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Summer Annual Grasses

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Bermudagrass is the most important summer perennial grass in the South, but many other grasses play an important role in a complete forage system. Annual grasses such as pearlmillet (Figure 1), sudangrass (Figure 2), sorghum-sudangrass hybrids, forage sorghums and grain sorghums (Figure 3) can be used to supplement bermudagrass or other warm-season perennial grasses.

Summer annual forages are often planted to provide supplemental grazing, hay or silage for livestock. This is especially important for livestock that require higher nutrient densities to maintain acceptable weight gains or milk production.

Figure 2. Sudangrass

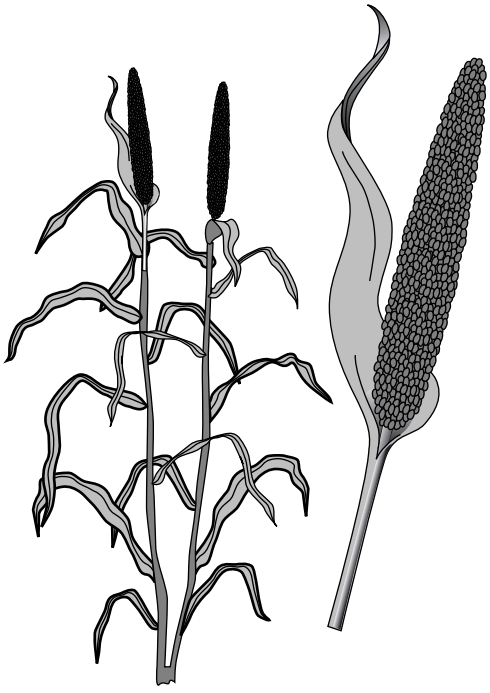

Figure 1. Pearlmillet

Figure 3. Sorghum

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The establishment of these species in late spring allows producers to provide periods of rest for perennial cool-season pastures, such as tall fescue or mixtures of tall fescue and legumes. By resting cool-season perennial pastures in July and August, these stands are more persistent and supply more fall grazing.

Much of the land area used for the production of summer annual forages can also be double-cropped by planting temporary winter pastures, such as wheat, rye, oats, triticale or ryegrass, to provide forage in late fall, winter and spring.

Overview

The term *sudangrass* technically refers to the annual species of sorghum with aboveground growth that resembles johnsongrass. These plants have wide leaves, fine stems and regrow quickly after cutting, relative to other sorghum types. The term *sudangrass* is also used loosely to refer to sorghum-sudangrass hybrids, which are very popular with producers. Sorghum-sudangrass hybrids can be viewed as intermediates between the true sudangrasses and forage sorghums. They typically yield more dry matter per acre than true sudangrasses but less than forage sorghums when harvested once. The hybrids usually have coarser stems than true sudangrasses.

Pearlmillet is another annual warm-season grass that exhibits growth characteristics similar to sudangrasses and sorghum-sudangrass hybrids, although it technically belongs to a different genus of plants. Sudangrasses, sorghum-sudangrass hybrids and pearlmillet are typically established by drilling or broadcasting seed. They can be used as hay, silage or greenchop and are well suited for rotational grazing systems. Like the sorghum-sudangrass hybrids and sudangrass, pearlmillet exhibits very active regrowth after the initial harvest.

Forage sorghums are tall-growing types with suitable characteristics for establishment as a row crop and subsequent harvest as row-crop silage. Most forage sorghums have been specifically selected for once-a-year harvest as silage. These plants generally have poor regrowth potential, except in the deep South, and are commonly grown in arid areas where conditions are not favorable for growing corn. Grain-type sorghums (milo) can also be used as a silage crop. Forage and grain sorghums are not good choices for summer grazing.

Sudangrass

Sudangrass is a fast-growing, summer annual grass with wider leaves and larger heads than johnsongrass, but it does not possess the underground rhizomes that make johnsongrass extremely difficult to eradicate. It is adapted to a wide range of soil and climatic conditions.

Because of its aggressive tillering habit, the seeding rate for sudangrass is less critical than for many other annual forage crops. A twofold difference in seeding rate will normally not make a significant difference in forage yield. Seeding rates of 20 to 30 pounds per acre are sufficient to develop a good stand on most soils (Table 1). Because seed size may vary, check the bag for the proper seeding rate.

Table 1. Recommended Seeding Rates and Depths for Sudangrass, Sorghum-Sudangrass Hybrids and Pearlmillet

Planting dates should be between May 15 and July 15 in northern Arkansas. In southern Arkansas, planting may begin on May 1.

Crop	Seeding method	Seeding rate (lb/acre)*	Seeding depth*
Sudangrass	drill	20	1" to 1 1/2"
	broadcast	30	
Sorghum-sudangrass	drill	20 to 30	1" to 1 1/2"
	broadcast	30 to 45	
Pearlmillet	drill	15	1/2" to 1"
	broadcast	25	

*Follow instructions on seeding rates and depths on the seed bags. Seed sizes may vary.

Adequate germination should occur when the soil temperature ranges between 68 and 86 degrees F. Poorer stands are frequently obtained at lower and higher soil temperatures. This normally occurs when producers attempt to plant early or late (see Table 1). Although planting late is justified when staggered production is desired, it often results in low yields because growth is hampered by summer droughts, cool fall temperatures and premature frosts. Inadequate surface soil moisture, particularly in the heat of summer, also makes late planting risky. A well-prepared, firm, moist seedbed is best for establishment. Acceptable stands may be established by planting in a killed or suppressed sod with a no-till drill. If it is dry or if precipitation is not anticipated before emergence, firming of the seedbed with a roller or cultipacker is desirable after planting.

Defer grazing until plants are 20 to 24 inches tall to reduce the risk of prussic acid poisoning. *(See section on* **Prussic Acid and Nitrates** *later in this publication.)* Graze slow-growing plants when they are at least 24 inches tall; then graze down to about 10 to 12 inches and rotate the cattle to another pasture. If excess stemmy growth remains after grazing, clip or cut it for hay to increase the quality of new regrowth. Uneven grazing can be partially controlled by using high stocking rates coupled with a rotational grazing system. Cut sudangrass hay at the boot stage or when it reaches 3 feet in height, whichever comes first. If possible, pass hay through a conditioner to crush the stems. This practice will substantially reduce drying time.

To reduce risk of prussic acid poisoning, do not harvest or feed drought-damaged plants in any form within four days following a good rain, regardless of plant height. Some reference sources may recommend a seven-day wait prior to use. Do not use plants as greenchop, pasture or harvest as silage for at least seven days following a killing frost. In some cases, only certain portions of a field are killed by the initial frost event. Under these circumstances, prussic acid remains a potential hazard after subsequent frosts.

Sudangrass and other summer annual grasses are excellent choices for dairy pastures in Arkansas. Plant at two-week intervals to provide continuous grazing for dairy cows. The crop should be planted about 35 days before grazing is needed. An acre of sudangrass can provide forage for two or three dairy animals if properly fertilized and managed.

Application of 30 to 60 pounds of actual nitrogen on each hay or silage cutting will reduce the risk of nitrate accumulation under stressful growing conditions and is usually better than one large application per year. **However, this management practice will by no means eliminate the risk entirely.** Under grazing conditions, space applications of nitrogen at similar intervals. For instance, apply nitrogen at seeding, after first grazing and then later in the summer if maximum yields are needed.

It is always wise to have soils tested prior to planting summer annual grasses. In the absence of a recent soil test, apply 45 pounds per acre of actual phosphate and potash to support good production.

Pearlmillet

Pearlmillet is more leafy throughout the growing season than sudangrass and presents no danger from prussic acid poisoning. It makes excellent dairy pasture and may also be used safely by horses. It is more sensitive to cold weather than sudangrass or other sorghums, especially in the germination or seedling stage. However, pearlmillet is generally more tolerant of diseases, acid soils and high humidity than the sorghums. It is best adapted to light-textured, well-drained soils with pH of about 6.0. Apply any additional lime needed to correct for low pH prior to planting. Production and harvesting practices for pearlmillet are similar to those outlined previously for sudangrass. Seeding rates (Table 1) are lower (use 15 to 25 pounds per acre), but the seeding dates and planting depths are similar.

Grazing can be initiated when plant height reaches 1 to 1 1/2 feet. However, harvest pearlmillet as hay when it reaches 2 to 4 feet. It is sensitive to close clipping or grazing height. Leaving residual stubble heights of less than 4 to 6 inches can result in reduced production of regrowth or cause plants to die. If uneven grazing has occurred, clip pastures to a 6-inch stubble height prior to a rest period. This improves the quality of forage regrowth. If possible, use a mower-conditioner when mowing for hay to ensure that the thick stems are crushed. Pearlmillet typically ranges from 3 to 8 feet in height, and dry matter yields in Arkansas forage variety trials have ranged from 4 1/2 to 5 tons per acre over three cuttings when soil test recommendations are followed.

Sorghum-Sudangrass Hybrids

The sorghum-sudan hybrids are very popular in Arkansas. Forage quality is similar to older sudangrass varieties, but the yields are usually higher. Establishment and fertilization practices are nearly identical to those described for sudangrass. Because these varieties tend to develop thicker stems, fields targeted specifically for hay or silage production may be planted at a higher seeding rate to maintain a higher percentage of leaf in the canopy and, subsequently, to reduce drying time during harvest. The prussic acid potential of sorghum-sudangrass hybrids may be greater than true sudangrasses.

Do not graze these hybrids before they are 24 inches tall. When the canopy is reduced to a 4- to 6-inch stubble height, remove cattle from sorghum-sudangrass pastures. Grazing closer than 4 to 6 inches reduces the leaf area and results in a much slower regrowth. Do not graze again until the canopy reaches a height of 18 to 24 inches.

Cut sorghum-sudangrass hybrids for hay (use a mower-conditioner if available) at the boot stage or when 3 feet tall, whichever comes first. These hybrids are excellent choices for either greenchop or silage. Greenchopped forages should be fed immediately to allow cattle time to consume as much forage as possible before respiratory heating limits acceptability. **Horses should not graze sudangrass or sorghum-sudangrass pastures or consume hay harvested from these sites. Horses consuming these forages may contract cystitis syndrome disease.**

Forage and Grain Sorghums

There are many factors to consider when choosing a sorghum hybrid for silage – yield potential (forage and grain), maturity (full-season vs. short-season), forage quality and resistance to lodging, disease and insects. Many cultivars of sorghum have been selected, primarily by commercial seed companies, for once-a-year harvest as silage. These varieties are typically tall-growing types that are not really supplemental forages. They are managed much like corn grown for silage and have little regrowth potential, except in the deep South.

Grain sorghum hybrids, which typically are shorter in height and have higher grain-to-forage ratios than forage types, are also a viable option for use as a silage crop. Bird-resistant grain sorghum varieties that may contain elevated levels of tannins should be avoided.

Forage sorghum varieties selected for one-time harvest as silage can take more than 100 days to mature. These varieties are not good options for most Arkansas producers, unless they have access to land suitable for row crop production and the equipment necessary for the establishment, harvest and storage of row-crop silages.

Grain sorghum seed varies greatly in size (11,000 to 27,000 seeds per pound); however, forage sorghums can have as many as 55,000 to 68,000 seeds per pound. This variability with respect to seed size can have a substantial effect on plant population if plant-ing rates are determined on a seed weight per unit area basis. Therefore, base planter calibration on desired seed spacing within the row rather than seed weight per unit area. A general seeding rate for drill planting is 5 to 6 pounds per acre, but check recommendations for the chosen variety.

Planting rates for sorghum silage are similar to those used for grain-type sorghums. Plant populations can range from 70,000 to 100,000 plants per acre when moisture is not limiting. Generally, plant populations per unit area are held constant at the appropriate level for expected soil moisture conditions, regardless of row spacing. Planter calibration is based on a 65 to 70 percent emergence rate. Assuming your planter is set for 30-inch rows, plant one seed every 2 inches to get a plant population of 70,000 plants per acre.

Forage and grain sorghums developed for one-time harvest as silage typically require herbicide strategies to control weeds. Consult the appropriate Extension personnel in your area to develop the most appropriate strategy for your specific situation.

Planting date is critical for several reasons. Planting too early when soil temperatures are low subjects seed to longer attack by soil microorganisms and can result in delayed emergence, slower initial growth and thin stands. As soil conservation recommendations encourage producers to reduce tillage and retain more crop residue in the seedbed, soil temperatures often remain cooler and the soil may remain wetter than in conventionally-tilled soils; therefore, no-till and reduced-till establishment is best suited to fairly well-drained sites.

Late plantings are more susceptible to reduced dry matter production due to slow grain fill and fall freezes that may occur before the desired maturity level for ensiling is reached. Premature frost also increases the risk of prussic acid poisoning in ruminant livestock if frost-damaged sorghum forage is immediately grazed, used as greenchop or ensiled without field wilting or field drying. Forage or grain sorghum hybrids can exhibit wide variation in the time necessary to reach harvest maturity as silage. For example, some hybrids reach half-bloom in as little as 50 days, while others need more than 100 days to reach the same growth stage. Proper varietal selection is an important consideration that can help limit the risk of frost damage.

Planting depth for forage sorghum hybrids normally ranges from 2/3 inch to 2 inches, depending on soil texture and available moisture. Plant seeds deep in light, sandy soils that have limited moisture available near the soil surface. Good soil contact with the seed aids germination. Quick germination and emergence occur when the soil temperature reaches about 68 degrees F. Sorghum seed is relatively small, and this results in a slower initial growth habit than corn, particularly before the growing point reaches ground level at about 30 to 35 days postemergence.

Row spacing for forage sorghums is usually dictated by the type of harvesting equipment available to the producer. Therefore, management decisions are based primarily on logistical, rather than agronomic, considerations. Rows are commonly spaced about 30 inches apart to allow producers to take advantage of direct-cut harvester heads designed primarily for corn silage. However, adjust this spacing if older harvesting equipment (designed for 36-inch or wider rows) is used.

Recent developments in direct-cut technology that permit row-planted silage crops to be direct cut across or independent of the established rows ultimately may allow more flexibility during harvest. Although forage- and grain-type sorghum hybrids can be successfully established with a drill, subsequent direct-cut harvest options (for silage) are currently limited. Establishment with a drill is a better option for sudangrasses, sorghum-sudangrass hybrids or pearlmillet, which are not selected for a one-time harvest as silage.

Fertilizer and lime needs are best determined by soil tests supported by both past experience and field history information. Forage sorghums generally perform best when soil pH ranges from 6 to 7.

Harvesting grain sorghum as a silage crop removes more nutrients from the field than harvesting only the grain. In particular, large quantities of nitrogen, phosphorus and potassium are removed. Generally, nitrogen is the nutrient most likely to be lacking for optimum production. Typical fertilizer recommendations for nitrogen can range up to 180 pounds per acre in situations where no water

stress is expected. **The large yields of dry matter that can occur when any summer annual forage is harvested strictly as hay or silage can quickly lead to depleted levels of soil nutrients. Soil testing and the subsequent fertilizer recommendations provided by the University of Arkansas Division of Agriculture are an important component of the management needed to use these crops effectively.**

Typically, forage sorghums are harvested for silage when grain is in the mid- to late-dough stage. The moisture content of these forages at mid- to late-dough stage can vary substantially. Ideally, moisture content at harvest should be less than 70 percent to ensure proper fermentation and to prevent excessive effluent losses. Forage sorghums are frequently not that dry at harvest. These silages are prone to heavy effluent losses, especially in upright silo types, and may produce elevated levels of acetic acid during fermentation. Silage fermentations that produce excessive amounts of acetic acid are less efficient, and the fermented forage may be less acceptable to cattle. In contrast, overly mature whole sorghum grains are poorly digested by ruminants, and this problem is not adequately resolved by the ensiling process. Excessively dry silages (< 60 percent moisture) may be more difficult to chop and pack properly, and drier silages frequently have a shorter bunk life at feedout.

It is important to remember that forage sorghum varieties vary widely with respect to agronomic characteristics and forage quality. Forage sorghums range from 6 to more than 20 feet tall, and whole plant yields typically range between 4.5 and 8.9 tons of dry matter per acre. Tall-growing forage sorghums are prone to lodging, which can make harvest as silage nearly impossible with conventional row-type harvesters. Generally, the chances of lodging are decreased in shorter plants and/or in plants with larger stalk diameters. Some producers routinely use higher planting rates to limit stalk diameter and improve forage quality, but this practice can increase the risk of lodging.

Grain-type sorghums are typically shorter than forage types (< 5 feet), and the chances of lodging are greatly reduced. Whole-plant yields for grain-type sorghums are up to 35 percent less than those observed for forage types grown in common environments. Producers should be cautious about relying extensively on grain sorghums for silage production because dry matter yields can be greatly reduced in dry years. Grain yields for forage sorghums are often competitive with those of shorter grain types; however, the proportion of grain in the total silage mass is frequently less.

The crude protein content of harvested grain and forage sorghums ranges from about 6 to 11 percent; however, grain-type hybrids typically have crude protein concentrations that are 1 to 3 percentage units higher than forage types. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) fractions are generally lower in grain-type sorghums because the stover is diluted by the higher grain-to-stover ratios common to grain-type varieties. Grain-type varieties are frequently more digestible because the proportion of grain in these plants is larger than in forage types. In addition, grain-type varieties can be expected to have higher dry matter concentrations at ensiling than forage-type sorghums.

Quality characteristics of forage sorghums and other summer annual forages are summarized in Table 2. Most of the values reported are based on Arkansas averages for producer samples sent to the Cooperative Extension Service for analysis.

Prussic Acid and Nitrates

Prussic acid and nitrate poisoning may be a problem with most summer annual forages. The prussic acid potential of sudangrass and sorghum-sudangrass hybrids is high in the early stages of growth and decreases steadily in the fall until frost. It remains dangerous to livestock after frost until these plants are completely dry. This may take from

Table 2. Average Quality Characteristics of Summer Annual Forages

Forage	Type	Number of Samples	Crude Protein	NDF	ADF	TDN
Johnsongrass[1]	hay	98	11.0	65	38	62
Pearlmillet[2]	fresh	–	8.5	–	–	61
Sorghum-sudangrass[1]	hay	222	11.4	65	39	61
	silage	30	9.0	67	38	62
Sorghum[1]	silage	63	10.1	56	33	56

[1] Average of samples produced in Arkansas. See FSA3043, *Composition of Selected Livestock Feeds*.
[2] Taken from *Nutrient Requirements of Beef Cattle*, 7th revised edition, issued in 1996, under the direction of the Subcommittee on Beef Cattle Nutrition, Board of Agriculture of the National Research Council.

one to seven days. High prussic acid concentrations are found in the leaves. Short, leafy plants have a higher prussic acid potential than tall, coarse ones. For this reason, the risk of prussic acid poisoning is greater in immature plants or vegetative regrowth. Also, plants wilted from drought or frost should not be grazed until they either regain a normal appearance several days after rain or after they turn brown and dry after frost. Prussic acid dissipates as the forage dries down for hay and is not a problem in well-cured hay. There is no risk of prussic acid poisoning with pearlmillet. Prussic acid can be reduced by up to 70 percent by field wilting prior to conservation as hay or silage.

Nitrogen fertilization increases the total nitrogen, prussic acid and nitrate content of summer annual forages. Apply nitrogen fertilizer with caution on any site that is droughty. Forages grown under stress can be inexpensively tested in the laboratory for nitrates. In contrast, testing for prussic acid is relatively expensive, and comparatively few laboratories offer this service.

When harvesting forages known or suspected to have dangerous levels of nitrates, a good management practice is to raise the cutter bar to a 6- to 12-inch height. Because most nitrates tend to accumulate in the lower portion of the stalk, raising the cutterbar is effective at reducing nitrates in the harvested forage. Silage fermentation can also be used as a management tool. The fermentation process normally reduces the concentration of nitrates in forages by about 50 percent.

For an in-depth discussion of nitrate poisoning in cattle, please refer to FSA3024, *Nitrate Poisoning in Cattle*.

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