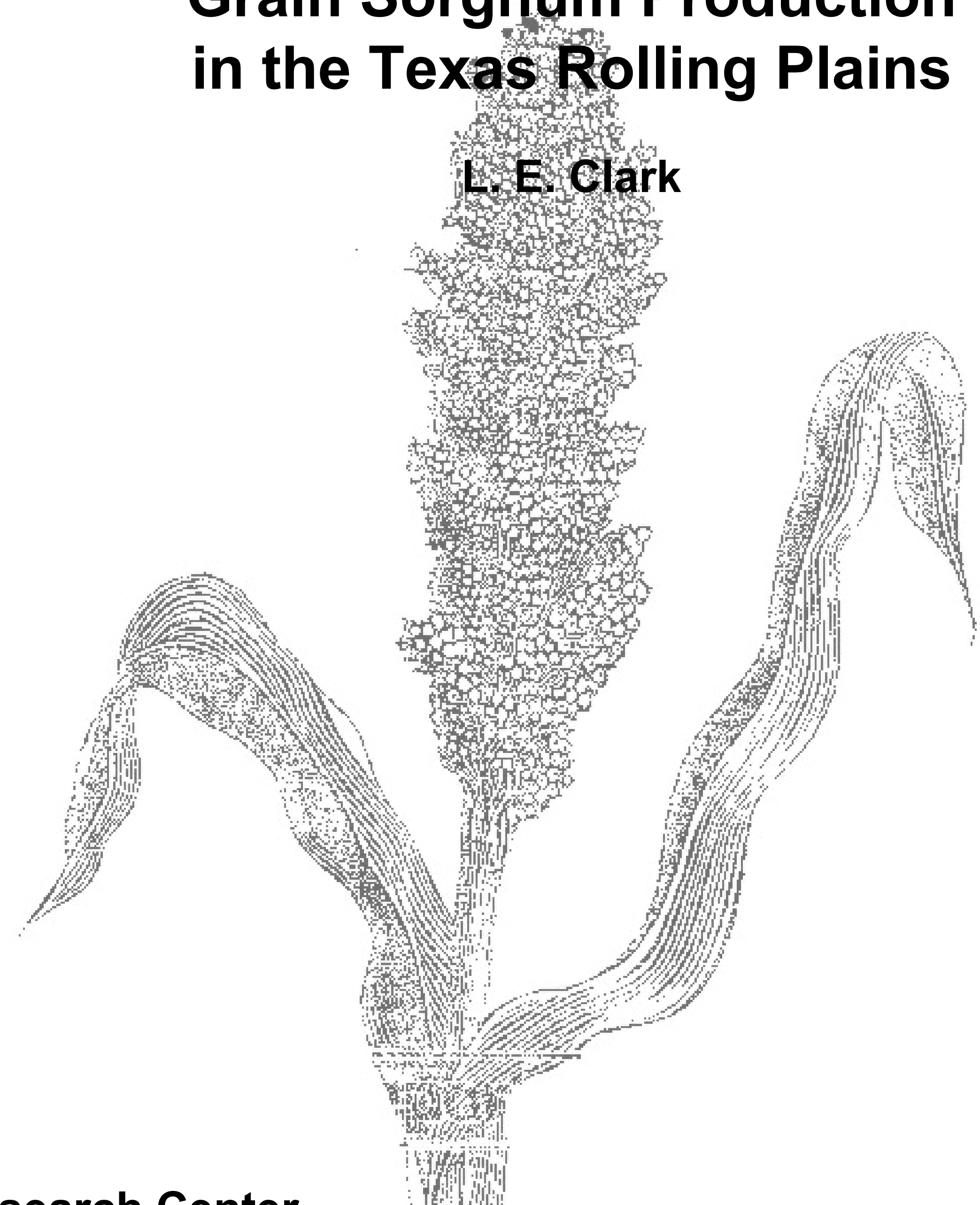

Research Center

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GRAIN SORGHUM PRODUCTION IN THE TEXAS ROLLING PLAINS

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Interest in grain sorghum production has increased recently in response to changes in farm legislation and to favorable grain prices. The following guidelines are prepared in anticipation of questions from farmers in the Texas Rolling Plains who may not be accustomed to growing grain sorghum. These comments are directed primarily to dryland production of grain sorghum in the Rolling Plains, but many apply equally to irrigated production. Recommendations in this presentation may not apply to production in other areas of the state or nation. Additional information is available in Profitable Grain Sorghum Production in the Rolling Plains. Bulletin B-1577. Texas Agric. Ext. Service.

Planting Dates

Sorghum can be planted from early April through early July; however, it should be planted either in early or late plantings, instead of in mid-season (May or early June). Sorghum should be planted during a period from about April 1 through April 20, or from June 20 through the first week in July. These comments are supported by data from several studies conducted from 1978 through 1993.

There has been a significant advantage for late over early plantings in tests conducted at Chillicothe over a period of four years (Table 1). Mid-season plantings can sometimes produce higher yields than early plantings, but rarely, if ever, produce higher yields than late plantings at Chillicothe. Planting sorghum in sequential plantings over a large area creates a “midge nursery effect" by providing a continuum of flowering sorghum on which midge can increase to highly damaging numbers that can destroy later plantings. A break of five to six weeks in the flowering period from late April through mid-June can reduce the buildup of midge that can otherwise be devastating to late sorghum plantings.

Data from tests planted in 1978-1982 at Chillcothe show a significant advantage to late plantings (Table 1). Mean yield of late June or early July plantings (3693 lbs per acres) was more than double the mean yield of all earlier plantings (1764 lbs per acre).

Table 1. Grain yields of sorghum from different planting dates and years at Chillicothe.

Year of study	Planting date	Grain yield, lbs/acre of sorghum, dryland	Grain yeild, lbs/acre of sorghum, irrigated
1978	May 10	2100	
	July 6	4060	
1979	April 5	1190	1090
	May 15	1740	3400†
	June 28	3625	4115†
1980	June 3		2030‡
	June 27		3570‡
1982	April 6	1565	
	June 3	2085	
	June 30	3095	

† May 15 and June 28 dates received the same amount of water from irrigation
‡ June 3 and June 27 dates received the same amount of water from irrigation

Dryland tests were planted each year except 1980, when there was insufficient seedbed moisture to obtain a stand. Irrigated tests were planted in 1979 and 1980. Yield from the dryland test planted June 28, 1979 was higher than from either of the earlier irrigated plantings, and only about 12% (<500 lbs) lower than the yield from the irrigated test planted June 28. The low yield from the April 5 irrigated test resulted from failure to irrigate the test after early grain fill, and stress lodging caused significant loss of grain. The latter response is typical of a situation that could occur if a side-roll system were used for irrigating sorghum. When sorghum reaches its maximum height, a side-roll system will not traverse the sorghum, and thus it cannot be irrigated at a critical developmental stage of maximum water use.

In 1980, only the irrigated test produced a harvestable yield, and the late June planting yielded more than the early June planting. In 1981, only a dryland test was planted, and only the late June planting produced a harvestable yield (data not shown). In 1982 the late June planting produced more than the early April or early June plantings.

Subsequent tests were grown in 1991-1993 at the Chillicothe and Munday Stations. These were hybrid tests that consisted of 20 hybrids common to both locations and all years. Means of all 20 hybrids are presented for the six site-year tests in Table 2. Actual planting dates for each test designated as early or late are presented in Table 3.

Sorghum produced higher yields from late plantings in two of the three years at Chillicothe. In 1993 the early planting at Chillicothe produced a higher mean yield than the late planting. The late planting suffered from poor stands caused by management decisions that could have been avoided.

Response to planting dates at Munday was opposite to the usual trend at Chillicothe. Early plantings yielded more than late plantings all three years (Table 2). The reason(s) for the reversal in response to planting dates at the two locations is not readily apparent, nor is there a good definition of this reaction in terms of locations over the Rolling Plains area. However, it appears from these data that early plantings may be more appropriate for the area south and

Table 2. Mean grain yields of 20 sorghum hybrids grown under dryland conditions in early and late planted tests at Chillicothe and Munday in three years, 1991-1993.

		Location	
		Chillicothe	Munday
Year	Planting date	-----------------lbs grain per acre ------------------	
1994	Early	2594	5875
	Late	3740	2887
1992	Early	3226	5653
	Late	5125	4070
1993	Early	2994	3722
	Late	2509	2263

Table 3. Actual planting dates for early and late planted Chillicothe and Munday sorghum tests.

		Location	
		Chillicothe	Munday
Year	Planting date	-------------- planting date --------------	
1991	Early	4-30	4-11
	Late	6-27	6-27
1992	Early	4-9	4-9
	Late	7-7	6-23
1993	Early	4-12	4-9
	Late	6-24	6-25

perhaps east of Chillicothe, while late plantings the southern area and later in the northern area is reflected in planting activities during the 1970s through the 1990s, as shown in Texas Crop Statistics Reports for the period.

Sorghum Development In Relation to Planting Dates

Plant development from early plantings at Chillicothe may be delayed by low temperatures at planting time. Therefore, hybrids may be later than maturity classifications indicate, although relative maturity among hybrids probably will hold true. Relative maturity of hybrids also should hold true for late plantings, but in late plantings the maturity is hastened by higher temperatures prevailing during the growing season.

Relative maturity normally is measured by the number of days from planting to flowering (when about one-half the plants have begun flowering). In April plantings at Chillicothe, most hybrids classified as medium or medium-late will flower in about 75-85 days, depending on the planting date and temperatures prevailing in different years. In late June plantings at Chillicothe, this range usually will be from 50-60 days. The number of days to flowering may be shorter at Munday than at Chillicothe for early and late plantings. The reason for this is not clear, but the shorter time from planting to flowering may be a factor in causing early plantings do relatively better at Munday.

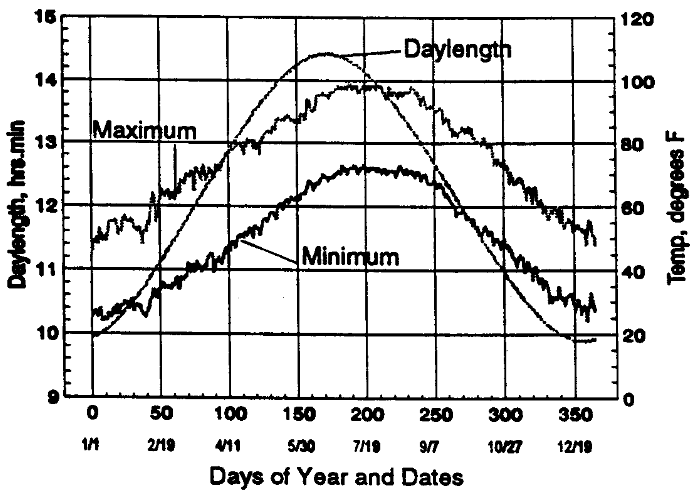
The time from flowering to maximum dry weight of the grain (physiological maturity), or maximum yield, is approximately 40-45 days after flowering, depending again on when sorghum is planted. In early plantings, this period may be reached in about 40 days, because high temperatures in late June and July hasten grain development. In late June plantings, the period may be extended because temperatures usually have begun to moderate during the flowering and grain development periods. Not only may temperatures moderate, but day length is significantly shorter in late August and September when sorghum grain from late plantings is developing. This makes the amount of heat accumulated less than in June and July when days are longest. The relationship between time of year, temperatures, and day length are shown in Fig. 1 below.

Mid-season plantings are not recommended because favorable temperature and rainfall during May and early June contribute to excessive vegetative growth. By the time flowering and grain development periods are reached, there is a large vegetative plant that has used an excessive amount of water with little reserve left in the soil for grain development. Early plantings tend to produce a similar situation, but the results are not always so pronounced as in mid-season plantings.

Land Preparation

An important consideration in successful sorghum production in the Texas Rolling Plains is being prepared for any situation that may occur. Timely land preparation often can make the difference in getting a crop planted and established, or failing to do so. Untimely land preparation can result in the seedbed being too dry, or too cloddy at planting time. Working the land when it is too wet can result in a cloddy seedbed in which seed will not be in contact with necessary moist soil for proper germination. Also, when soil is cloddy, the seedbed tends to dry out rapidly so that moisture that may have been present initially may be lost. Waiting too long to prepare a seedbed, until just before planting time for instance, can result in a dry seedbed, one that does not have an opportunity to be rewetted from rainfall that may be received in an untimely manner. Seedbeds should be prepared as early as possible in the growing season to avoid losing significant moisture by delayed plowing.

Fig. 1. Daily mean maximum and minimum temperatures from 1971-1995 at the Chillicothe Research Station, Hardeman County, Texas and day length at Wichita Falls, Texas.



Preparing the land for planting immediately after harvesting the previous crop is a good option for grain sorghum production. This can be done following a late June planting of sorghum, cotton, or other crop without shredding stalks. Stalks from an early sorghum crop will need to be destroyed with one, or probably more operations, or sprayed with a suitable chemical to prevent regrowth and subsequent depletion of soil moisture. If stalk destruction is not required, such as with late plantings, beds can be reestablished in the same location by running the furrows with lister sweeps or by plowing the beds with a disk bedder, either of which will leave many of the stalks standing. Leaving stalks standing from the previous crop, either sorghum, cotton, or other crop such as guar, can provide protection against wind erosion during the winter and early spring months. Weeds can be managed during the winter and spring with a pre- or postemergence herbicide. Stalks and volunteer sorghum can be managed prior to planting in the spring with a rodweeder.

If subsoiling and diking equipment is available, furrows can be subsoiled, diked, or both simultaneously immediately after the bedding operation. Subsoiling furrows, with or without diking, is a recommended practice that can enhance water infiltration and storage from rainfall received. This operation customarily has been performed with a parabolic shank subsoiler, but it can be done with any "big-ox' type implement with shanks spaced to run only in furrows between rows that are 36 to 40 inches wide. Restricting traffic to furrows avoids compacting the seedbed with vehicular traffic, and limiting the number of trips across the field can reduce soil compaction by vehicular traffic and reduce input costs (Table 4).

Grain production, production costs, and net returns from a four-year study are presented in Table 4. There was little mean yield advantage to the reduced tillage system over the four years of this study, but production costs were reduced, resulting in a significant increase in net returns. Cost advantages to the reduced tillage system over the conventional tillage system amounted to $15.73 per acre for the solid plantings and $18-56 for the skip-row plantings. About 1/3 of the cost savings were in variable costs and 2/3 in fixed costs. Gross returns were based on $5.14 per cwt. which was derived from loan price plus deficiency payments for years in which the study was conducted. Differences in yield, though not statistically significant between tillage systems, resulted in small differences in gross returns.

Table 4. Production costs and returns to land, management, and risk per acre for dyland grain sorghum grown in four tillage-row pattern systems at Chillicothe, 1984-1987.[†]

	Production systems[‡]			
Costs and returns	RT-Solid	RT-2 x 1	CT-Solid	CT-2 x 1
Mean yields, lbs/acre	3262 a[•]	2693 b	3216 a	2637 b
Gross returns, $/acre[§]	167.67 a	138.41 b	165.30 a	135.55 b
Variable costs, $/acre				
Fertilizer	16.97	16.97	16.97	16.97
Sorghum seed	1.80	1.20	1.80	1.20
Herbicide	4.74	4.74	3.79	3.79
Aerial application	3.50	3.50	3.50	3.50
Fuel and lube (machinery)	7.78	7.78	9.16	9.16
Repairs (machinery)	2.28	2.28	2.68	2.68
Labor (machinery)	8.19	8.19	12.37	12.37
Crop insurance	3.00	3.00	3.00	3.00
Total preharvest costs	48.26	47.66	53.27	52.67
Custom harvest	12.00	12.00	12.00	12.00
Custom haul	8.15	6.73	8.04	6.59
Total harvests costs	20.15	18.73	20.04	18.59
Total variable costs	68.41	66.39	73.31	71.26
Fixed costs, machinery &	35.60	35.60	46.43	46.43
Total production costs	104.01 c	101.99 d	119.74 a	117.69 b
Net returns, $/acre	63.65 a	36.42 c	45.56 b	17.86 d

• Means within rows joined by the same letter are not significantly different (LSD=0.05).

† From: Clark, L. E., and T. O. Knight. 1996. Grain production and economic returns from dryland sorghum inresponse to tillage systems and planting patterns in the semi-arid southwest USA. J. Prod. Agric. 9:249-256.

‡ RT, reduced tillage; CT,conventional tillage; Solid, contiguous rows; 2x1 skip-rows with two rows planted and one row skipped.

§ Gross returns calculated as: (mean yield/100) x ($4.14)/cwt. The price based on government loan rate plus deficiency payments for 1984-1987, was obtained from the Hardeman County CFSA Office.

An earlier study be Gerard, conducted over a five-year period, showed significant sorghum grain yield increases due to combinations of subsoiling an diking (Table 5). Subsoiling alone

Table 5. Mean grain yield response of dryland sorghum to combinations of subsoiling and diking furrows on an Abilene clay loam at Chillicothe, Texas, 1981 - 1985.

Tillage Treatments	Grain yield, lbs per acre†
Check, rerun beds only	1750
Rerun beds and subsoil furrows	1955
Rerun beds with alternate furrows diked	2250
Rerun beds with all furrows diked	2625
Rerun beds with all furrows subsoiled and diked	2625

† Data are five-year mean yields. Data adapted from: Gerard, C. J. 1987. Furrow Diking and Subsoiling Studies in the Rolling Plains. Texas Agric. Stn. Bull. B-1585.

Produced a five-year mean yield increase of 200 lbs per acre (11.7%) over the check. Diking alternate furrows produced an increase of 500 lbs per acre (28.6%), and diking all furrows produced a yield increase if more than 875 lbs per acre (50%) over the check. Subsoiling in combination with diking did not produce a further yield increase. Subsoiling and diking have produced a greater response in years with yields in the median range. Yield response to these tillage treatments has been minimal in years of high or low rainfall resulting in high or low yields. This was the case in the study reported in Table 4, in which there was no significant yield advantage in 1984 (< 2000 lbs per acre) and 1987 (> 5000 lbs per acre). There was a response to tillage systems in 1985 and 1986 when yields were between 2500 and 3500 lbs per acre.

Fertilization

Grain sorghum will always respond to a good fertility program. The best practice is to take soil samples and have them analyzed to provide a guide for proper fertilization. In the absence of information from soil analyses, and depending on the cropping and fertility history of the land, a reasonable fertility program for dryland grain sorghum is 50 lbs of N and 30 lbs of P_20_5 per acre for most soils. These are the fertilizer rates used in the above study, and the four-year mean yield of solid planted sorghum was more than 3200 lbs per acre. The 1987 yield in this study was over 5000 lbs per acre. Individual hybrid yields in nonirrigated hybrid yield tests over the past 20+ years have exceeded 6000 lbs per acre using the suggested fertility program when rainfall was adequate.

Fertilizer can be applied any time from land preparation through early plant development. The latter option depends on the availability of side-dress equipment. Application just prior to planting, if this does not cause significant soil moisture loss by excessively disturbing the soil, is a good practice. It reduces the risk of losing fertilizer elements, especially nitrogen, to the deep soil profile and possible groundwater contamination. Knifing fertilizer, either liquid or dry formulations, into the soil in bands on both sides of rows is a good practice where it is applicable. Broadcast application of fertilizer immediately prior to the last land preparation operation is an acceptable option. Liquid fertilizers can be applied only to the soil and should be incorporated in some manner. Liquid fertilizers applied to sorghum plants after they are established will burn and usually kill sorghum if the fertilizer is applied in concentrations to supply adequate levels of nutrients. They cannot be applied to established sorghum except in extremely low concentrations, such as through an irrigation system.

Plant Populations

A desirable plant population for dryland grain sorghum in the Rolling Plains is 30,000 to 40,000 plants per acre. This population can be obtained in several ways. The number of seed to plant to obtain the above plant populations depends on when planting is done and the conditions prevailing at planting time. Thus, different planting rates need to be considered for early vs late planting in the Rolling Plains. In early plantings (April) about 60% of high quality seed planted will produce plants. This accounts for seed that fail to produce a plant as a result of the following conditions: 1) cold (and possibly wet) soil conditions associated with low temperatures in April; 2) seedling diseases that may be present in cold, wet soils; 3) soil crusting following rainfall; 4) seed that are not in contact with moist soil for whatever reason; 5) non-viable seed.

Another consideration is that seed germinating 90%, for example, in laboratory tests do not usually have 90% emergence in the field. Laboratory tests that form the basis of germination percent on the seed tag do not measure seed vigor, and vigor plays a major role in the percentage of seed that emerge in the field and establish plants.

When planting is delayed until late June, emergence percent normally is higher than from early planting. In late plantings, about 75% of seed will establish plants in prevailing warm soil temperatures. Thus, a lower planting rate is required for late plantings.

Table 6. Suggested plant populations for sorghum production in the Rolling Plains.

Number of plants per acre†	Number plants per 10 row-feed for different row widths				
	40-inch	36-inch	30-inch	20-inch	16-inch
30,000	23	21	17	12	9
35,000	27	24	20	13	11
40,000	31	28	23	15	12

† Plant populations should be increased by 40 to 50% for irrigated sorghum.

Tables 7 and 8 present information on suggested planting rates and in-row spacing of seed to obtain a range of populations in different planting dates. Planting rates should be based on number of seed, and not weight of seed, because different hybrids have different size seed. It is important to avoid obtaining an excessive plant populations when soil moisture (rainfall) is limiting, as it is in dryland production in the Rolling Plains. Therefore, the plant populations and seeding rates to obtain those populations suggested in Tables 6-8 should be followed closely. If preplant rainfall has been limited, one of the lower planting rates is suggested. Conversely, if preplant rainfall has been favorable, a higher recommended rate is suggested.

The amount (weight) of seed to buy can be estimated from the above information. If the desired plant population is 35,000 plants per acre in an April planting, the number of seed to plant, assuming 60% of the seed planted produce plants, is 35,000/0.60 = 58,333 seed per acre. This is equivalent to about 4.5 lbs of seed per acre. For a June planting, assuming 75% of the seed produce plants, 35,000 plants per acre would require about 3.5 lbs of seed per acre (35,000/0.75 = 46,666 seed per acre). For purposes of calculations, I used 13,000 seed per lb. This ignores seed size differences, but it is adequate for seed purchases if information on seed

Table 7. Number of seed to plant to obtain populations indicated in Table 6 for April planting dates.

Number of plants per acre	Number of seed to plant per 10 row-feed for different row widths for April plantings				
	40-inch	36-inch	30-inch	20-inch	16-inch
30,000	38	34	29	19	15
35,000	45	40	33	22	18
40,000	51	46	38	26	20

Table 8. Number of seed to plant to obtain populations in Table 6 for June planting dates.

Number of plants per acre	Number of seed to plant per 10 row-feed for different row widths for June plantings				
	40-inch	36-inch	30-inch	20-inch	16-inch
30,000	31	28	23	15	12
35,000	36	32	27	18	14
40,000	41	37	31	20	16

size (number per lb) is not available. Most seed companies provide information on seed size that can help in determining the amount of seed to buy.

Selection of Hybrids

Some guidelines are offered for selection of hybrids to plant. A medium maturity hybrid probably would be desirable if an early planting date is selected. Medium or medium-late hybrids can be used in late plantings, because hybrids mature in a shorter time in late plantings, and medium-late hybrids clan be well tolerated. Hybrids classified as early (short-season) or late (full-season) usually are not desirable in the Rolling Plains. Early hybrids normally limit yield potential, and late hybrids, if selected, should be grown only under full irrigation. Planting date is less critical under irrigated conditions, but more water will be required in early plantings to achieve yields equal to those from late plantings.

If current data are available from sorghum hybrid tests in or near the area where plantings are to be made, these data will provide better information on local adaptation than will data from tests in remote areas. Data from hybrids tested in the chosen area for three to five years are more reliable than from a single year.

As suggested elsewhere, disease resistance is not an extremely important factor for this area, but most hybrids have a high level of inherent disease resistance. Insect resistance is an important consideration. Planting hybrids that are resistant to greenbugs can save control costs. Resistance to other insects is less readily available in most sorghum hybrids, although sorghum midge resistance is available and increasing in importance.

There is more than one biotype of greenbug that attacks sorghum. An early biotype is known as biotype "C", and some hybrids carry resistance to this biotype. The predominant type currently is biotype "E". An "E" at the end of the name or number of a hybrid indicates resistance to biotype "E" greenbugs. A new type, biotype "I" has been identified, and resistance to biotype C or E does not mean that the hybrid is resistant to biotype 1. Resistant hybrids are not immune to any biotype, so scouting for greenbugs is still important in making control decisions.

Lodging resistance is an important criterion in choosing a sorghum hybrid. There are four types of lodging: 1) root lodging, 2) stalk lodging or breaking, 3) weakneck lodging, 4) post freeze lodging. All types are important, but some become more important depending largely on planting date decisions. The four types are discussed below.

Root lodging, as the name indicates, results from weak root systems that allow plants to fall over. This type can occur in any planting situation, but is most commonly expressed under conditions of high rainfall and accompanying high winds when sorghum grain has developed and added significant weight to the top of plants. Many hybrids are resistant to root lodging.

Stalk lodging or collapse is identified by the stalk breaking, usually a few inches above ground level. It is further distinguished from root lodging by the observation that in stalk lodging the roots remain in position in the soil. Stalk lodging is a response to water stress (as discussed elsewhere) and can occur in sorghum planted at any date. The charcoal rot organism, (Macrophomina phaseolina (Tassi) Goid), which is associated with drought stress and high temperatures during the grain-filling period, may or may not be associated with stalk lodging in the Rolling Plains. Hybrids that have resistance to post-flowering (stress) lodging are suggested if water stress conditions are common. Such hybrids are identified as having a favorable "stay-green" rating, provided by some seed companies. </P

Weakneck lodging is identified by the breaking of plants about midway of the plant, at or near the highest node (joint) on the stalk. There is resistance to this type lodging; however, hybrids are seldom identified by seed companies as having resistance or susceptibility to weakneck.

Post freeze lodging is expressed as stalk breakage, and it may occur either close to ground level or near the top node like weakneck lodging. In the Rolling Plains, it occurs exclusively in late plantings when freezes occur prior to harvest. Some hybrids are resistant, but they are seldom identified as such by seed companies.

Hybrids with a good resistance rating to the conditions most likely to exist in a given production situation should be chosen for planting. Management decisions that affect conditions important in selecting hybrids include planting dates, planting patterns, plant populations, and water availability, including preseason rainfall and the availability and dependability of irrigation water.

Planting Patterns

The most reliable, uniform stands of sorghum for grain production can be obtained with row crop planters, although grain drills may be used. Row crop planters are more easily and accurately adjusted to obtain the desired planting rate to avoid planting an excess amount of seed. Row crop planters usually are used to plant in rows 30 to 40 inches apart, but grain drills may be used to plant in narrow rows, similarly to wheat. It is suggested that if grain drills are used, alternate seed outlets in the drill be stopped up to provide row spacings of no less than 16 or 20 inches. With the above recommended plant populations, planting in 8- or 1 0-inch row widths may result in plants being farther apart within the rows than between rows.

In wide rows, such as 40-inch rows, a skip-row planting pattern of two rows planted and one skipped (2 x 1 planting pattern) usually is not recommended in much of the Rolling Plains. Tests at Chillicothe in late plantings have shown that a 2xl skiprow pattern produced yields about equal to solid (contiguous or non-skip-rows) 40-inch rows only at low yield levels. It follows that skipping two or more rows, a practice used in some instances, probably is not beneficial.

Summary data from two of these studies are presented in Tables 9 and 10. Data in Table 9 represent test means of sorghum hybrids grown in solid and 2 x 1 skip-row tests for seven years. The seven-year mean is 14.5% higher for solid (3150 lbs per acre) than for the skip-row tests (2752 lbs per acre). Mean yield from the solid planting was lower in 1983, the lowest yield levels obtained during the seven-year period. Mean yield of the solid planting was higher at the higher yield levels except for 1985, in which mean yield from the solid planting was 2% less than from the skip-row. In 1985, stress lodging occurred during the late season. This was followed by continuing rainfall that caused sprouting and loss of grain from the lodged plants, so the potential yield was not realized.

In another study (Table 10) much the same response was obtained. Skip-row yielded more than the solid planting only in 1984 when yields were less than 2000 lbs per acre. Yield differences between the two planting patterns increased as yield levels increased to over 5000 lbs per acre.

Data from a third test done in 1984-85 (Table 11) shows the yield response to row patterns by hybrids with different levels of resistance to stress lodging. Yields are from combine harvesting (broadcast header), so grain from severely lodged plants was not harvested. Yields of two of the resistant hybrids were higher in solid plantings, while yields of susceptible hybrids were higher in the skip-row planting. The resistant hybrid, A35 x Tx2737, is very late in maturity at Chillicothe, so it did not have the ability to express its yield potential on the limited water available. Therefore, it responded more favorably to the skip-row planting.

Table 9. Mean dryland grain yields of hybrids in solid and skip row plantings at Chillicothe for the 7-yr period 1983-1989.†

Year	Planting Pattern	
	Solid	2 x 1 skip-row
	-------------------- lbs per acre --------------------	
1983	1429	1981
1984	2789	2527
1985	2978	3038
1986	4154	2971
1987	5196	3981
1988	3338	2941
1989	2163	1824
7-year mean	3150	2752

† The number of hybrids range from 26 to 39 in tests over the 7-year period. The same hybrids were grown in solid and skip row plantings within each year.

Table 10. Yield response of dryland grain sorghum to row patters in years 1984-1987.

Year	Grain yield, lbs/acre	
	Solid	skip-row
1984	1670	1740
1985	2750	2500
1986	3390	2575
1987	5150	3845
Mean	3240	2665

Table 11. Yield of five sorghum hybrids in reaction to stress lodging under dryland conditions in solid and skip-row plantings at Chillicothe, 1984-1985.

Hybrid	Reaction to stress lodging	Grain yield, lbs/acre†	
		Solid	Ski-row
A35*Tx430	resistant	2620	2185
A35*Tx2737	resistant	2340	2450
DK-46	resistant	2335	2005
ATx399*Tx430	susceptible	1590	2070
ATx623*Tx430	susceptible	960	1750

† Mean yields of hybrids from tests grown in 1984 and 985.

These data suggest that a solid planting pattern of 40-inch rows may produce higher yields when yield levels are from 2,500 to 5,000 lbs per acre. For the range between 2,000 and 2,500 lbs per acre of anticipated yield, the choice of solid or 2 x 1 skip-row planting probably is not a major consideration. When the soil profile is essentially full of water at planting, yields of more than 2,000 to 2500 lbs per acre should be anticipated. Within-row planting rates should be the same for solid and skip-row planting, because sorghum in skip-row patterns will tend to compensate by producing tillers in response to greater amounts of rainfall, especially if the rainfall is received early in the season. The tillers formed are basal tillers that have the potential to produce as much yield as the main stalk.

Skip-row planting may be beneficial, especially in early plantings, if water stress occurs during the flowering and grain development period and results in poor panicle (head) and grain development. If water stress occurs after early grain formation in a crop with a potentially high yield, stress lodging also may occur. Most seed companies advertise their hybrids that are intended for dryland production as being drought resistant, and some rate their hybrids for "stay-green", a term that indicates the hybrids carry resistance to stress lodging. Stress lodging almost always occurs after grain development has begun, and is more likely to occur in early than in late plantings. A 2xl skip row pattern may provide reserve soil moisture to reduce or prevent severe stress lodging, but in the absence of significant water stress, skip-row plantings may limit yield.

Weed Control

Crop rotations usually are the most effective means of controlling weeds, but rotations require advanced planning. A rotation with cotton probably is the best system to assist with weed control. Herbicides can be used effectively to control weeds in the alternate crop that cannot be readily controlled in the target crop.

Any productive soil in the Rolling Plains is suitable for sorghum production, but different soils present unique challenges for herbicide use in weed control. Regardless of soil type, land free of johnsongrass should be chosen for sorghum production because johnsongrass is a sorghum species; thus any herbicide that would kill johnsongrass would kill the sorghum crop.

Most of the soils are medium textured (clay loams) or coarse textured (fine sandy loams and loamy fine sands). Atrazine is not labeled for preemergence use on Rolling Plains soils. It can be used on clay loam soils, however, as a post emergence application on sorghum that is six inches tall or taller. In appropriate situations where other crops will not be harmed, 2,4-D (preferably the amine, which is less volatile than the ester) can be used for broad leaf weed control in sorghum without regard to soil type.

Sandy loams and loamy fine sands present more of a challenge with herbicides. Dual®, Lasso®, or Outlook®, which are more expensive than the previously mentioned herbicides, can be used at low rates (i.e. in bands over the seed row) if planting seed are treated with appropriate seed safeners. Seed safeners are applied to the seed by the seed company upon request. Either of the herbicides can be banded over the seed row to reduce costs compared with broadcast applications, with cultivation following later. Pendimethalin (Prowl®, etc.) and trifluralin (Treflan®, etc.) are registered for Rolling Plains soil types to be used as lay-by treatments. These can be used over-the-top of established sorghum plants, following banded applications of other materials, or other early season weed control measures. It is necessary to cultivate to cover root systems of sorghum prior to application of either material, and a following cultivation for incorporation is required. Labels must be read and label directions followed carefully with use of all agricultural chemicals.

The above discussion is not an exhaustive presentation of sorghum herbicides. Other herbicides and herbicide combinations are available, with more detailed information on availability and use of herbicides with sorghum in Suggestions for Weed Control in Sorghum, Bulletin B-5045, Texas Agric. Ext. Service. Information from other references also is available.

Harvest

Sorghum from early plantings in most years should be ready to harvest by or before mid-September. Grain dries down rapidly under warm temperatures in late August and September at Chillicothe. In late plantings, sorghum grain matures when temperatures have moderated significantly; thus, grain dries down more slowly than from early plantings. Sorghum from late plantings usually can be harvested before the first killing freeze, but if hybrids have a good stalk and resist postfreeze lodging, harvest can be done after significant freezes occur. If sorghum is planted by early July, a freeze is extremely unlikely to damage the grain.

Potential Production Hazards

The most significant yield-limiting factor for dryland sorghum production is rainfall. While the amount of rainfall cannot be controlled, production practices can partially overcome limited rainfall. These production practices include timely land preparation, timely planting, and attention to plant populations. These factors and other aspects of water enhancing and conserving practices are discussed above.

Diseases

Sorghum grown in the Rolling Plains is relatively free of significant disease problems. Stalk lodging (stalk breakage a few inches above the ground) when sorghum is approaching maturity may be associated with charcoal rot (a stalk rot disease). The most important factor contributing to stalk lodging is moisture stress. Stalk lodging is most likely to occur when growing conditions have been favorable for high yields and moisture becomes severely limiting when sorghum is approaching maturity. In addition to lodging, incomplete development of grain may occur. It can be a problem in irrigated sorghum that cannot be irrigated adequately during the grain development period. A limited amount of water for irrigation, or irrigation methods such as side-roll systems that cannot traverse sorghum, because of height after it produces heads, can contribute to this problem.

Seedling diseases can be present in early planted sorghum, but these usually are not severe and are little cause for concern in most years.

Insects

The most likely insect to be a major factor in sorghum production in the Rolling Plains is the greenbug (Schizaphis graminum (Rondani) which can occur in large numbers. Greenbugs feed on the under side of leaves, and are found first on the lower leaves. They can occur on plants that range from small to mature, and can be a problem any time during the growing season. The size of sorghum plants in relation to number of greenbugs serves as a guide to treatment decisions. It is recommended that plants six inches tall or less be treated when greenbugs infest plants in sufficient numbers to cause visible leaf damage. Plants at boot to early heading should be treated before one functional leaf is killed. If mature plants have sufficient numbers of greenbugs to kill two leaves, treatment is recommended. With sorghum hybrids that are resistant to greenbugs, the need for insecticide control measures is less than for susceptible hybrids. Early detection from scouting fields is a very important first step and the only effective means of adequately timing insecticide applications for controlling greenbugs when they are present in large numbers.

The sorghum midge can be a factor in yield loss in sorghum. These insects are small, orange to rust colored gnats that swarm around sorghum heads when plants are flowering (anthers are apparent). This is the only time they can cause damage, so the time frame for control of the sorghum midge is limited to the flowering period. Early detection, from scouting fields when plants are flowering, is the only means of identifying the presence of the sorghum midge and providing a means of adequate timing of insecticide applications.

The sorghum midge has not been a major pest in recent years, but if sorghum acreage is increased, the possibility exists that this pest may increase in number and importance. Planting dates can be an important means of managing the midge. Planting either early or late and providing a complete break in the availability of sorghum, the presence of which is necessary for significant midge buildup in mid-season, can help in managing the midge. Making successive plantings throughout the year provides a "midge nursery" for the buildup of midge populations that can be severely damaging to late planted sorghum. For this and reasons discussed elsewhere, sorghum should not be planted in May and early June.

Corn leaf aphids frequently feed in the whorls of sorghum plants, but these usually can be ignored because they very rarely cause economic damage. Also, corn earworms (cotton bollworms) and fall armyworms frequently feed on leaves of sorghum plants, most frequently in the leaf whorls before plants boot. These usually are of little concern, and effective control is unlikely even if it is attempted because the worms are protected by being in the leaf whorls. Other economically less important insects can attack sorghum and should be dealt with if they occur in sufficient numbers at critical stages of plant development.

Mites are not insects, but they should be managed in the same manner as insects on sorghum. The Banks grass mite is the most damaging of the mites found on sorghum usually occurs on sorghum that is under water stress. When mites are present they form webs that can cover the under side of leaves, and extremely heavy infestations can produce severe damage. Desiccation of leaf tissue followed by death and lodging of plants are the ultimate symptoms. There is little or no significant plant resistance in sorghum, and mites should be managed by scouting and treating with a labeled pesticide when necessary.

A detailed account of sorghum insects and their control measures is available in: Managing Insect and Mite Pests of Sorghum, Bulletin B-1220, Texas Agric. Ext. Service. Information from other references also is available.

Bird Damage

Bird damage can occur any time after sorghum grain has begun to develop, through complete grain maturity. The extent and severity depend on the bird pressure, or number and kinds of birds involved. The most frequently affected sorghum is that planted near buildings, trees, or any favorable roosting site. Bird pressure may be more severe during late fall in late planted sorghum because of migratory birds. Large acreages of sorghum tend to dilute bird damage, but there are no highly effective control measures.