Irrigating Grain Sorghum

KEY POINTS

- Grain sorghum has a fibrous root system that can extend to depths of 4 to 6 feet, which can help it tolerate droughty conditions.
- Sorghum yield potential can be greatly reduced depending on the timing of drought stress relative to growth stage.
- A period of about 1 week prior to the grain head being pushed out of the boot and continuing through 2 weeks past flowering is the most critical period to avoid water stress.

Figure 1. Sorghum plant with poor head exertion because of minor drought stress.

Sorghum Characteristics

Grain sorghum has a fibrous root system that can extend to depths of 4 to 6 feet. This extensive root system helps sorghum tolerate droughty conditions better than corn. Sorghum yield potential can be greatly reduced depending on the timing of drought stress relative to growth stage (Table 1).

Table 1. Potential Reduction in Yield from Moisture Stress*

Growth Stage	Percent Yield Reduction
Emergence to V8	10 - 15
Boot to Flowering	30 - 50
Soft Dough to Maturity	10 - 20

*2013 Arkansas grain sorghum quick facts. University of Arkansas

Row Spacing and Seeding Rate for Irrigation

Available soil moisture is an important factor in determining sorghum row spacing and planting population. Narrower rows can lead to quicker canopy closure, which can help minimize the evaporation of soil water. High populations can increase total water requirements potentially resulting in moisture water stress, especially during peak plant water needs.

Water Use by Growth Stage

It is estimated that a total water use (soil evaporation and plant transpiration) of 28 inches of water/acre is needed to produce a sorghum yield of 7,000 lb./acre.[1] However, total water usage by a sorghum plant can vary due to product maturity, planting date, environmental conditions, and ultimately final yield.

Daily water use during a sorghum plant's life varies depending on the growth stage (Table 2, page 2). During seedling development (germination to 6 mature leaves), water use is relatively low, but stress during this time can affect future growth, plant size, and yield potential. Preservation of soil moisture through conservation tillage, residue management, row spacing, weed control, and planting date are important during early development as soil water evaporation can occur quickly.

The reproductive phase begins with bloom and lasts around 45 days until physiological maturity or black layer occurs. About 0.35 inch of water/day will be used by the plant from just before bloom until early grain fill. Poor head exertion can occur if stress occurs during this phase (Figure 1). Additional water after maturity will not add weight to the seeds (Figure 2).

When moisture is adequate, the University of Arkansas suggests terminating furrow irrigation when > 50% of the heads are at hard dough and terminating pivot irrigation when > 75% of the heads are at hard dough.[3] University of Nebraska Extension information suggests basing final irrigation timing on soil moisture deficits, soil type, and growth stage. If soil deficit information is not available, Table 3 provides final irrigation timing recommendations based on existing growth stage and irrigating to a fully refilled root zone, which is difficult to achieve with irrigation and is not a recommended practice.[2]

When to Irrigate

- Assuming the soil water profile is adequate to full at planting, additional water should not be necessary until the reproductive stage begins.
- At the beginning of the reproductive stage, a 4-inch irrigation can last until the flag leaf appears.
- Two 3-inch irrigations about two weeks apart at flag leaf or boot stage should carry the plants to the soft dough stage of kernel fill.
- A 3- to 4-inch irrigation at soft dough stage should allow for the completion of grain fill.[1]

Tools and Equipment

Several tools are available to help determine the need for additional water:

- A standard rain gauge placed at the edge of a field can provide information on natural rainfall.
- Local radio, TV, and internet websites may also provide rainfall information, but will not be specific to each field.
- Depending on the state, web based evapotranspiration (ET) calculators may be available to help determine water usage, needs, and availability.
- Moisture sensors can be installed at 1-, 2-, and 3-foot depths to measure moisture levels at various depths.
- The sensors should be located within the crop row and not placed into low areas. Information from the sensors should be read and recorded at least twice a week.
- Soil probes are another means of measuring soil water and compaction. If the probe cannot penetrate the surface, there is no subsurface moisture.
- Prior to sorghum boot stage, the probe should be able to be pushed to a depth of 3 to 4 feet, which indicates there is about 4 to 6 inches of stored water depending on soil type.
- During heading, flowering, and grain fill, the probe should go to a minimum depth of 8 to 10 inches.
- After black layer, a probe depth of at least 6 to 8 inches should indicate sufficient moisture is available to help maintain stalk integrity until harvest.[4]

Table 2. Estimated Grain Sorghum Water Use by Growth Stage*

Days after Planting	Inches/day
0 - 30 (early plant growth)	0.05 - 0.10
30 - 60 (rapid plant growth)	0.10 - 0.20
60 - 80 (boot and flowering)	0.25 - 0.30
80 - 120 (grain fill to maturity)	0.25 - 0.10

*2013 Arkansas grain sorghum quick facts, University of Arkansas

Table 3. Last Irrigation Determination Guidelines* (assumes root zone is completely refilled)

Soil Type	Stage of Growth for Last Irrigation
Silty Clay Loam	4 days after soft dough
Upland Silt Loam	1 day after soft dough
Bottomland Silt Loam	10 days after half bloom
Very Fine Sandy Loam	3 days after soft dough
Sandy Loam	6 days after soft dough
Fine Sands	10 days after soft dough

*1991 Predicting the last irrigation for corn, grain sorghum and soybeans. Neb-Guide G82-602-A. University of Nebraska.

Figure 2. Irrigating grain sorghum after black layer does not add weight to the seed.

Sources: [1] Stichler, C. and Fipps, G. 2003. Irrigating sorghum in South and South Central Texas. L-5434. Texas A&M University. [2] Klocke, N.L., Eisenhauer, D.E., and Bockstadter, T.L. 1991. Predicting the last irrigation for corn, grain sorghum and soybeans. NebGuide. G82-602-A. University of Nebraska. [3] Kelley, J. and Lawson, K. 2013. Arkansas grain sorghum quick facts. University of Arkansas. [4] New, L. 2004. Grain sorghum irrigation. PROFIT. B-6152. Texas Cooperative Extension. The Texas A&M University System. Other source: Stichler, C., McFarland, M., and Coffman, C. 1997. Irrigated and dryland grain sorghum production, South and Southwest Texas. Texas A&M University. 150410115543