

Warm-Season Annual Grasses for Summer Forage

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In Virginia, cool-season grasses produce ample forage in the spring and fall, but high temperatures and short-term drought stress often limit growth during the summer months. Therefore, there is a need for additional grazing, hay or green-chop during July and August. Warm-season annual grasses can fill this gap with relatively high quality forage when properly managed. Advantages to using summer-annual grasses include fast germination and emergence, rapid growth, high productivity, and flexibility of utilization. Warm-season grasses can be grazed as needed and excess growth can be harvested as hay or silage. Major disadvantages include the high cost of annual establishment and the increased risk of stand failure due to variable rainfall in late spring and early summer.

Summer-annual grasses that can be grown in Virginia include sudangrass (*Sorghum bicolor*), forage sorghum (*Sorghum bicolor*), sorghum x sudangrass hybrids, pearl millet (*Pennisetum americanum*), foxtail millet (*Setaria italica*), and crabgrass (*Digitaria* species). These species should be seeded alone rather than in mixtures since they mature at different times. One-third to one-half acre will provide adequate grazing for one mature animal during the critical summer months. Seeding one-half of the acreage as early as possible and the remainder four to six weeks later can extend the useful period of these supplemental forages. In some cases, warm-season annual grasses can be used in a double cropping system with winter annuals such as small grains or annual ryegrass.

Sorghum

Sorghum is a coarse, upright growing grass that is 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 and produce more vegetative growth and less grain. Forage sorghum is usually preferred for forage production due to a higher yield potential. In most cases, sorghums are harvested once per season as either green-chop or silage, but can

be grazed or hayed. Silage yields are similar to corn, but sorghum is lower in energy. The primary advantage of utilizing sorghum for silage production is its greater drought tolerance. Like corn, sorghums are normally planted in rows to facilitate mechanized harvesting.

Sorghum is best adapted to fertile, well-drained soils that have a good water holding capacity. Although sorghum will grow at a pH of 5.5, optimum production is achieved when the pH is maintained between 6.0 and 6.5. Phosphorus and potassium should be applied according to soil test prior to seeding. In the absence of a soil test, apply 70-90 lb/A of P₂O₅ and K₂O if the sorghum is to be grazed. Apply 60 to 80 lb/A of nitrogen at seeding and 40-60 lb/A after each cutting or intensive grazing. If forage sorghum is to be harvested as silage, fertilize as if corn silage is being grown.

Sorghum should be planted approximately one to two weeks after corn, when the soil temperature has reached at least 60° F. It can be either conventionally or no-till seeded using a corn planter or grain drill. In wide rows, seed should be planted at a rate of 5-10 lb/A. When seed is broadcast, 15-20 lb/A should be used. Seeding depth should be between 1 and 1 1/2 inches. Planting too early and too deep are common causes of poor sorghum stands.

In order to reduce the chances of prussic acid poisoning, forage sorghum should not be grazed until it reaches a height of at least 30 inches. If regrowth is desired, do not graze closer than 5-7 inches. Regrowth should be managed in the same manner. Forage sorghum can be cut for hay, but curing is difficult due to thick stems. Mower-conditioners should be used to crush stems, which reduces drying times considerably. Mower swaths should be made as wide as possible to increase surface area for drying. Cut for hay or wilted silage at the late boot to early head stage. Forage sorghum can also be direct ensiled when the seed has reached the soft dough stage.

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Forage Sorghum Facts

Common Name: Forage Sorghum

Scientific Name: *Sorghum bicolor*

Origin: Northeast Africa

Growth Characteristics: Coarse stemmed, erect, tall growing annual grass.

Adaptation: All of Virginia

Major Uses: Primarily silage, but can be used for hay and grazing.

Drought Tolerance: Very good

Soil Drainage: Well drained to somewhat poorly drained.

Weight per Bushel: 56 pounds

Number of Seed per Pound: 13,000 to 20,000

Seeding Rate: 5-10 lb/A when planted in wide rows, 15-20 lb/A when broadcast.

Seeding Date: 1-2 weeks after corn, when soil temperature is at least 60° F.

Seeding Depth: 1 to 1 1/2 inches

Time to First Grazing: 45-60 days

Expected Yield: Hay-3 to 5 tons dry matter per acre, Silage-15 to 30 tons silage per acre.

Soil pH: Will grow at 5.5, but optimum growth is obtained when pH is 6.0 to 6.5.

Fertilization: Apply phosphorus and potassium according to soil test. Nitrogen, 60-80 lb/A at establishment and 40-60 lb/A after each intensive grazing or cutting. If grown for a single cut silage crop, fertilize as if corn silage is being grown.

Seasonal Distribution: 90% of growth in June, July, and August.

Grazing Management: Must be at least 30 inches tall before grazing. Graze to a height of 5-7 inches. Manage regrowth in same manner.

Hay or Wilted Silage Management: Cut at the late boot to early head stage. Use mower- conditioner to crush stems. Use wider mower swaths to increase surface area for drying.

Direct Cut Silage Management: Chop when the seed has reached the soft dough stage.

Forage Related Disorders: *Prussic acid poisoning.* To reduce the chances of prussic acid poisoning, do not graze young, drought stressed, frosted, or damaged plants. *Nitrate poisoning.* To avoid nitrate poisoning, do not apply excessive amounts of nitrogen fertilizer. Do not graze drought stressed or slow growing plants.

Sudangrass and Sorghum-Sudangrass Hybrids

Sudangrass is a relative of sorghum that has been used extensively in the past, but has declined in popularity with the development of sorghum-sudangrass hybrids. True sudangrass possesses fine stems and regrows rapidly after grazing. It is medium yielding and well adapted to pasturing. 'Piper' and 'Wheeler' are two popular varieties that contain lower amounts of prussic acid. 'Piper' is probably the safest sorghum or sudangrass variety to graze.

Sorghum-sudangrass hybrids are developed by crossing sorghum with true sudangrass. The result is a tall growing annual grass that resembles sudangrass, but has coarser stems, 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 when young, drought stressed, or frosted forage is grazed. A number of commercial varieties are available. Extensive variety testing has shown little difference between these varieties. Therefore, variety selection should be based on local availability and price and closer attention should be paid to management.

Sudangrass and sorghum-sudangrass hybrids 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 acid soils. A pH of 6.0 to 6.5 is required for maximum production. Phosphorus and potassium should be applied according to soil test. In the absence of a soil test, apply 70 to 90 lb/A of both P_2O_5 and K_2O prior to seeding. Apply 60 to 80 lb/A of actual nitrogen

at seeding and 40-60 lb after each cutting or intensive grazing. Do not apply nitrogen at the onset of drought conditions.

Sudangrass and sorghum-sudangrass should be planted approximately two weeks after corn, when the soil temperature has reached at least 65° F. It can be either conventionally or no-till seeded. Seed can be broadcast at a rate of 25-35 lb/A for sudangrass or 30-40 lb/A for sorghum-sudangrass onto a fine, but firm seedbed, and then cultipacked to ensure good soil-seed contact. When seeding using a grain drill, reduce seeding rates to 15-20 lb/A for sudangrass and 20-30 lb/A for sorghum-sudangrass. Seeding depth should be between 1/2 and 1 inch. Seeding depths greater than 1 inch should be avoided.

Like sorghum, sudangrass and sorghum-sudangrass hybrids contain prussic acid. Sorghum-sudangrass hybrids contain higher concentrations of prussic acid than recommended varieties of sudangrass. In order to reduce the chances of prussic acid poisoning, sudangrass and sorghum-sudangrass hybrids should not be grazed until they reach a height of at least 24-30 inches. If regrowth is desired, do not graze closer than 5-7 inches. Regrowth should be managed in the same manner. Sudangrass and sorghum-sudangrass hybrids can be cut for hay, but curing is difficult due to coarse stems. Mower-conditioners should be used to crush stems, which reduces drying times considerably. Mower swaths should be made as wide as possible to increase surface area for drying. Cut for hay or wilted silage at the late boot to early head stage. Sudangrass and sorghum-sudangrass hybrids can also be directly ensiled when the grain has reached the soft dough stage.

Sudangrass and Sorghum-Sudangrass Facts

Common Name: Sudangrass and Sorghum-Sudangrass Hybrid

Scientific Name: *Sorghum bicolor*

Origin: Northeast Africa

Growth Characteristics: Erect, tall growing annual grass.

Adaptation: All of Virginia

Major Uses: Grazing, hay, and silage.

Drought Tolerance: Very good

Soil Drainage: Well drained to somewhat poorly drained.

Weight per Bushel: 25-40 pounds

Number of Seed per Pound: Sudangrass-55,000 and Sorghum-Sudangrass-20,000.

Seeding Rate: Sudangrass, 25-35 lb/A broadcast or 15-20 lb/A drilled; Sorghum-Sudangrass, 30-40 lb/A broadcast or 20-30 lb/A drilled.

Seeding Date: 2 weeks after corn, when soil temperature is at least 65° F.

Seeding Depth: 1/2 to 1 inches

Time to First Grazing: 45-60 days

Expected Yield: Hay-2 to 5 tons DM per acre, Silage-12 to 15 tons 35% DM silage per acre.

Soil pH: Optimum growth is obtained when pH is 6.0 to 6.5.

Fertilization: Apply phosphorus and potassium according to soil test. Nitrogen, 60-80 lb/A at establishment and 40-60 lb/A after each intensive grazing or cutting.

Seasonal Distribution: 90% of growth in June, July, and August.

Grazing Management: Must be at least 24-30 inches tall before grazing. Graze to a height of 5-7 inches. Manage regrowth in the same manner.

Hay or Wilted Silage Management: Cut at the late boot to early head stage. Use mower- conditioner to crush stems. Use wider mower swaths to increase surface area for drying.

Direct Cut Silage Management: Chop when the seed has reached the soft dough stage.

Forage Related Disorders: *Prussic acid poisoning.* To reduce the chances of prussic acid poisoning, do not graze young, drought stressed, frosted, or damaged plants. *Nitrate poisoning.* To avoid nitrate poisoning, do not apply excessive amounts of nitrogen fertilizer. Do not graze drought stressed or slow growing plants.

Foxtail and Pearl Millet

Millet has smaller stems and tends to be leafier than forage sorghum, sudangrass, and sorghum-sudangrass hybrids. *Pearl Millet* is usually preferred over *Foxtail Millet* since it will regrow after cutting or grazing. Foxtail millet may be a good choice when a single cut smother crop is desired. 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. Therefore, variety selection should be based on seed availability and cost. Dwarf varieties are available and tend to be better suited for grazing.

Pearl millet is better adapted to more acid 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. Phosphorus and potassium should be applied according to soil test. In the absence of a soil test, apply 70 to 90 lb/A of both P₂O₅ and K₂O prior to seeding. Apply 60 to 80 lb/A of actual nitrogen at seeding and 40-60 lb after each cutting or intensive grazing. Do not apply nitrogen at the onset of drought conditions.

Pearl millet and foxtail millet should be planted approximately two weeks after corn, when the soil temperature has reached at least 65° F. Pearl millet is more sensitive to cold stress than sorghum and may be killed by low temperatures in early spring when sorghum is not. It can be either conventionally or no-till seeded. Seed can be broadcast at a rate of 25-40 lb/A onto a fine, but firm seedbed, and then cultipacked to ensure good soil-seed contact. When seeding using a grain drill, reduce seeding rate to 15-20 lb/A. Seeding depth should be between 1/2 and 1 inch. Seeding depths greater than 1 inch should be avoided.

Pearl millet grows rapidly and will provide grazing in as little as 45 to 60 days. Unlike *Sorghum* species, there is no concern with prussic acid poisoning, so grazing can begin earlier. Grazing should begin when pearl millet has reached a height of 18 inches. If regrowth is desired, do not graze closer than 8-12 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 wilted silage at the late boot to early head stage. Pearl millet can be direct ensiled when the grain has reached the soft dough stage.

Pearl Millet Facts

Common Name: Pearl Millet

Scientific Name: *Pennisetum americanum*

Origin: North Central Africa

Growth Characteristics: Erect, leafy, annual grass that grows from 3-8 feet tall.

Adaptation: All of Virginia

Major Uses: Excellent summer grazing, can be used for hay and silage.

Drought Tolerance: Very good, better adapted to sandier soils than *Sorghum* species.

Soil Drainage: Well drained to somewhat poorly drained.

Weight per Bushel: 45-55 pounds

Number of Seed per Pound: 86,000

Seeding Rate: 25-40 lb/A broadcast or 15-20 lb/A drilled.

Seeding Date: 2 weeks after corn, when soil temperature is at least 65° F.

Seeding Depth: 1/2 to 1 inches

Time to First Grazing: 45-60 days

Expected Yield: Hay-2 to 4 tons DM per acre.

Soil pH: Optimum pH is 5.5 to 6.5, better adapted to lower pH than *Sorghum* species.

Fertilization: Apply phosphorus and potassium according to soil test. Nitrogen, 60-80 lb/A at establishment and 40-60 lb/A after each intensive grazing or cutting.

Seasonal Distribution: 90% of growth in June, July, and August.

Grazing Management: Start grazing at 18 inches tall. Graze to a height of 8-12 inches. Manage regrowth in same manner.

Hay or Wilted Silage Management: Cut at the late boot to early head stage. Use mower- conditioner to crush stems.

Direct Cut Silage Management: Chop when the seed has reached the soft dough stage

Forage Related Disorders: *Nitrate poisoning*. To avoid nitrate poisoning, do not apply excessive amounts of nitrogen fertilizer. Do not graze drought stressed or slow growing plants.

Crabgrass

Crabgrass is commonly considered a weed, but possesses significant potential for 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. However, most native crabgrass is not managed to its full potential. 'Red River' is the only variety of improved crabgrass available. Crabgrass productivity is determined by available moisture and nitrogen fertilization. 'Red River' crabgrass can produce 8,000 to 10,000 pounds of dry matter per acre under optimum growing conditions.

Crabgrass is best utilized in rotation with a cool-season annual crop such as rye or annual ryegrass.

Crabgrass is best adapted to well-drained soils such as sands, sandy loams, loamy fine sand, loams, and silt loams that do not crack extensively. Crabgrass will produce on moist clay loams, but produces only moderately on clays, silts, and silty-clay loams. Optimum growth occurs at a slightly acid pH. In most cases a pH range of 6 to 6.5 should be targeted. Phosphorus and potassium should be applied according to soil test. In the absence of a soil test, apply 70-90 lb/A of both P₂O₅ and K₂O. Nitrogen

fertilization on crabgrass should be in the range of 75 to 150 lb/A of actual nitrogen. As a general rule, apply 1 to 2 lb of nitrogen per expected growing day per acre. Nitrogen can be applied as either a single application at seeding or tillering or a split application with 1/2 to 2/3 of the total being applied at seeding or tillering and the remainder after the first harvest or grazing. 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.

Crabgrass should be seeded starting in early May, when the soil temperature is at least 60^o F. It is best established by broadcasting seed onto a fine, but firm seedbed, at a rate of 3-6 lb/A followed by cultipacking. The seeding depth should be 1/4 to 1/2 inch. In most cases, crabgrass must be mixed with a carrier to facilitate accurate metering and flow through grain drills and fertilizer spreaders. There are a number of carriers that can be used including fertilizer, soybean meal, cracked grain, coarse sand, pelleted or granulated lime, hard seeds such as wheat, and dry saw dust. Potential bridging and clogging problems can be avoided if carrier materials are screened prior to usage. A preferred carrier mixture for crabgrass is 3-6 lb of seed + 94-97 lb of dry fertilizer with the mixture planted at 100 lb/A. 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% 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 1 to 2 days, or the seed viability may be reduced.

Crabgrass can produce grazable forage in as little as 35 days, but normally 40 to 60 days is required. Like pearl millet, it does not contain prussic acid. In addition, no known forage related disorders are caused in horses, making it a good choice for summer annual pastures. Crabgrass must be grazed rotationally in order to maintain productivity. Grazing can be started at 6 to 8 inches and stopped at 3 to 4 inches. Hay should be cut at the early to late boot stage or at a height of 18 to 24 inches. Crabgrass is an annual that acts like a perennial through reseeding. Therefore, it 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 in late winter or early spring is needed to incorporate the volunteer seed and guarantee a uniform stand.

Crabgrass Facts

Common Name: Crabgrass

Scientific Name: *Digitaria* species

Origin: Southern Africa

Growth Characteristics: Annual with creeping growth habit, long runners, and very leafy.

Adaptation: All of Virginia

Major Uses: Excellent summer grazing, can also be used for hay and silage.

Drought Tolerance: Fair to good

Soil Drainage: Well drained soils that do not crust severely.

Weight per Bushel: 25 pounds

Number of Seed per Pound: 825,000

Seeding Rate: 3-6 lb/A pure live seed (PLS).

Seeding Date: Early May, when soil temperature is consistently 60 to 70^o F.

Seeding Depth: 1/4 to 1/2 inches

Time to First Grazing: 30-45 days under good growing conditions.

Expected Yield: Hay-2 to 6 tons DM per acre.

Soil pH: Prefers slightly acidic pH, target should be 6.0 to 6.5.

Fertilization: Apply phosphorus and potassium according to soil test. Nitrogen, 75 to 150 lb/A annually as either single application early in season or split application 1/2 to 2/3 early in season and remainder after first cutting. Do not apply nitrogen to seedlings in 1-4 leaf stage.

Seasonal Distribution: 90% of growth in June, July, and August.

Grazing Management: Start grazing at 6-8 inches tall. Graze to a height of 3-4 inches. Manage regrowth in same manner.

Hay, Green Chop or Wilted Silage Management: Cut at the early to late boot stage or at a height of 18-24 inches.

Forage Related Disorders: *Nitrate Poisoning.* Although crabgrass can accumulate nitrates in rare situations, few cases of poisoning have been documented.

Maximizing Utilization of Summer Annual Grasses

The most efficient way to utilize summer annual grasses is by grazing. These grasses should be rotationally grazed to maximize production and utilization. The grazing area should be restricted to supply only enough forage for 1-3 days to reduce waste, protect regrowth, and eliminate 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 5-7 inches. This is especially important for pearl millet, which depends more on terminal buds for regrowth.

Although summer annual grasses 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.

Forage Related Disorders

Nitrate Toxicity

Nitrates can accumulate in summer annual grasses at toxic levels (Table 1). This most often occurs when heavy nitrogen fertilization is followed by drought. Nitrates are taken up by the plant but not utilized, since plant growth is restricted by the drought. Any factor that slows plant growth in combination with heavy nitrogen fertilization can result in nitrate accumulation. In cattle, nitrate is converted to nitrite in the rumen, and the nitrite is absorbed into the blood stream. Nitrite interferes with the blood's ability to carry oxygen. Symptoms of nitrate poisoning include trembling, staggering, rapid and labored breathing, rapid pulse, frequent urination followed by collapse, coma, and death. The onset of symptoms and death is rapid and usually occurs within one to two hours. In animals affected by nitrate poisoning, the blood will take on a brownish chocolate color, along with nonpigmented skin and mucus membranes. Nitrates are stable in hay and can cause poisoning months later. When high nitrate forage is harvested as silage, nitrates can be reduced by 40-60% during the ensiling process.

It is very important to have all suspect forages tested before grazing or feeding. Testing is available at Virginia Tech's Forage Testing Lab. Contact your local Extension agent for more information.

Table 1. Nitrate levels in forages.

Nitrate Concentration	Forage	Status	Comments
---%---	---ppm---		
0-0.25	0-2,500	SAFE	Generally considered safe.
0.25-0.5	2,500-5,000	CAUTION	Can be a problem for pregnant and young animals. Limit to 1/2 of ration. Do not feed with non-protein N. Check water for nitrates.
0.5-1.5	5,000-15,000	DANGER	Limit to 1/4 of ration. Supplement with energy, minerals, and vitamin A.
Over 1.5	Over 15,000	TOXIC	Forage should not be fed. If forage must be fed, limit to less than 15% of ration.

Adapted from Southern Forages, 1996.

Prussic Acid Poisoning

A potential problem with sorghum, sudangrass, and sorghum-sudangrass hybrids is prussic acid or cyanide poisoning. Under normal conditions the sorghums contain little free cyanide. However, when freezing, drought stress, wilting, or mechanical injury damages plant tissue, an enzymatic reaction occurs and free cyanide is produced. The cyanide is readily absorbed into the bloodstream where it interferes with normal cellular respiration. Symptoms of cyanide poisoning are similar to nitrate poisoning and 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 that have been frosted 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; therefore, hay that has been properly cured is safe to feed. Properly ensiled forage is also safe to feed. When forage is being utilized as green chop, it is important to feed the green chop 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.

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. This can lead to urinary disorders, lack of coordination, and paralysis in severe cases. Although pearl millet is generally safe for equines, foxtail millet should be used sparingly since it may cause a laxative effect, excessive urination, and kidney and bone problems. Crabgrass has not been shown to cause any disorders in horses and may therefore be a good alternative for summer annual pastures. Properly cured and stored hay from any of these species is safe to feed to horses and ponies.

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