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Warm-Season Annual Grasses for Summer Forage

John Fike, Professor and Extension Forage Specialist, School of Plant and Environmental Sciences, Virginia Tech; Gabe Pent, Superintendent, Shenandoah Valley AREC, and Ozzie Abaye, Professor, School of Plant and Environmental Sciences, Virginia Tech

Virginia's cool-season grass pastures are highly productive in the spring and fall, but high temperatures and short-term drought stress often limit their growth during summer months. Incorporating warm-season grasses can be a beneficial strategy for meeting feed resources during this period of forage deficit. This publication focuses on warm-season annual grasses and how to properly manage them to supply additional grazing, hay or green-chop during July and August (figure 1). Warm-season grasses require somewhat different management than cool-season forages, but they provide relatively high-quality feed resources when properly managed.

Under suitable conditions, summer annual forages germinate and emerge quickly and grow rapidly. Their high productivity and multiple uses provide flexibility for farm operations. Warm-season grasses can be grazed as needed, and excess growth can be harvested as hay or silage. They also can be used as a smother crop for weed suppression during renovation of cool-season perennial pastures and hayfields.

The same features that provide these benefits – tall form, rapid growth, and abundant biomass production – also can present challenges. Without proper management, many warm-season forages can

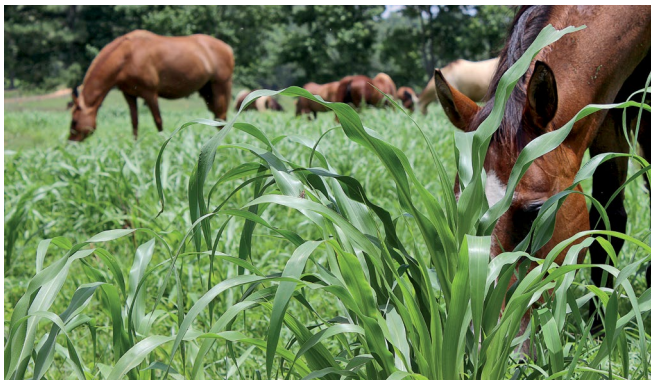

Figure 1. Warm-season grasses can fill summer production gaps for a variety of animals and with a variety of methods. Dairy cows graze forage sorghum (bottom right) and horses graze young forage millet plants (top right). These forages also can be grown for baleage, silage, and sometimes hay (top left). *Photos courtesy of David Hunsberger, King's Agriseed.*

quickly get ahead of a grazing herd, in which case they may become overly mature or have limited regrowth, or both. Warm-season forages also have annual establishment costs and potential risk of stand failure due to variable rainfall in late spring and early summer. Toxicities associated with some species largely can be avoided with appropriate management.

Several warm-season annual grasses can be grown in Virginia. These include sudangrass (*Sorghum bicolor drummondii*), forage sorghum (*Sorghum bicolor*), sorghum x sudangrass (sudex) hybrids, pearl millet (*Pennisetum americanum*), foxtail millet (*Setaria italica*), crabgrass (*Digitaria species*) and teff (*Eragrostis tef*). Generally, warm-season annual grasses should be seeded separately rather than in mixtures because they reach maturity at different times. One-third to one-half acre generally will provide adequate grazing for one mature animal during the critical summer months. Seeding half of the acreage as early as possible for your location and the remainder four to six weeks later can extend the useful period of these supplemental forages.

These grasses can be planted in combination with warm-season annual legumes such as Korean and Kobe lespedeza (*Kummerowia stipulacea* and *K. striata*) and cowpea (*Vigna unguiculata*), although adding such species increases management complexity and establishment costs. Later plantings of some warm-season annual grasses can work well when mixed with brassicas, and rotations of warm-season annuals with cool-season annuals such as small grains or annual ryegrass also can be highly productive.

Sorghum, Sudangrass, and Sorghum x Sudangrass Hybrids (Sudex)

Sorghum is a coarse, upright growing grass used for both grain and forage production. Grain sorghum is shorter and has been bred for higher grain yields. Forage sorghums grow from 6 to 15 feet tall, produce more vegetative growth and less grain, and mature later than grain types. Newer brachytic dwarf types are now available and typically will reach 4 to 6 feet at maturity. Brachytic sorghums (figure 2) are shorter because the internodes – the section of stalk between leaves – are shorter than on traditional sorghums. Leaf and grain yields are similar for both types, and dwarf types can support similar yields by tolerating a lower cutting height. They are very resistant to lodging as the grain head has less leverage on the shorter stalks.

Figure 2. Brachytic-type warm-season forages have shorter internodes between leaves on the plant. This reduces the amount of less-digestible stem. Yields can be maintained by harvesting lower to the ground, and the shorter plant resists lodging. *Photo courtesy of David Hunsberger, King's Agriseed.*

Forage sorghum is usually preferred over grain types for forage production due to a higher yield potential. Because mature sorghum seeds are relatively small and hard, the plant should be cut for silage when about half the grain is at the soft dough stage. In most cases, sorghums are

harvested once per season as either green-chop or silage. Although silage yields are similar to corn, sorghum typically is lower in energy, but this is affected by variety, seed maturity, and presence of the BMR gene (see section on BMR Genes).

Like corn, sorghums are normally planted in rows to facilitate mechanized harvesting. Sorghum is best adapted to fertile, well-drained soils that have good water-holding capacity. However, the primary advantage of using sorghum for silage production is its greater drought tolerance. Sorghums use about 40 percent less water than corn and can tolerate extended dry periods. The plants stay green in the field until they receive sufficient precipitation to re-initiate growth. Thus, sorghum may be a better fit for soils with lower water-holding capacity.

Sudangrass, a relative of sorghum used extensively in the past, declined in popularity for a time following the development of sorghum-sudangrass hybrids. Several newer releases, particularly with the BMR trait, have helped renew interest in the crop. Sudangrass is medium yielding and well-adapted to grazing. Sudangrass produces more roots and has less leaf surface than corn, features that support greater drought resistance. Fine stems, narrower leaves, and multiple tillers make sudangrass better suited for hay than forage sorghum or sorghum-sudangrass crosses. Most varieties regrow rapidly after grazing or haying, although cutting or grazing too low (below the bottom two nodes) will limit regrowth.

Sorghum-sudangrass hybrids are developed by crossing sorghum with true sudangrass. The result is a tall-growing annual grass that resembles sudangrass, but with coarser stems, a taller growth habit, and higher yields. Like sudangrass, hybrids will regrow after grazing if growth is not limited by environmental factors. Sorghum-sudangrass hybrids contain greater concentrations of prussic acid and can cause poisoning in cattle if grazed when the forage is young, drought-stressed, or frosted (see section on Prussic Acid and Nitrate Toxicity). A number of commercial varieties are available and yield differences among varieties generally are limited – though there are exceptions. Select varieties based on local availability, price, and test data from states with similar conditions to your region. Compare forages based on yield of digestible dry matter when considering BMR and non-BMR varieties.

Management for Sorghums, Sudangrasses and Their Hybrids

Soils and fertility. Sorghum, sudangrass, and their crosses are best adapted to well-drained, fertile soils, but will grow on imperfectly drained soils when surface water is removed. These grasses do not tolerate low pH and require liming when grown on acidic soils. Although sorghum will grow at a pH of 5.5, optimum production is achieved between pH 6.0 and 6.5. The pH optimum for sudangrass generally ranges from 5.8 to 6.2. Phosphorus and potassium should be applied according to soil test. About 40 pounds per acre of P2O5 and 180 pounds of K2O will be removed in a 5-7 ton silage crop. Lower rates (70 to 90 pounds) of each nutrient can be applied when the stand is grazed. In the absence of a soil test, apply 70 to 90 pounds per acre of both P2O5 and K2O prior to seeding.

Apply 60 to 80 pounds per acre of actual nitrogen at seeding and 40 to 60 pounds per acre after each cutting or grazing. A general recommendation is to apply 1 to 1.25 pounds of nitrogen for each day of growth to harvest. In this manner, 40 to 50 pounds of nitrogen would be applied at planting with an anticipated harvest or grazing at about 40 days or 40 inches in height. Using the guideline with regrowth, 30 to 40 pounds of nitrogen would be applied for a 30-day regrowth period following first harvest. Because sorghum species accumulate nitrates when stressed, it is advised to reduce or avoid nitrogen application if entering or during a period of drought.

Planting management. Sorghums and sudangrasses should be planted approximately one to two weeks after corn, when the soil temperature has reached at least 60 to 65 degrees F. Seed can be broadcast or drilled (Table 1), but the seeding rate should be adjusted accordingly. Plant into a firm, moist seedbed. If broadcasting, follow by cultipacking to ensure good soil-seed contact. Sorghum can be conventionally or no-till seeded using a corn planter or grain drill, although using corn planters will make it easier to manage row spacing. Planting too early and too deep are common causes of poor sorghum stands. Sorghum-sudan crosses generally have much bigger seeds and can be planted deeper, where moisture is more likely available.

Table 1. Seeding recommendations for sorghum, sudangrass, and sorghum-sudan hybrids.

Forage type	Seeding depth, inches*	Seeding rate by planting method		
		Singulation planter	Drill	Broadcast
		seed/acre	lb./acre	lb./acre
Sorghum	1 to 1.5	80,000-100,000**	5-10	15-20
Sudangrass	0.5 to 1	--	15-20	25-35
Sorghum-sudan hybrids	0.75 to 1.5	--	20-30	30-40

*Although planting too deep can be a problem, seeding deeper (to 1.75 inch) may be useful on sandy, droughty soils.

**Seed count per pound will vary by year and variety. Pounds per acre can be calculated as seed desired per acre divided by seeds per

Harvest management. Sudangrass and sorghum-sudangrass hybrids should not be grazed until they reach a height of 24 to 30 inches or more. Grazing/harvest management is critical to avoid potential toxicity issues (again, see the prussic acid insert) and to support regrowth. If regrowth is desired, grazing or cutting height should be maintained above the bottom two internodes; this is about 4 inches for brachytic types and closer to 6 inches for traditional varieties. For hay or baleage, harvest at the late boot to early head stage.

Although sudangrass and sorghum-sudangrass hybrids can be cut for hay, curing can be slow due to coarse stems. Mower-conditioners should be used to crush stems; this will reduce drying time considerably. Also, make mower swaths as wide as possible to increase surface area for drying. It is critical that crops made for hay be fully dried before putting in a barn to avoid fires. Wrapping bales at 40-60 percent moisture for baleage may also be an option for conserving.

Sorghum, sudangrass, and sorghum-sudangrass hybrids can also be directly ensiled. With sorghum, consider starting harvest once fields have about 80 percent of plants in head and 50 percent at soft dough stage, and a moisture percentage in the mid 60s. If the plants are too wet, it may be useful to cut and wilt before chopping. Longer (1 inch or more) chop lengths are suitable with BMR sorghums, and shorter (half-inch) lengths with traditional varieties.

Sugarcane aphids represent a potential threat to sorghum crops. The aphids suck on the bottom of leaves and take energy (sugars) from the plant. Thus, plant productivity is decreased, and, if severe, can lead to stand death. A layer of sticky, shiny "honeydew" around the base of the plant can be one of the first signs of aphids. Once detected in a region, fields should be scouted on a weekly basis. Timely application of insecticide is needed to prevent yield loss once aphid presence reaches a critical threshold. Applications generally are justified when 50 aphids per leaf are present on 25 percent of plants.

BMR Genes

The term "BMR" references the brown midrib (figure 3) common to warm-season grasses that carry this trait. Plants with the BMR mutation not only have a signature brown-colored midrib in the leaf, they typically have lower lignin and higher digestibility than non-BMR lines. In the past, this was associated with lower yield and greater lodging, but selection and breeding progress has reduced these limitations. Differences in yield and digestibility also have been observed among plants with different BMR genes (e.g., bmr-6, bmr-11, bmr-12, bmr-18). Forage testing has revealed plants with bmr-6 generally have superior nutritional value.

Figure 3. Many warm-season grasses now are available with the brown midrib mutant trait. This sorghum leaf has the distinctive brown-colored midrib. *Photo courtesy of David Hunsberger, King's Agriseed.*

Prussic Acid and Nitrate Toxicity

Prussic acid poisoning is a potential problem with sorghum and sorghum-sudangrass hybrids, and to a lesser degree with sudangrass. Under normal conditions, sorghums contain little free cyanide. However, when freezing, drought stress, wilting, or mechanical injury damages plant cells, an enzymatic reaction occurs and free cyanide is produced. In animals, cyanide is readily absorbed into the bloodstream and interferes with normal cellular respiration. Symptoms of cyanide poisoning include labored breathing, excitement, gasping, convulsions, paralysis, and death. The onset of symptoms and death is very rapid, occurring in minutes to several hours. In contrast to nitrate poisoning, the blood of animals affected by cyanide poisoning is fully oxygenated and cherry red in color.

In most situations, sorghum species pose little danger to grazing animals when properly managed. Young plants or regrowth after grazing contain higher concentrations of prussic acid and should not be grazed until plants have reached a height of 30 inches. Drought-stressed plants should not be grazed until growth has resumed after rainfall (usually 4-5 days). Plants hit by frost should not be grazed for 14 days or until the leaves are dead and dried out, whichever is longer.

Cyanide does dissipate from plant tissue; thus, hay that has been properly cured is safe to feed. Properly ensiled forage is also safe.

When forage is fed as green chop, it is important to do so in a timely manner. If the green chop is allowed to heat, cyanide is released, and the forage becomes toxic. If questionable forage must be grazed or utilized as green chop, feed dry hay along with the fresh plant material. Never turn hungry animals into questionable forage. The use of tester animals may be advisable before allowing the entire herd to graze potentially toxic forage.

Nitrate toxicity occurs when nitrates accumulate in warm-season annual grasses at toxic levels (table 2). This most often occurs when heavy nitrogen fertilization is followed by drought. When plant growth is restricted by drought, nitrates are taken up by the plant but not converted to proteins or other plant metabolites. Any factor that slows plant growth in combination with heavy nitrogen fertilization can result in nitrate accumulation. Nitrates are found in higher concentrations in the lower portion of the stem, although accumulation can be found higher in the plant and in the leaves.

In ruminants, nitrate is converted to nitrite in the rumen before being absorbed into the bloodstream. Nitrite interferes with the blood's ability to carry oxygen. Symptoms of nitrate toxicity are similar to prussic acid poisoning and include trembling, staggering, rapid and labored breathing, rapid pulse, and frequent urination followed by collapse, coma, and death. The onset of symptoms and death usually occurs within one to two hours. In animals affected by nitrate poisoning, the blood and nonpigmented skin and mucus membranes will take on a brownish chocolate color.

Nitrates are stable in hay and can cause poisoning months after harvest. In silage, nitrates can be reduced by 40 to 60 percent during the ensiling process. It is very important to have all suspect forages tested before grazing or feeding. Commercial test kits can be purchased for this purpose.

Table 2. Forage nitrate levels, safety status, and management considerations

Nitrate concentration		Safety	
—— % ——	—— ppm ——	Status	Comment
<0.25	<2,500	SAFE	Generally considered safe.
0.25-0.5	2,500-5,000	CAUTION	Can be a problem for pregnant and young animals. Limit to 50% of the ration. Do not feed with nonprotein N. Check water for nitrates.
0.5-1.5	5,000-15,000	DANGER	Limit feed to not more than 25% of the ration. Supplement with energy feeds, minerals, and vitamin A.
>1.5	>15,000	TOXIC	Forage should not be fed.

Adapted from Southern Forages, 3rd Edition (2002). Donald M. Ball, Carl S. Hoveland, and Garry D. Lacefield. Potash and Phosphate Institute, Norcross, Georgia.

Millets, Crabgrass, and Teff

Pearl and foxtail millets have smaller stems and tend to be shorter and leafier than sorghum or sudangrass and their hybrids. In general, millets also can tolerate wetter soils much better than sorghum, sudangrass, and sorghum-sudan hybrids. Pearl millet usually is preferred over foxtail millet because it regrows after cutting or grazing. Foxtail millet may be a good choice when a single-cut smother crop is desired. Similar to species in the sorghum family, pearl millet can accumulate nitrates during stressful growing conditions. However, a primary benefit of pearl millet is that it does not contain prussic acid. Like sorghum-sudangrass hybrids, pearl millet varieties show little difference in yield, and newly released BMR varieties are currently being evaluated in the Southeast. Therefore, variety selection should be based on seed availability and cost. Dwarf varieties tend to be better-suited for grazing.

Crabgrass is an aggressively-spreading stoloniferous grass that produces abundant leaves. These traits lend to its common reputation as a weed, but they also speak to its significant potential for covering soil and supplying high-quality summer forage. A primary advantage of crabgrass is that it is well-adapted to Virginia and occurs naturally in most summer pastures, especially those that have been overgrazed. Most such naturalized crabgrass is not managed to its full potential; the forage also may be best utilized in annual rotations with cool-season annual forages such as cereal rye or annual ryegrass, and it is more productive with some rotational grazing management. Some of the currently available improved crabgrass varieties include Dal's Big River, Impact, Mojo, Quick-N-Big, Quick-N-Big Spreader, and Red River. These improved cultivars can produce 8,000 to 10,000 pounds of dry matter per acre under optimum growing conditions.

Teff is a unique summer grass. An intermediate between true tropical and temperate grasses, teff also can thrive both in droughty and waterlogged soils once established. The plant is a fine-stemmed bunch grass with large crowns and many tillers that grow 10 to 50 inches tall with smooth, narrow, long leaves and slender culms (figure 4). Teff has a very shallow but massive, fibrous root system. Seeds are extremely small and great care must be taken to keep near the soil surface at planting.

Management for Millets, Crabgrass, and Teff

Soils and fertility. Pearl millet is better adapted to more acidic soils and soils with a lower water-holding capacity than sorghum, sudangrass, or sorghum-sudangrass hybrids. A pH of 5.5 to 6.5 is required for maximum production. Crabgrass is more site-sensitive and best adapted to well-drained soils such as sands, sandy loams, loamy fine sand, loams, and silt loams that

Figure 4. Teff has many tillers and a large root system once established (bottom). More typically grown for hay (top), the grass can be grazed with appropriate management that allows the root system to get large enough (middle). *Photos by Ozzie Abaye.*

do not crack extensively. Crabgrass is less productive on clays, silts, and silty-clay loams. In most cases, a pH range of 6 to 6.5 should be targeted for crabgrass, as optimum growth occurs at a slightly acidic pH. Teff is the best-suited of these forages to marginal and heavy soils. The grass grows successfully on soils with low pH and poor fertility and performs better on heavy clays than on loamy or sandy soils.

For millets and crabgrass, phosphorus and potassium should be applied according to soil test. In the absence of a soil test, apply 70 to 90 pounds per acre of both P2O5 and K2O prior to seeding. These recommendations should apply to teff as well, although these nutrient inputs have received little attention in U.S. research.

About 100 to 150 pounds of actual nitrogen per acre is recommended for millets and crabgrass. As a general rule, apply 1 to 2 pounds of nitrogen per expected growing day per acre. Nitrogen applications of 60 to 80 pounds of nitrogen per acre at seeding, followed by 40 to 60 pounds after each cutting, will support high-biomass yields. Similar or slightly lower nitrogen inputs will be acceptable for management under intensive grazing.

Do not apply nitrogen at the onset of drought conditions. Also, if nitrogen is not applied before crabgrass emergence, delay application until seedlings have started to tiller. Applying nitrogen to crabgrass seedlings in the one- to four-leaf stage may thin or kill stands.

Nitrogen application rates to teff generally are lower than for millets and crabgrass. The crop responds well to 50 to 60 pounds of nitrogen per acre. This rate can be applied at seeding and after each cut. Applications above 50 pounds of nitrogen per acre likely are not economical and often cause lodging, greatly increasing harvest difficulty.

Planting management. Pearl and foxtail millets should be planted approximately two weeks after corn, when the soil temperature has reached at least 65 degrees F. Pearl millet is more sensitive to cold stress than sorghum and can be killed by low, early spring temperatures that sorghum would survive.

Crabgrass and teff should be seeded starting in early May, when the soil temperature is at least 60 degrees F. Although these grasses can be planted into cooler (about 50 degrees F) soils, germination and emergence will be slowed.

Millets can be either conventionally or no-till seeded, while crabgrass and teff may be more easily established in a tilled, firmly packed seedbed. There is little research regarding seeding rates with no-till establishment methods for teff and crabgrass, but it can be difficult to keep planting depth shallow and consistent with a drill. Given the low seeding rates (table 3) and small seed size for crabgrass and teff, these forages may be better suited to broadcast seedings, followed by a disk harrow, cultipacker, or both (see insert on Establishing Small-seeded Forages). Coated seed may work well when drilled from the small seed box.

Table 3. Seeding recommendations for millets, crabgrass, and teff

		Seeding rate by field preparation method	
Forage type	Seeding depth, inches	Drilling, lb/acre	Broadcast, lb/acre
Foxtail millet	0.5 to 1	15-20	25-40
Pearl millet	0.5 to 1	15-20	25-40
Crabgrass	0.25 to 0.5	5-8*	3-6
Teff	0.125 to 0.5	8-12*	4-7

Establishing Small-seeded Forages

Small-seeded forages such as crabgrass and teff can be challenging to establish. In some cases, coated seed is available and can aid planting accuracy. For uncoated seed, mixing with a carrier can facilitate accurate metering and flow through grain drills and fertilizer spreaders. Carriers that can be used include fertilizer, soybean meal, cracked grain, coarse sand, pelleted or granulated lime, hard seeds such as wheat, and dry sawdust. Potential bridging and clogging problems can be avoided if carrier materials are screened prior to use. A preferred carrier mixture for crabgrass is 3-6 pounds of seed plus 94-97 pounds of dry fertilizer, with the mixture planted at 100 pounds per acre. This combination flows well through grain drills and provides needed plant nutrients.

Drills must be calibrated for seed-carrier mixtures. A good starting point for crabgrass-fertilizer mixtures is about 75 percent of the setting for wheat.

When the seed mixture is broadcast using a spinner-type fertilizer spreader, it is important to remember that the fertilizer will be spread two to three times as far as the lighter seed. In order to achieve a uniform application and correct seeding rate, the amount of seed-carrier mixture being spread should be reduced by one-third to one-half, and one-third to one-half the normal spreading swath should be taken. When using a seed-fertilizer mixture, it is important to utilize the mixture within one to two days, or the seed viability may be reduced.

Grazing and harvest management. Unlike with sorghums, there is no concern with prussic acid poisoning with millets, crabgrass, or teff, so grazing can begin earlier with these species. Crabgrass causes no known forage-related disorders in horses, making it a good choice for summer annual pastures (see insert on Horses and Summer Annual Grasses).

Pearl millet grows rapidly and may provide grazing in less than 45 to 60 days. Grazing should begin when pearl millet has reached about 18 inches in height. If regrowth is desired, do not graze closer than 8 to 12 inches. Regrowth should be managed in the same

manner. Pearl millet can be cut for hay, ensiled, or used for green-chop. Cut for hay or baleage at the late boot to early head stage or directly ensile when the grain has reached the soft dough stage.

Crabgrass can produce grazable forage in as little as 35 days, but 40 to 60 days is more typical. Rotational grazing management maintains plant productivity. Start grazing at 6 to 8 inches and stop at 3 to 4 inches. When using for hay, cut crabgrass at the early to late boot stage or at a height of 18 to 24 inches. Cutting too low, particularly if the plant has headed, can limit regrowth. Crabgrass is an annual but can be maintained over years through self-reseeding. That is, the plant must go to seed at least once during the growing season. In most cases, animals should be removed at least two to three weeks before the first expected frost in the fall to allow for reseeding. Shallow tillage or harrowing in late winter or early spring is needed to incorporate the volunteer seed and guarantee a uniform stand. In systems where a cool-season annual is established through shallow tillage in the fall, no further soil disturbance should be needed to ensure an adequate stand of crabgrass the following summer.

Teff can be grazed or harvested as a high-moisture crop and ensiled, but it most frequently has been used for hay. Like crabgrass, it is better suited for hay production than the sorghums and millets given its finer stems. Teff has feed characteristics similar to timothy, which has spurred interest in this crop for sale into horse hay markets. When harvested for hay, teff should be cut in the pre-boot to early-boot stage, usually about 50 to 55 days after planting. Subsequent harvests typically can occur 40 to 45 days after cutting. Teff regrowth depends largely on leaf area remaining after harvest. Cut teff no shorter than 3 to 4 inches to support regeneration during the growing season; cutting lower will stunt the crop.

Grazing data with teff are limited, but anecdotal evidence suggests management practices are critical to stand maintenance. Because teff is shallow-rooted, it is easily uprooted under the right conditions. If only being grazed, the first grazing should occur at the pre-boot stage or earlier so that animals do not grip stems and pull the plants out of the ground. It is also important to prevent forage losses by trampling, which causes teff to lodge. Thus, it may be advantageous to take the first harvest as a hay cut. This will allow continued root development and help the regrowth resist uprooting during grazing.

Maximizing Utilization of Summer Annual Grasses

Grazing is an efficient way to utilize warm-season annual grasses, although stocking density needs to be adjusted (relative to cool-season pastures) to manage their rapid growth. Rotational grazing maximizes production and utilization. Restrict the grazing area to supply only enough forage for one to three days. This reduces waste, protects regrowth, and eliminates the potential of prussic acid poisoning from new plant tissue. It is important to leave adequate stubble if regrowth is desired; never graze millets or sorghums closer than 5 to 7 inches. This is especially important for pearl millet, which depends more on terminal buds for regrowth.

Making baleage may be the most successful strategy for conserving the larger warm-season annual grasses. Although they can be harvested as hay, curing is often difficult. The following suggestions will help ensure rapid and successful curing:

- Do not allow forage to become overly mature; cut at 30-40 inches in height.
- Always use a cutter-conditioner to crush stems.
- Use more roller pressure than normally used for other forage crops.
- Use a higher stubble height, which helps keep forage off the ground.
- Make mower swaths as wide as possible to maximize surface area for drying.
- Do not windrow forage until plants on top of the swaths are dry enough to bale.
- Swath perpendicular to prevailing winds.

Horses and Summer Annual Grasses

Horses should not graze sorghum, sudangrass, and sorghum-sudangrass hybrids. In some cases, Sorghum species can cause cystitis, an inflammation of the bladder in equines. This can lead to urinary disorders, lack of coordination, and paralysis in severe cases. Pearl millet is generally safe for equines, but foxtail millet should be used sparingly since it may cause a laxative effect, excessive urination, and kidney and bone problems. Crabgrass and teff have not been shown to cause any disorders in horses and may therefore be a good alternative for warm-season annual pastures. Properly cured and stored hay from any of these species is safe to feed to horses and ponies.

Originally published as VCE publication 418-004 by Chris Teutsch, currently Extension Associate Professor at the University of Kentucky Research and Education Center.

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