Irrigated and Dryland
Grain Sorghum Production
South and Southwest Texas

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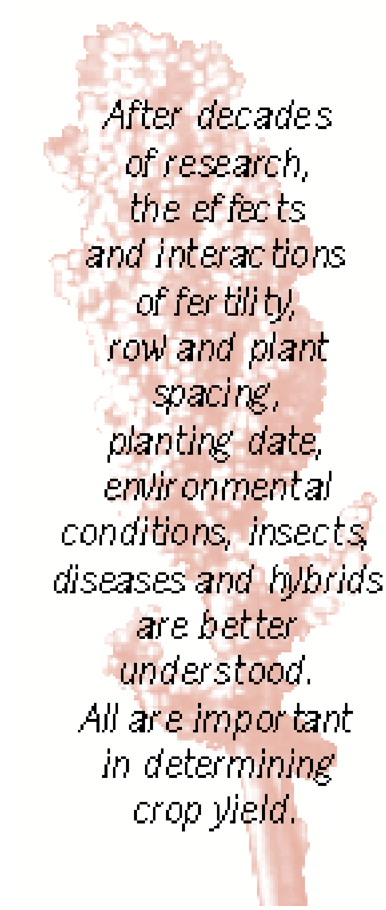

Many people try to put the growth, development and eventual yield of the grain sorghum plant into a simple formula, when it is a complex series of many processess and interactions. Only after decades of research, the effects and interactions of fertility, row and plant spacing, planting date, environmental conditions (water, temperature, etc.), insects, diseases and hybrids are better understood. All are important factors in determining crop yield. A brief summary of the basic growth processes and important interactions follows to assist in making better production decisions as conditions in the field change. Information related to weed and insect control is not addressed in this publication, but can be found in ***Suggestions for Weed Control in Sorghum (B-5045)*** and ***Managing Insect and Mite Pests of Sorghum (B-1220)***.

Growth and Development

Like other crops, seed production in sorghum is a one-time event and all root, leaf and stem development is directed toward completion of the reproductive cycle. Since both the number and weight of seed determine yield, it is important to understand the plant processes that influence seed development. Plant growth in each stage of development is dependent on the previous stage. Stress in any stage of development will reduce yield potential.

Many producers falsely believe that sorghum is "tough" and requires little management. Although sorghum can survive and produce seed under adverse conditions, yields can be greatly reduced by environmental stress and poor management. Like any other crop, sorghum responds to optimum growing conditions and good management.

Seedling Development

The seedling development stage begins at germination and ends 30 to 35 days after emergence when plants have five to six mature (fully expanded) leaves. Emergence and early plant growth are highly dependent upon growing conditions. Plant growth requires energy, but it takes time to produce carbohydrates with a few small leaves which are subject to destruction by wind, hail, frost, insects and pests. As plants slowly develop their root systems and absorb water and nutrients, leaf tissue expands and produces carbo-

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hydrate energy for future growth. During this period of development, water and nutrient uptake are low, and only about 25 percent of the total crop nutrient demand will be absorbed.

Rapid Growth

In the rapid growth stage, 40 to 65 days after emergence, growing point differentiation occurs and the panicle or head begins to develop. This stage continues through head exertion. During this period, plants are especially sensitive to any type of stress such as temperature extremes, nutrient deficiencies, or water deficits or excesses, any of which may reduce potential seed numbers. Some herbicides (e.g., phenoxy or atrazine) applied at this time may cause florets to abort resulting in a "blasted" head. The rate of water and nutrient uptake increases rapidly during this period with about 70 percent of the nitrogen, 60 percent of the phosphorus and 80 percent of the potassium being absorbed into the plant. Plants use a portion of these nutrients for growth with the remainder stored in the leaves and stalks for later use. By the time the "flag leaf" is visible in the whorl, 80 percent of the total leaf area is capturing sunlight and converting it into energy. The rapid growth stage is the most critical stage of plant development and the period during which growing conditions have significant impacts upon yield.

Reproduction

The final growth stage begins with booting or head exertion and ends with mature grain. Water stress during this period reduces the manufacturing of carbohydrates and ultimately reduces yield. Water usage peaks shortly after flowering at 0.30 to 0.35 inches of water per day. The remaining portion of nutrients is absorbed during this high water use period. (R. L. Vanderlop describes in detail nine stages in ***How a Sorghum Plant Develops***, Bulletin No. S-3 Kansas State University.)

Planting

Sorghum seed are small in comparison to the seed of cotton, corn and soybean. Sorghum does not have the large reserves of energy and minerals to withstand as much stress as other crops with larger seeds. About 75 percent of the seeds planted may be expected to survive and produce emerged seedlings. Thus, planting rates should be adjusted according to planting conditions. Relatively slow growth due to cool temperatures, poor soil moisture conditions and competition from weeds may delay development and seriously reduce grain yields. The minimum soil temperature at the desired planting depth for germination and emergence of sorghum is about 55° F.

The size of sorghum planting seed may vary greatly among hybrids; therefore, careful attention should be given to proper equipment calibration during planting to obtain the desired seeding rate. Seeding rate should not be based on pounds of seed per acre, but rather the correct number of seed per acre.

Plant Density

Sorghum plants are very water efficient and have the ability to compensate considerably in grain yield with respect to growing conditions and planting rates. If soil moisture is limiting, grain yield will be greater if plant density is lower. Furthermore, if soil moisture is favorable due to irrigation or adequate rainfall, there is a level of plant density above which no additional grain yield will be achieved from an increase in plant density. If a modest plant density is used for an area typically limited by adequate moisture and above average rainfall is received, sorghum plants can adjust their grain numbers and weight considerably to compensate for the improved growing conditions.

Depending upon soil moisture conditions, recommended seeding rates vary between 30,000 and 100,000 plants per acre for South Texas. Under limited moisture conditions, 2 to 4 plants per foot for 38-inch row spacings will normally use all available soil moisture (Table 1). Irrigated sorghum performs better with about 80,000 plants per acre when planted in wide single or double row configurations or when narrow row patterns are used (Table 2). Sorghum plants are more efficient when each plant is given space to intercept sunlight and competition between plants is minimized. In addition, closer spacing (i.e., double row or narrow rows) will promote shading of the soil surface to reduce evaporation losses and weed competition.

Tests conducted at the North Plains Research Center at Etter demonstrate a similar response to irrigation levels and seeding rates (Figure 1).

Fertility

The concentration of nutrients in different plant parts may

Table 1. Effects of plant density and row spacing on grain yields of dryland sorghum.

Row Width	Plants/Acre 27,000	Plants/Acre 41,000	Plants/Acre 55,000	Plants/Acre 76,000
38	2,358	2,745	2,635	2,567
2 rows/bed 38 in. rows	2,440	2,687	2,415	2,617

Source: Texas Agricultural Experiment Station, Uvalde, Texas (1976 -1980)

Table 2. Effects of plant density and row spacing on grain yields of irrigated sorghum.

Row Width	Plants/Acre 27,000	Plants/Acre 41,000	Plants/Acre 55,000	Plants/Acre 82,000
26	3,564	4,075	4,787	4,815
38	2,906	3,026	3,203	3,726
2 rows/bed 38 in. rows	2,725	3,547	3,976	4,100

Source: Texas Agricultural Experiment Station, Uvalde, Texas (1977 -1981)

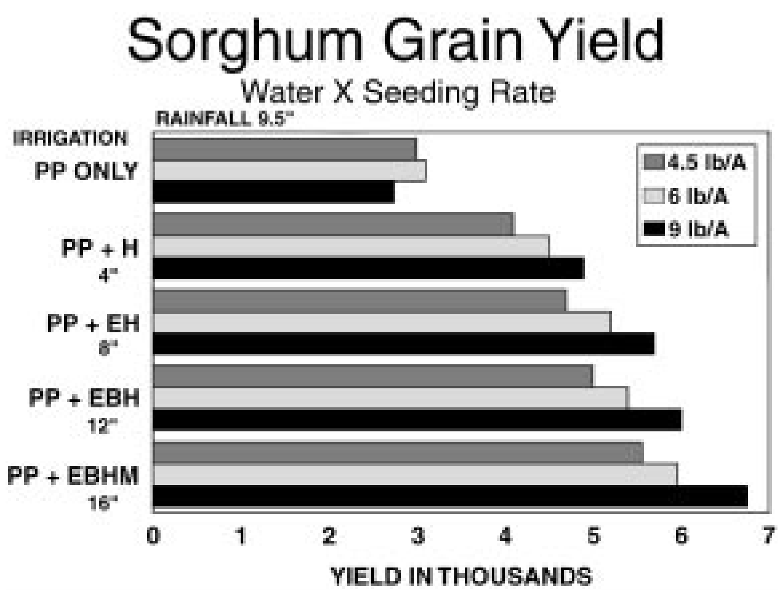


Figure 1. Relationship of seeding rate, water use and yield.

(PP=preplant; E = Early, 6-8 leaf; H = heading, flowering to soft dough; B = boot, flag leaf; M = milk to soft-dough)

Source: Texas Agricultural Experiment Station, Etter, Texas

vary considerably depending upon the conditions under which the crop has been grown. Table 3 gives the approximate nutrient content of sorghum grain and stover where grain yield was 5,600 pounds per acre (100 bu/A).

Table 4 shows the amount of nitrogen, phosphorus and potassium absorbed by grain sorghum plants during various stages of development in the process of producing 7,500 pounds of 14 percent moisture grain per acre. The amounts of secondary and micronutrients used to produce 7,500 pounds of grain per acre are shown in Table 5. Nutrient distribution in dry matter between grain and stover is presented in Table 6. Note the amount of nitrogen and phosphorus in the grain. Conversely, a substantial amount of potassium is contained in sorghum stover relative to nitrogen and phosphorus. If green stover is removed repeatedly, soil phosphorus and potassium levels may be depleted.

Nitrogen

The standard nitrogen (N) recommendation for grain sorghum in Texas is 2 pounds per acre of elemental N for each 100 pounds per acre of grain production expected.

Thus a 5,000-pound grain yield would need about 100 pounds of elemental nitrogen per acre. Nitrogen is by far the most important nutrient for sorghum to maximize production. Nitrogen is normally used by plants for chlorophyll and protein production, which in turn is used in formation of new plant cells. The seed also stores N to enable early growth after germination. Fifty-eight percent of the N absorbed by sorghum plants may be found in the grain at harvest (Table 6). For maximum yields relative to the available water, N should not be lacking or grain development will be reduced.

Side-dress N applications should be made by 20 days after emergence. Later applications may excessively prune feeder roots but more importantly, developmental potential of the grain head is determined 30 to 40 days after emergence.

Table 3. Approximate nutrient content of a 5,600 lb/A sorghum crop.

Plant Nutrient	Pounds in Grain	Pounds in Stover
Nitrogen (N)	84	95
Phosphorus (P_2O_5)	42	20
Potassium (K_2O)	22	107
Sulfur (S)	8	13
Magnesium (Mg)	7	10
Calcium (Ca)	1.4	19
Copper (Cu)	0.01	0.02
Manganese (Mn)	0.06	0.11
Zinc (Zn)	0.07	0.14

Source: Kansas State University - Grain Sorghum Production Handbook

Nitrogen stress during this period will greatly influence yield. Under center pivot irrigation, N fertilizer may be applied several times during the early part of the growing season. Because N is relatively mobile in the soil, fertilizer placement is not as critical for N as it is for most other nutri-

Table 4. Approximate amounts of nutrients absorbed during various growth stages by sorghum plants yielding 7,500 lb/A of grain.

Growth Stage	Days after Planting	Nitrogen (N)		Phosphorus (P_2O_5)		Potassium (K_2O)	
		lb/A	% of Total	lb/A	% of Total	lb/A	% of Total
Seedling	0 - 20	9	5	2	3	18	7
Rapid Growth	21 - 40	61	33	18	23	103	40
Early Bloom	41 - 60	60	32	28	33	85	33
Grain Fill	61 - 85	27	15	21	26	39	15
Maturity	86 - 95	28	15	11	14	13	5
Totals	**Harvest**	***185***		***80***		***285***	

Source: Kansas State University - Grain Sorghum Production Handbook

Table 5. Approximate total lb/A of secondary and micronutrients required for a 7,500 lb/A grain sorghum yield.

Sulfur	Magnesium	Calcium	Iron	Zinc	Manganese	Boron	Copper
21	17	20	2.5	.21	0.17	0.1	0.3

Source: Kansas State University - Grain Sorghum Production Handbook

Table 6. Distribution of nutrients removed in sorghum grain and stover.

Crop Dry Matter	Dry Matter distribution	Nitrogen (N)		Phosphorus (P_2O_5)		Potassium (K_2O)	
		lb/A	% of Total	lb/A	% of Total	lb/A	% of Total
Grain 7,500 lbs	56%	107	58	28	35	28	10
Stover 5,280 lbs	44%	78	42	52	65	230	80

Source: Kansas State University - Grain Sorghum Production Handbook

ents. Nonetheless, N must be absorbed into the plant before it is supportive of plant growth and grain production.

Nitrate-nitrogen (NO^-_3, the form most available to plants) dissolves in soil water, but is negatively charged and thus not attracted to negatively-charged clay and organic matter particles. Nitrate-nitrogen will move with water and can be readily brought into contact with crop roots for quick absorption.

Ammonium-nitrogen (NH_4, also available to plants) is positively charged and is held by negatively-charged clay and organic matter particles in the soil until converted by soil bacterial action into the nitrate form. The conversion of N from ammonium form to nitrate form in the soil is referred to as "nitrification," and is most likely to occur when fields are arable. When fields are water-logged, nitrate can be converted to nitrogen gas (referred to as "denitrification") and lost from the soil by volatilization. Whether fertilizer N is applied as liquid or dry, ammonia, urea, ammonium sulfate or N-32, it should be incorporated into the soil as soon as possible to reduce potential loss of N to the atmosphere, especially where soil pH is above 7.

Phosphorus

Phosphorus (P) is the most controversial nutrient. Different soil testing laboratories use different chemical extractants to estimate "available P." As a result, there may be large differences between soil test values for the same soil sample obtained from different laboratories. In addition, fertilizer recommendations from different laboratories may also vary considerably. In most cases, soil P levels are sufficient to meet early season needs of grain sorghum plants. However, grain sorghum seed are small and contain only enough P to nourish young seedlings until emergence. If young seedlings develop under favorable conditions, P-deficiency symptoms often do not occur. However, if growing conditions are unfavorable (i.e., cool and/or wet), seedlings may show temporary P-deficiency symptoms.

In years where the planting environment is unfavorable for rapid growth and development, banding P fertilizer at low rates in the seed row may be beneficial. One key point to remember is that P is less available in cold soils. Most growers plant as early as possible to reduce sorghum midge damage and to minimize the effects of hot, stressful weather normally experienced later in the season. By doing so, sorghum seedlings often must establish and grow in much cooler soils than if planted later in the spring.

Since soil P is relatively immobile, or "fixed" in soils, placement in a concentrated form is particularly important in low to medium testing soils. By banding P near the seed, 2 to 4 inches below and 2 to 4 inches to the side, developing roots contact the fertilizer shortly after emergence. Placing P fertilizer in direct contact with sorghum seed at planting may cause emergence problems due to the salt effects caused by nitrogen in the fertilizer material.

Research has shown that plants obtain a higher proportion of the needed P from soil reserves. Only about 30 percent of applied P is used by the crop following fertilization, even though it may have been banded. Once soils are warm, some of the "reserve" P becomes available for plant use. The rate at which fertilizer P is converted to soil or "reserve" P depends upon several factors, but most important is the fertilizer P-to-soil contact. Confining P fertilizer to a band reduces fertilizer-to-soil contact and slows the rate of conversion, compared to mixing the same amount throughout the soil as with broadcast applications.

Phosphorus can also be applied as a "pop-up" fertilizer, sprayed in the seed furrow at planting. Corn and sorghum usually respond better than cotton to "pop-ups." However, when using a product like 10-34-0 or 11-37-0 as a "pop-up," it is important not to exceed the equivalent of 5 pounds of elemental N per acre in the seed furrow, or salt injury from the N is likely to occur. Under irrigated or high rainfall conditions, up to 10 pounds of N/acre may be applied without injury. A rain following planting will dilute the nitrogen and also lessen the chance of injury. High P to low N ratio specialty fertilizers, such as 4-29-2 or similar products, lend themselves to "pop-up" applications with minimal injury risk.

Potassium

Potassium (K) is needed in all plant parts for maintenance of water balance, disease resistance and stalk strength. However, as indicated in Table 6, very little K is removed from the field if only grain is harvested. If the stover is harvested as green forage, then a much larger amount of potassium is removed. Most medium to fine textured soils in Texas are inherently high in potassium. Soil test levels should be monitored over years to look for any trends of reduced K.

Other Nutrients

Two other important nutrients for grain sorghum production in Texas are zinc and iron. Where soil phosphorus levels are "high" or "very high" and zinc levels are "low" to "medium," application of additional phosphorus may induce a zinc deficiency. If soil test results indicate a possible zinc deficiency, zinc fertilizer should be broadcast and incorporated preplant or banded at planting. Foliar applications of zinc should be used as a salvage measure since this will only prevent symptoms on new growth.

If iron chlorosis has been observed during previous years in a field, iron fertilizer materials should be applied to the foliage through multiple sprayings early in the season. Table 7 gives suggested foliar treatments to correct iron and/or zinc deficiencies.

Organic Fertilizers

In areas where organic fertilizer materials such as feedlot manure, gin trash, poultry litter, or treated municipal sewage are available, producers may choose to use these as a nutrient source for grain sorghum. Since the nutrient content of organic fertilizers can vary greatly, samples of the materials should be tested prior to use to determine proper rates of application. One significant advantage of organic fertilizers is that the nutrients become available over a longer period of time as the material decomposes, compared to the immediate availability of nutrients from inorganic sources.

Some problems in the use of organic fertilizer materials are: 1) obtaining the ratio of nutrients called for in the fertilizer recommendation for the sorghum crop; 2) determining the amount of animal manure to apply to meet crop needs; and 3) minimizing weed seeds or other impurities (from materials such as gin trash).

By understanding the nutritional requirements of sorghum, adequate nutrients can be applied to reach the yield potential of the crop without applying excess nutrients which may reduce profits and/or contribute to excessive nutrient loads in water and soils.

Water

Grain sorghum is a very drought tolerant crop. Sorghum develops a diffuse root system that may extend to a depth of 4 to 6 feet. Table 8 shows the amount of water used by a sorghum crop from various soil depths during a season. Moisture stress early in the season will limit head size (number of seed per head) and delay maturity — more time is required to complete the plant's life cycle. If stress occurs later in the season, the seed size is greatly reduced. The number of heads per acre is not affected by moisture stress unless it is so severe as to prevent head formation.

During the seedling stage, only a small amount of moisture in the soil surface is required to establish the crop. More moisture is lost during this stage through evaporation from the soil surface than through the crop canopy. Water conserving practices such as residue management, timely planting for quick establishment, narrow row spacing and weed control will minimize soil moisture losses.

About 30 to 35 days after emergence, five to six true leaves are visible and the plant begins rapid growth. Nearly half of the total seasonal water will be used during this stage prior to heading. Near the end of this period, daily water use will be near maximum (about 0.35 inches/day/acre).

The most critical period for water availability for a sorghum plant begins about one week before head emergence

Table 7. Suggested sources, rates and timing of iron and zinc foliar sprays.

Deficiency	Product*	Product/100 gals water	Product/Acre	Timing
Iron	Iron sulfate (20% Fe)	20 lbs (2.5% solution)	1 lb 2 - 3 lbs	10-14 days after emergence - 5 gals/A over crop row. Follow with 2 apps. @ 10-14 day interval @ 10-15 gals/A
	Iron chelate (10% Fe)	8 lbs (1%)	0.4 - 0.5 lbs	same as above
Zinc	Zinc sulfate (30% Zn)	2 lbs (1/2 %)	0.2 - 0.4 lbs	10-20 gals/A in first 30 days
	Zinc chelate (9% Zn)	2 qts (0.1%)		10-20 gals/A in first 30 days
Iron & zinc	Iron sulfate + Zinc sulfate + urea fertilizer	15 lbs + 1 lb + 2 lbs	3/4 Iron + 0.1-0.2 Zinc 1.5 lb Iron + 0.2-0.4 Zinc	10-14 days after emergence - 5 gals/A over crop row. Follow with 2 apps. @ 10-14 day interval @ 10-15 gals/A
	Iron sulfate + Zinc chelate	15 lbs 3 pts	3/4 Iron + 2.4 fl oz. 1.5 lb Iron + 5 fl oz.	10-14 days after emergence - 5 gals/A over crop row. Follow with 2 apps. @ 10-14 day interval @ 10-15 gals/A
	Iron chelate + Zinc chelate	6 lbs 3 pts	follow mfg. directions	10-14 days after emergence - 5 gals/A over crop row. Follow with 2 apps. @ 10-14 day interval @ 10-15 gals/A

*Include a surfactant or other wetting agent. Product conposition may vary. Select similar products or adjust mixing ratios to achieve comparable rates of nutrient application.

Source: Updated information based on research results and recommendations through the Texas Agricultural Extension Service Soil, Water and Forage Testing Laboratory.

Table 8. Total water absorbed from various depths in a soil profile.

Soil Depth (feet)	Inches of Water Absorbed	Percent of Total
0 - 1	8.9	35
1 - 2	6.6	26
2 - 3	4.0	16
3 - 4	2.8	11
5 - 6	1.3	5

Source: USDA/ARS Report No. 29

or the "boot" stage, and continues through two weeks past flowering (Figure 2). Sorghum plants require good soil moisture during this period for maximum yields. Adequate soil moisture prior to the "boot" stage will assure the highest potential seed set. The actual seed number and seed size will be dependent upon the availability of soil moisture following flowering. Moisture demand drops rapidly after the grain has reached the "soft-dough" stage. The soft-dough stage has occurred when immature seeds squeezed between the thumb-nail and the index finger do not exude a "milk" or white juice. The combined drop in moisture demand, natural drought tolerance in sorghum, and the extensive root system generally make late irrigations unprofitable.

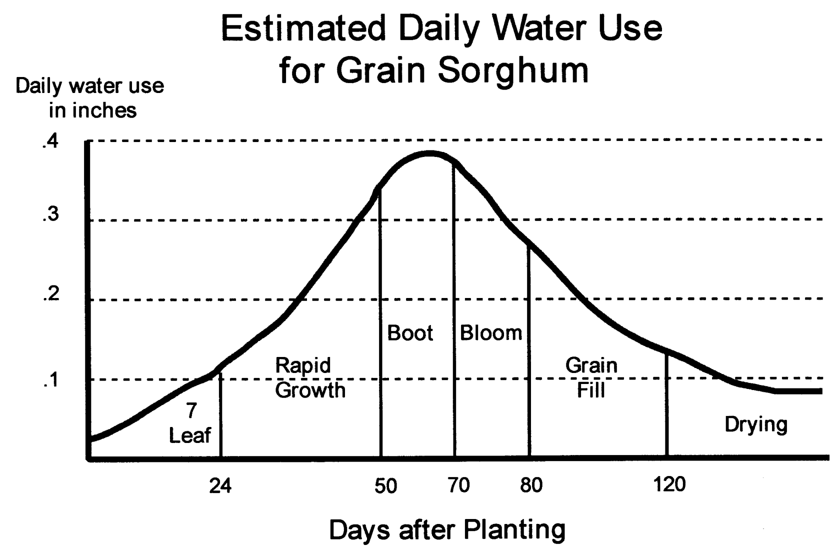
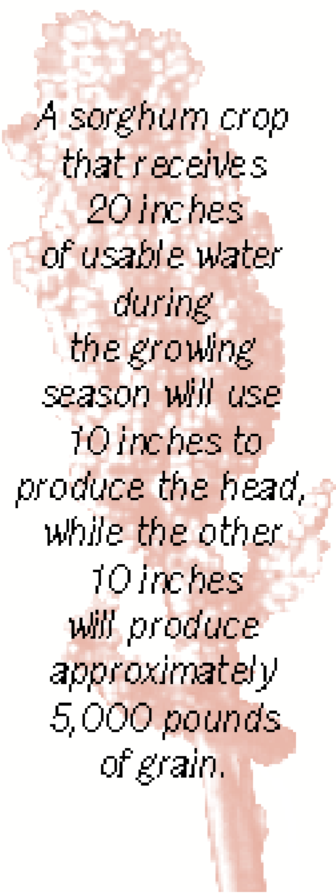


Figure 2. Daily water use in inches.



Since water is the first limiting factor to crop production in South Texas, yield goals should be based upon the amount of water available during the season. Research at Texas Tech University indicates that a minimum of 10 inches of available water is required for sorghum plants to produce a head (D. R. Krieg, personal communication). Each additional inch will yield approximately 385 to 400 pounds of grain. Thus, a sorghum crop that receives 20 inches of usable water during the growing season will use 6 to 8 inches to produce the head, while the other 12 to 14 inches will produce approximately 5,000 pounds of grain.

Maturity selection of hybrids is also important in water management. Table 9 suggests the amount of expected water needed by the crop of different maturity groups.

Besides the total amount of available water, the timing of irrigation (or rainfall) is also important. Research done in the Texas High Plains indicates that as the amount of water received by the crop increases, grain yield/inch of water applied decreases. Results of two years of field studies at the Etter Experiment Station on the High Plains to determine the best combinations for irrigation timing are shown in Table 10. Sixteen irrigation treatments were used. In the first year of the test, 10.5 inches of rain fell in the growing season with 6.1 inches occurring late during bloom and grain fill. During the second year of the test, 8.9 inches fell early in the growing season with 6 inches falling prior to and during bloom.

Average yields for the two years showed increased production with additonal water. The results also show important year-to-year yield differences within the same irrigation timings when rain fell early or late. Irrigation timing is just as important as the amount of water applied. Figure 3 shows the best timing for one, two, three, and four in-season irrigations and the amount of additional grain produced with each subsequent irrigation.

More recently, first year experiments conducted at the Uvalde Research and Extension Center support the Etter findings. At Uvalde in 1996, no

Table 9. Approximate maturity and water use of grain sorghum by seasonal types.

Maturity Range	Days to Bloom	Number of leaves	Plant Height	Days to Maturity*	Inches of Water
Early	55 - 60	6 - 9	30 - 36	90 - 105	10 -15
Medium	65 - 75	9 - 12	36 - 45	110 - 115	15 - 20
Medium late	75 - 85	12 - 16	40 - 50	115 - 120	20 - 25
Full season or late	75 - 85	14 - 18	50 - 60	120 - 125	25+

* Physiological maturity - the point after which there is no increase in seed weight.

Table 10. Two-year sorghum grain yield responses to irrigation at various stages of plant development. Preplant irrigations totalled 4 inches and all post plant irrigations were 4 inches each ('69 late rains, '72 early rains).

Preplant	Early (6-8 leaf)	Mid to Late Boot	Heading/ Flowering	Milk to Dough	1969 Yield	1972 Yield	2 Yr Average
X					1,441	2,786	2,113
X	X				1,799	2,842	1,820
X		X			4,019	4,249	4,134
X			X		3,167	4,908	4,037
X				X	1,141	3,268	2,204
X	X	X			3,659	3,907	3,783
X	X		X		4,181	5,710	4,945
X	X			X	1,260	4,201	2,730
X		X	X		5,237	5,582	5,409
X		X		X	3,677	5,097	4,387
X			X	X	3,954	4,727	4,340
X	X	X	X		6,396	5,990	6,193
X	X	X		X	3,716	5,573	4,644
X	X		X	X	4,417	5,932	5,174
X		X	X	X	5,956	5,960	5,958
X	X	X	X	X	6,800	6,782	6,791

Source: Texas Agricultural Experiment Station, Etter, Texas

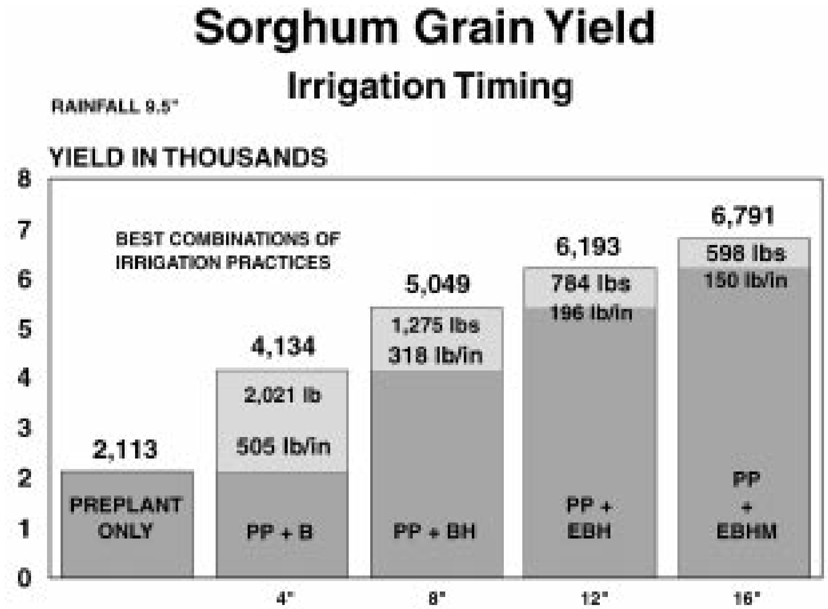


Figure 3. Estimated daily water use for grain sorghum.

Source: Texas Agricultural Experiment Station - Etter, Texas

effective rain fell during the growing season. Results indicate only the effects of irrigation rate and timing. (unpublished data, C. Fernandez).

Not only is the amount of water applied important, but also the timing (Table 11), relative to the developmental stage of the crop. Based on the results of the experiments at Etter and Uvalde, several important conclusions can be drawn.

- Preplant irrigations alone do not produce optimum yield.
- One irrigation at any time prior to dough stage was equal in yield to two irrigations at heading and dough. If an irrigation is missed during head initiation (45 DAE), later irrigations will not increase yields substantially.
- If two in-season irrigations are possible, 45 DAE and heading will produce the greatest yields.
- If three inseason irrigations are possible, 30 DAE, 45 DAE and heading produce greater yields than 45 DAE, heading and dough stage.
- Irrigations at the dough stage failed to substantially increase yields.
- Four irrigations in addition to the preplant watering produced the highest yields.

Table 11. Effects of irrigation timing on grain sorghum yield.

Preplant	30 DAE	45 DAE	Heading	Dough	Grain Yield per Acre	Heads/ Acre	Grains/ Head	Weight/ Grain
X					1,079	31,914	627	22.6
X	X				2,811	48,076	1,277	20.2
X		X			2,890	51,653	1,406	17.5
X			X		3,016	48,283	1,043	26.5
X	X	X			3,387	50,277	1,548	19.1
X		X	X		4,905	53,923	1,560	25.9
X			X	X	2,704	47,663	883	28.9
X	X	X	X		5,404	52,006	1,746	26.2
X		X	X	X	5,116	52,478	1,698	25.4
X	X	X	X	X	5,773	53,028	1,804	27

DAE = days after emergence; 30 DAE = head initiation; 45 DAE = rapid growth; Heading = boot-flowering; Dough = soft dough stage

If the response of sorghum plants to 1 inch of irrigation water is an additional 385 to 400 pounds/acre of grain, every effort should be made to reduce water runoff. Not only do water conservation practices such as furrow diking reduce the chances of erosion and nutrient loss, they also increase grain yields. Three years of research on the Texas Rolling Plains demonstrate the potential for furrow diking to increase sorghum yields (Table 12). The greatest impact from furrow diking was observed in dry years (1980, 1981).

Six years of studies in Uvalde on dryland grain sorghum production produced up to 72 percent higher yields in dry years when fields were diked. Table 13 shows the effects of various tillage systems on average production between 1984 and 1990, which included both wet and dry years.

Table 12. The effects of furrow diking and subsoiling on sorghum grain yields.

Tillage Treatment	1979		1980		1981		Average Yield (Lbs/A)	Percent of Check
	Lbs/A	%	Lbs/A	%	Lbs/A	%		
Undiked	4,353	100	547	100	1,038	100	1,979	100
Subsoiled	4,941	114	580	106	1,116	108	2,212	112
Diked	4,865	112	751	138	2,240	216	2,619	132
Subsoiled and diked	5,136	119	791	145	2,248	217	2,725	138

Source: Texas Agricultural Research Center, Vernon

Table 13. Effect of furrow diking on dryland sorghum production.

Treatment	Average Yield*	Percent of Bedded & no dikes**
Bedded and no dikes	1,747 a	
Flat (no beds formed)	1,821 a	104
Bedded and diked during the growing season	1,826 a	105
Bedded and diked during the fallow season	2,128 b	122
Bedded and diked continuously	2,321 b	133

* Average yields followed by the same letter do not differ statistically.
** Normal land preparation for dryland sorghum in the Wintergarden area.

Source: Texas Agricultural Research Center, Uvalde

Summary

Efficiency is doing the right thing and effectiveness is doing the right thing at the right time. Not only are production inputs important, but proper timing often determines if these inputs are fully utilized. Crop management is effectively managing all aspects of production to enable the crop to produce its best economic yield. Careful management of all aspects of production, from land preparation to harvest, will maximize yields and profits.

References

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