



Summer Annual Forages

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Summer annual forages are warm-season grasses that tolerate hot, dry weather and are adapted to most areas of Kansas. They include forage sorghums, sudangrass, sorghum-sudangrass hybrids, hybrid pearl millet (*Pennisetum glaucum*), and foxtail millet (*Setaria italica*). The timeliness of growth and the potential for high-yielding, high-quality forage can make summer annuals an important component of forage programs.

Selecting a type or variety of summer annual should be based on the needs of individual livestock programs. Summer annual grasses have different growth characteristics which influence how they are best used. Large differences in yield and quality occur among species, varieties, and hybrids. Many cultivars are adapted to specific areas in Kansas.

Sudangrass. Sudans produce less forage than most other summer annuals, but their small stems, extensive tillering, and rapid regrowth potential are ideal for grazing and haying operations.

Hybrid sudangrasses are variety crosses that are more productive than the parents. They primarily are used for grazing, haying, and green chop operations.

Sorghum-sudangrass hybrids. Sorghum-sudangrass hybrids are the most common summer annual grasses in Kansas. They can produce high forage yields, but over 50 percent of the production is stem. Consequently,

the plants are better suited for silage or green chop than grazing.

Forage Sorghum. Forage sorghums are robust plants with succulent stems that mature late in the growing season. They produce high yields but have limited regrowth ability, making them best suited for one-cut silage operations.

Hybrid Pearl Millet. Hybrid pearl millet is a leafy summer annual that is more drought-resistant than sudangrass. Because it has high forage quality and regrows rapidly, it is ideally suited for haying and grazing operations. Hybrid pearl millet, however, is sensitive to overgrazing, and at least eight inches of stubble is necessary for regrowth.

Foxtail Millet. Foxtail millet has low quality and palatability, and forage yields are relatively poor. It is shallow-rooted and easily pulled out of the ground when grazed. If harvested after heading, the awns and bristles can injure livestock. Foxtail millet has limited value in Kansas because other summer annuals are better suited for forage programs.

Planting

Time of Planting.

Summer annuals should be planted when the soil temperature reaches 70°F to 75°F. Planting in cooler soils reduces seed germination and emergence. Hybrid pearl millet and foxtail millet seeds are particularly intolerant of cold, wet soils and should not be planted until late May or early June.

Seeding date should be timed so the forage becomes available when it is needed. It usually takes four to six weeks after planting before summer annuals can be used.

Seeding Method. Most summer annuals can be planted with a grain drill. Sorghums usually are planted in 30-inch rows, but row width has little effect on total forage production.

Optimum planting depth of summer annual grasses varies with soil type and moisture, but generally is 1–1½ inches. Hybrid pearl millet and foxtail millet have small seeds and should be planted three-fourths to one inch deep. Germination is enhanced by covering the seed with moist soil to provide firm seed-to-soil contact.

Seeding Rate. Seeding rates for summer annuals are relatively high because only 65–70 percent of the seeds normally emerge. Rates vary across the state depending upon plant variety, rainfall, growing conditions, and intended use of the forage.

When drilling in narrow rows, hybrid pearl millet and forage sorghums should be planted at 10–20 pounds per acre; foxtail millet planted at 15–30 pounds per acre; and sudangrasses and sorghum-sudangrass

hybrids planted at 20–25 pounds per acre. Seeding rate of forage sorghums planted in wide rows is 4–6 pounds per acre. Use the lower rates in dry areas and the higher rates in irrigated areas. For pasture and hay operations, seed at the higher rates to produce plants with fine stems.

Fertilization

Summer annual forages have nutrient requirements similar to grain sorghum and must be fertilized to be productive. Fertilizer and lime needs are best determined by soil tests.

Nitrogen is the nutrient most frequently lacking for optimum production. On nitrogen deficient soils, apply 30–40 pounds of nitrogen per acre for each expected ton of dry matter production. Split applications provide better nutrient distribution and reduce the potential for nitrate or prussic acid toxicity. Nitrate accumulation is likely if excessive nitrogen is applied or if production is limited by drought. To minimize nitrate accumulation potential, application rates should be based on a profile nitrogen soil test and previous crop and manure credits.

Phosphorus, potassium, and other nutrient applications should be based on soil test recommendations. Because phosphorus does not appreciably move in the soil, it should be applied either preplant or banded at seeding. Lime is recommended if the soil pH is 6.0 or less in the eastern third of the state, or less than 5.5 in other areas. Iron chlorosis is likely a problem on calcareous, high pH soils in central and western Kansas. Foliar application of iron and preplant incorporated manure are the most effective methods of correcting iron chlorosis; however, manure should not supply nitrogen in excess of recommended nitrogen rates.

Weeds

Rapidly growing summer annual grasses are competitive with weeds that emerge after seeding, and weed control

may not be cost-effective. Cultivation can control weeds if row spacing is adequate.

Herbicides are an alternative for problem weed species, although there are few herbicides labeled for weed control in most summer annual forages. Atrazine may be either soil-applied or foliar-applied on forage sorghum and sorghum-sudan hybrids. Other herbicides are brand specific and should not be applied unless specifically approved on the label. **Follow label instructions carefully and use herbicides with caution.** Refer to the annual KSU Extension publication, “Chemical Weed Control for Field Crops, Pastures, Rangeland, and Noncropland,” for recent information on herbicides for summer annual forages.

Insects

Many summer annual forages are susceptible to insects that attack sorghums. Infestation problems vary throughout the state and from season to season. Greenbugs generally are a concern because they occur statewide and are capable of causing serious damage to sorghums and sudangrasses. Hybrid pearl millet is highly resistant to greenbug damage.

Chinch bugs are often a problem in central and eastern Kansas, particularly during dry seasons or if the summer annual is planted into wheat stubble. Heavy infestations of destructive insects may necessitate spraying with an approved insecticide. **Follow label directions carefully when applying insecticides.**

Utilization

Harvesting summer annuals depends upon the livestock operation, weather, available equipment, storage facilities, and the needs, abilities, and preferences of the producer.

Grazing. Sudangrasses and hybrid pearl millets can provide high-quality forage when the nutritional requirements of livestock are not being met by native pasture. Sorghum-sudangrass

hybrids can be grazed, but are less palatable than sudans or hybrid pearl millet, and livestock performance is lower. Because forage sorghums have thick stems, limited regrowth ability, and are notorious prussic acid producers, they are undesirable for grazing operations.

The objective of a grazing program is to keep the plants in a vegetative stage and prevent them from seeding. Sudangrasses and hybrid pearl millet should not be grazed until 18 inches tall; sorghum-sudangrass hybrids should not be grazed until 24–30 inches tall. Ideally, the pasture should be rapidly grazed to a six- to eight-inch stubble, rested until regrowth reaches the appropriate height, and then regrazed. Overstocking removes too much stubble and severely reduces regrowth production. At the other extreme, if a pasture is understocked, the plants mature and become stemmy. Forage production thus is wasted because cattle selectively graze the leaves and avoid the stems. If the grass is more than 36 inches high, remove the cattle and cut the forage for hay or silage.

Summer annual grazing programs may either supplement or complement native grass. A supplementary system allows livestock to graze summer annual pasture simultaneously with native range. Supplementary systems require tillable land adjacent to native range at an approximate ratio of one acre cropland to three acres rangeland. Once the summer annual is ready to graze, cattle are allowed free access between native and planted forages.

In complementary or sequential grazing programs, native and summer annual pastures are grazed as separate entities. Livestock are moved from native grass to summer annual pasture around mid-July and remain until the end of the growing season. The livestock thus receive a higher quality forage, and the late-season rest benefits native range by increasing vigor of the perennial grasses.

Complementary annual pastures often are continuously grazed during the summer because that approach requires minimal management and labor input. Continuous grazing of summer annual pastures, however, is wasteful and inefficient. Depending upon moisture, fertility, and temperature, regrowth varies widely from week to week through the growing season. Because stocking rates cannot be periodically adjusted to correspond with fluctuations in forage production, continuously grazed complementary pastures generally either are under- or overused.

Highest stocking rates and most efficient use of summer annual pastures are obtained with a rotational grazing system. This system involves subdividing a pasture and stocking one section with enough cattle to graze the plants to a six- to eight-inch stubble in 10–14 days. The cattle then are moved to the next field. With three or more fields in the rotation, the planting dates can be staggered so the cattle are sequentially rotated to a field that is ready to graze (Table 1). Implementing a rotational system requires controlled management and constant monitoring because the number of days each field is grazed in succeeding rotations varies according to regrowth production. Applying 30 pounds of nitrogen per acre after the cattle are removed will hasten regrowth.

With a rotational grazing system, summer annuals can provide nearly 90 days of high-quality forage. During

this time, each acre can supply forage for two to six yearling steers. Actual stocking rates are difficult to predict because they depend upon plant species, cattle size, soil type, fertilization, moisture, and other managerial and environmental factors. Highest stocking rates occur with irrigation, fertilization, and attentive planning. Until the ability and commitment of each producer is established through experience, conservative stocking is a prudent approach.

Hay. Sudangrasses and hybrid pearl millets are best adapted for hay operations. Sorghum-sudangrass hybrids can be cut for hay, but their thick stems are difficult to cure, and crushing, crimping, or a hay conditioner is required to speed drying.

For high-quality hay, plants should be cut before the heads emerge. Harvesting after heading substantially reduces forage quality. Summer annuals can produce two or three hay crops if six to eight inches of stubble is left for regrowth. Applying 30 pounds of nitrogen after the first cutting will hasten regrowth and increase protein content.

Silage. Forage sorghums and sorghum-sudangrass hybrids are best suited for silage. Important characteristics of a variety or hybrid include potential yield, quality, and grain production. Late-maturing hybrids may produce high forage yields but little or no grain. Highest quality silage is from forages having at least 20 percent of their dry matter as grain.

Moisture content in the forage is a critical factor affecting sorghum silage. Harvest should be delayed until the hard dough stage when the plant water content normally reaches 60–70 percent. If cut earlier, the forage must be field wilted or mixed with dry feed to reduce moisture levels. High moisture silage becomes moldy, low-quality, and unpalatable. For more detailed information, see KSU Extension publication AF-144, “Producing Sorghum Silage,” and Experiment

Station Bulletin SB-642, “Summer Annual Forages for Livestock Production in Kansas.”

Haylage (Low-Moisture Silage). Haylage is low-moisture forage that has higher dry matter than silage. The forage is cut when it is 30–50 inches tall, left to wilt until the moisture content reaches 40–50 percent, and ensiled in an airtight silo. Haylage that is too dry will not preserve and can heat spontaneously if exposed to oxygen.

Green Chop. Sorghum-sudangrass hybrids are best suited to a green chop program. Once the crop reaches 30 inches it can be cut and fed daily as needed. With a cutting height of six to eight inches and adequate moisture and fertility, the regrowth can be harvested within 30 days.

Green chop is high-protein forage and commonly is fed to dairy cattle and other high-producing livestock. Field losses are low, but forage quality varies throughout the season. After heading, quality and digestibility are greatly reduced. The harvested forage should be fed immediately after cutting and not allowed to wilt and heat in the wagon or feed bunk.

Livestock Poisoning Potential

Summer annual forages may be potentially dangerous to livestock. Horses occasionally develop kidney problems and bladder paralysis if sorghums, sudangrasses, or foxtail millet are a major component of the diet. Hybrid pearl millet does not cause cystitis. New cultivars have reduced the hazard; however, horses should not consume high amounts of sorghums, sudangrasses, or foxtail millet.

Nitrate Toxicity. Under certain environmental and managerial conditions, all summer annual forages can accumulate potentially toxic nitrate levels. When plants are stressed by drought, shade, frost, or temperature extremes, nitrates accumulate. Heavy nitrogen fertilization, especially late in

Table 1. Rotational grazing scheme for summer annual forages.

- Pasture A.** Plant in late May. Begin grazing when the grass is 18 inches high. Move cattle to Pasture B when the stubble height reaches 6–8 inches.
- Pasture B.** Plant 10–14 days after Pasture A. Allow cattle to graze until stubble height reaches 6–8 inches and then move to Pasture C.
- Pasture C.** Allow cattle to graze until stubble height reaches 6–8 inches and then move back to Pasture A.

the growing season, increases the likelihood of nitrate accumulation.

Nitrates normally are highest in young plant growth; however, concentrations remain high in mature sorghum and sudangrass. Highest levels occur in the lower one-third of the plant stem. Thus, the cutter bar should be raised 6–12 inches to exclude basal stalks. Nitrate concentrations remain virtually unchanged over time if summer annuals are harvested for hay.

Potentially troublesome plants, such as sorghum and sudangrass, should be analyzed before feeding. Environmental conditions in Kansas create high nitrate concentrations in some forages virtually every year. Consequently, analysis is necessary to determine if the feed is potentially toxic. Toxicity is related to the total amount of forage consumed and how quickly it is eaten. Generally, if forages contain more than 6,000 ppm nitrate, they should be considered potentially toxic (Table 2.)

High nitrate forages still can be fed if proper precautions are taken. These include not feeding to hungry, sick, pregnant, or stressed animals; diluting the forage with other feeds; supplementing grain; and gradually adapting the animal to increasing nitrate amounts.

Prussic Acid Poisoning. Prussic acid, or hydrogen cyanide (HCN) poisoning, is caused by cyanide

Summary

Summer annual forages suitability potential.

Utilization	Pearl Millets	Sudans	Sorghum-Sudans	Forage Sorghums
Grazing	Excellent	Excellent	Fair	Poor
Haying	Excellent	Excellent	Fair	Poor
Silage	Fair	Fair	Excellent	Excellent
Green Chop	Fair	Fair	Good	Excellent

production in some summer annual forages under certain growing conditions. Sorghums and sudangrasses are commonly involved with prussic acid poisoning, but cultivars and hybrids vary widely in their potential cyanide production. Toxic cyanide levels are not a problem with pearl millet and foxtail millet.

Cyanide is concentrated in young, actively growing leaves. Prussic acid poisoning is commonly associated with cattle grazing new shoot growth at the end of a summer drought or after the first autumn frost. Plants growing in soils high in nitrogen and low in phosphorus and potassium tend to have high cyanide concentrations.

Precautions to avoid prussic acid poisoning include not allowing hungry or stressed animals to graze where prussic acid may be a problem; feeding grain or hay before turning animals to pasture; and not allowing animals to

graze sorghum after a light frost or after rain has ended a summer drought. The minimum plant height for safe grazing is 18 inches for sudangrass and 24–30 inches for sorghum-sudangrass hybrids. After a killing frost, cyanide is slowly released and the plant can be grazed after four days if no regrowth occurs.

Nitrate and prussic acid toxicity problems can be minimized with careful management. Their potential occurrence should not be a deterrent for incorporating summer annuals into a forage program. For more detailed information, see KSU Extension publication MF-1018, “Nitrate and Prussic Acid Toxicity in Forage.”

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Table 2. Level of nitrate in forage (dry matter basis) and potential effect on animals.

ppm Nitrate	Effect on Animals
0-3,000	Virtually safe.
3,000-6,000	Moderately safe in most situations; limit use for stressed animals to 50% of the total ration.
6,000-9,000	Potentially toxic to cattle depending on the situation; should not be the only source of feed.
9,000 and above	Dangerous to cattle and often will cause death.

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