Forages are the foundation of a successful pasture-based dairy. So when forage yield or quality drops, so does milk production. Successful forage systems consider more than annual forage yield or milk production per acre. They also consider plant persistence, long-term sustainability, cost per unit of milk produced and, ultimately, profitability. Graziers should consider all of these factors before developing a forage system for their farms.

From a biological perspective, there are three important concepts to understand when planning a forage system:

1. Forage yield and yield distribution
2. Forage quality
3. Stand persistence or reliability

Although all three factors are interrelated, we'll take a look at each of them separately.

**Forage yield and yield distribution**

Many producers consider yield the most important attribute for any forage. And no doubt, forages that do not yield well cannot be part of a productive forage program. But annual yield alone should not be used to select forages for pasture-based systems. For these systems, distribution of yield throughout the growing season is far more important than annual yield.

As an example, let's consider the two forages in Figure 5.1. Notice that forage “A” and forage “B” have the same annual yield. However, forage “A” produces 80 percent of its growth in May while forage “B” has a more even distribution of yield throughout the growing season. Forage “A” might be great for hay production, but forage “B” would be far superior for grazing all season long.

Although forages vary in their seasonal yield distribution, no forage is productive during all seasons of the grazing year. An important principle for developing a productive forage program for a pasture-based dairy is using the inherent differences in seasonal growth patterns to provide grazing for as much of the year as possible. We have tried to simplify this process by providing diagrams throughout the rest of the chapter that show the typical yield distribution for several forages used in Missouri. Use these diagrams to build a forage system that provides grazing for as much of the season as possible.

**Forage quality**

Almost any “mainstream” forage can be managed for dairy-quality feed. Some forages inherently contain more energy and protein than others, but nearly any can be managed to produce milk from pasture. The overriding concept here is that forage must be kept in a vegetative stage of growth to be of acceptable quality for milk production. In practice, this means that most cool-season grasses and short warm-season grasses such as bermudagrass and caucasian bluestem should be grazed when they reach 5 to 8 inches in height. Tall warm-season grasses should be grazed when they are 10 to 14 inches high. Waiting any longer than this will reduce forage quality as well as milk production.

Keeping the grass in a vegetative stage of growth may be difficult to accomplish on a whole-farm basis, especially in late spring. During this time of year, grass growth often exceeds what the milking herd can consume. Paddocks that become
more mature than the guidelines mentioned above should be "skipped" in the rotation and the milking herd “moved forward” to less mature paddocks. The "skipped" or mature paddocks should be harvested for hay or silage or grazed by dry cows or other nonlactating livestock as soon as is feasible. These paddocks can again be part of the rotation for the milking herd after the grass has been harvested and shows 5 to 8 inches of regrowth.

**Stand persistence or reliability**

Many producers undervalue long-term stand persistence of many perennial forage species. Considering that it costs $50 to $150 per acre to establish a new forage, it pays to make stands last.

Although we tend to equate persistence with the survival of individual plants, from a producer's perspective we are more interested in the "persistence of yield or productivity." In some cases, stand persistence may be the survival of individual plants, but in other instances it may involve the natural reseeding capability of a species (i.e. annual lespedeza or crabgrass). What is important to know is what “mechanism” each species uses to persist. For instance, birdsfoot trefoil is a short-lived perennial legume. It is short-lived because it is susceptible to several root and crown rot diseases. But if birdsfoot trefoil is given a 45- to 60-day rest period to reseed every other year, stands can last almost indefinitely. Its mechanism for persistence is reseeding. Similarly, annual lespedeza and crabgrass pastures can almost act as perennials if given a reseeding period each year.

On the other hand, a species such as alfalfa does not reseed well in Missouri. Instead, it relies on the survival and development of the individual plants that were seeded. Thus, its mechanism for persistence is plant longevity. Species that use plant longevity to persist must be carefully selected so that adapted varieties are planted. For these types of forages, it is most important to select varieties that can tolerate less than ideal soil or environmental conditions or that show resistance to common diseases or insects.

Another mechanism for persistence is vegetative propagation. An example is smooth bromegrass. Smooth bromegrass has rhizomes, or “underground runners,” that continually develop new plants to thicken the stand. Forages that use this persistence mechanism are often among the easiest to maintain. In summary, understanding what mechanism your forages use to persist is the first key to managing for maximum stand life.

Another factor that influences stand persistence is the soil environment. The most important aspects of the soil environment are the depth, drainage and fertility of your soils. For example, alfalfa is one of the most productive and nutritious forages available on well-drained and fertile soils. However, it does not survive well on poorly drained soils and does not tolerate low soil fertility. In this situation, a better choice might be to plant reed canarygrass and manage it to provide dairy-quality feed.

Picking a species adapted to your soil environment is key to a persistent forage. Table 5.1 lists the tolerance of many forages to poor soil drainage and low soil fertility. Use it as a guide to choose a species that matches the soil environment of your operation.

Forages also should be selected for cold hardiness and drought tolerance. Many forages might survive a mild winter or a wet summer, but what happens when growing conditions are less than ideal? It is under these conditions that differences in forage species become apparent. For instance, if we have a wet, cool summer, both timothy and orchardgrass persist quite well. However, when the weather turns dry, timothy does not persist as well because it has a shallower root system. Table 5.1 should be helpful in selecting a forage that can withstand less than ideal growing conditions.

Management also plays a vital role in stand persistence. Almost no forage can survive poor management and be productive. The major management factors that influence stand persistence are grazing frequency, residual leaf area after grazing and planned rest periods for reseeding or fall growth. For more information on the management factors that influence stand persistence, see Chapter 6, “Developing and Managing a Forage Program.”

**Summary**

There are several forages available to graziers. Selecting a set of forage species that considers yield distribution, forage quality and stand persistence is key to building a successful forage system for a pasture-based dairy. Before planning a forage system, take a few minutes to become familiar with the key characteristics of the forages adapted to your region. The rest of this chapter provides an overview of both the advantages and disadvantages of perennial and annual forages. It also lays a foundation for understanding how to put these species to work in your pasture-based dairy.
<table>
<thead>
<tr>
<th>Species</th>
<th>Yield potential</th>
<th>Tolerance to poor drainage</th>
<th>Tolerance to low soil fertility</th>
<th>Tolerance to drought</th>
<th>Tolerance to heat</th>
<th>Cold hardiness</th>
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</table>
Annual ryegrass

Annual ryegrass is increasingly being used for fall and winter pasture, particularly in southern Missouri. Annual ryegrass is easy to establish and, under ideal conditions, capable of producing 2,000 to 3,000 lb/acre of forage within 60 days of planting. If you manage to leave a 3- to 4-inch stubble, total season yields can approach 10,000 lb/acre in southern Missouri. Like tall fescue, annual ryegrass retains its forage quality well over the winter. In a vegetative state, annual ryegrass is often more than 18-percent crude protein and has acid detergent fiber (ADF) levels of less than 26 percent. As a result, dairy cattle milk well on it. The drawbacks to annual ryegrass are a lack of winter hardiness, particularly from unadapted cultivars, and annual establishment costs.

PRODUCTION AND MANAGEMENT TIPS FOR ANNUAL RYEGRASS

**Origin:** Southern Europe
**Adaptation to Missouri:** Best adapted to southern Missouri.
**Overwintering ability:** Good for adapted cultivars; poor for common seed or unadapted cultivars.
**Growth habit:** Nearly sod-forming grass.
**Tolerance to drought:** Fair

**Tolerance to poor drainage:** Good
**Defining characteristics:** Long leaves that show rolled vernal. Can be distinguished from perennial ryegrass because annual types have prominent awns and long auricles.
**Ease of establishment:** Easy
**Seeding rates:** Broadcast 30 lb/acre; drilled 20 lb/acre.

**Seeding dates:** Aug. 15 to Sept. 15
**Preferred seeding depth:** 1/4 inch
**Months from seeding to first grazing:** 2
**Preferred soil pH:** 5.5 or higher
**Fertilization:** 75 lb N/acre at establishment. Apply an additional 40 to 60 lb N/acre in late February and again in early April. Phosphorus and potassium to soil test.
**Timing of production:** 60 percent of growth from Feb. 1 to May 1.

**When to begin grazing:** When the grass reaches 5 to 8 inches in height.
**When to cut for hay:** Early boot stage, typically in late April.
**Lowest cutting or grazing height:** 4 inches
**Fall management:** Light grazing possible in late fall if a 4-inch stubble is maintained throughout winter.

Yield distribution of annual ryegrass in Missouri.
Orchardgrass

Orchardgrass is a popular grass for pasture, green chop, silage and hay throughout the central part of the eastern United States. The high rainfall, moderate winters and warm summers of southern Missouri make that region an optimal orchardgrass habitat. Under such conditions, orchardgrass both grows and tillers rapidly, which makes it especially useful in early spring pastures. Forage yields of 7,000 to 10,000 lb/acre are not uncommon under good management. Orchardgrass is more drought-tolerant than timothy or Kentucky bluegrass but is not as drought-tolerant as smooth bromegrass or endophyte-infected tall fescue. Orchardgrass does not persist as well as other species of cool-season grasses because it is susceptible to overgrazing, winter kill and leaf rust. Orchardgrass matures earlier than most other cool-season grasses, which makes early grazing or harvesting a must if dairy-quality feed is to be obtained. Choosing a variety that matures late can help increase forage quality.

### PRODUCTION AND MANAGEMENT TIPS FOR ORCHARDGRASS

- **Origin:** Europe and North Africa
- **Adaptation to Missouri:** Statewide
- **Overwintering ability:** Fair to good
- **Growth habit:** Bunchgrass
- **Tolerance to drought:** Fair
- **Tolerance to poor drainage:** Fair
- **Defining characteristics:** Flat ligule
- **Ease of establishment:** Moderate
- **Seeding rates:** 10 to 15 lb/acre
- **Seeding dates:** March to April; Aug. 15 to Sept. 15
- **Preferred seeding depth:** 1/4 to 1/2 inch
- **Months from seeding to first grazing:** 3 to 6
- **Preferred soil pH:** 5.5 or higher
- **Fertilization:** 40 to 60 lb N/acre after first grazing or harvest in spring; follow with another 40 lb N/acre after second grazing if conditions permit. Also, apply 40 to 60 lb N/acre mid-August for fall pasture. Phosphorus and potassium to soil test.
- **Timing of production:** 60 percent of growth before June 15.
- **When to begin grazing:** When the grass reaches 6 to 8 inches in height.
- **When to cut for hay:** Early heading stage, typically in late April or early May.
- **Lowest cutting or grazing height:** 4 inches
- **Fall management:** Light grazing possible in September and October; leave a 6-inch stubble for winter.

Yield distribution of orchardgrass in Missouri.
Perennial ryegrass

Perennial ryegrass is routinely used for dairy-cattle pasture in Australia and New Zealand. In Missouri, it persists best in the southern part of the state. Under good management, it is a high-quality and high-yielding grass; forage yields of 10,000 lb/acre have been reported in southern Missouri. Like tall fescue, perennial ryegrass produces most of its yield during spring and autumn but lags behind other grasses in mid-summer. Perennial ryegrass is aggressive under high rainfall and moderate temperatures and might crowd out other forage species under such conditions. It is not as tolerant of drought and temperature extremes as other cool-season grasses. Lack of persistence across the state has caused producers to avoid perennial ryegrass. Cultivars with improved plant persistence are currently being developed.

PRODUCTION AND MANAGEMENT TIPS FOR PERENNIAL RYEGRASS

**Origin:** Southern Europe

**Adaptation to Missouri:** Best adapted to southern Missouri.

**Overwintering ability:** Fair to poor

**Growth habit:** Nearly sod-forming grass

**Tolerance to drought:** Poor

**Tolerance to poor drainage:** Fair

**Defining characteristics:** Large, membranous ligule that may be notched near the apex; small, clawlike auricles.

**Ease of establishment:** Moderate to easy

**Seeding rates:** Broadcast 15 to 30 lb/acre; drilled 15 to 20 lb/acre.

**Seeding dates:** Late March to April 30; Aug. 15 to Sept. 15

**Preferred seeding depth:** 1/4 to 1/2 inch

**Months from seeding to first grazing:** 2 to 4

**Preferred soil pH:** 5.5 or higher

**Fertilization:** 40 to 60 lb N/acre after the first grazing or harvest in spring, followed by another 40 lb N/acre after the second grazing if growing conditions permit. In addition, 40 to 60 lb N/acre should be applied in mid-August for fall pasture. Phosphorus and potassium to soil test.

**Timing of production:** 60 percent of growth before June 15.

**When to begin grazing:** When the grass reaches 6 to 8 inches in height.

**When to cut for hay:** Early heading stage, typically in late April or early May.

**Lowest cutting or grazing height:** 3 inches

**Fall management:** Grazing possible in September and October if a 4-inch stubble is left for winter.
Prairiegrass

Prairiegrass, often called Matua grass, is a cool-season perennial bunchgrass that animals find highly palatable. Prairiegrass overwinters well if a 5-inch stubble is left in the fall.

Because individual plants do not persist well, the stands are best maintained by allowing for a reseeding period every year. Because the grass cannot tolerate continuous grazing, prairiegrass is best suited for rotational grazing with long rest periods.

PRODUCTION AND MANAGEMENT TIPS FOR PRAIRIEGRASS

**Origin:** The Pampas grasslands of South America

**Adaptation to Missouri:** Statewide

**Overwintering ability:** Good

**Growth habit:** Bunchgrass

**Tolerance to drought:** Good

**Tolerance to poor drainage:** Poor

**Defining characteristics:** Few large tillers and long, wide leaves. Grows 2 to 3 feet tall.

**Ease of establishment:** Moderate

**Seeding rates:** Broadcast 30 to 40 lb/acre; drilled 25 lb/acre.

**Seeding dates:** Sept. 1 to Sept. 15; Feb. 1 to March 15

**Preferred seeding depth:** 1/4 to 1/2 inch

**Months from seeding to first grazing:** 2

**Preferred soil pH:** 6.0 to 7.0

**Fertilization:** Apply 30 to 40 lb N/acre in early spring followed by 30 to 40 lb N/acre after each grazing to maximize regrowth. Phosphorus and potassium to soil test.

**Timing of production:** Late winter and early spring; late summer and early autumn.

**When to begin grazing:** When the grass reaches 8 to 10 inches in height. Allow regrowth rest period of 26 to 42 days.

**When to cut for hay:** Boot stage

**Lowest cutting or grazing height:** 3 inches

**Fall management:** Light grazing possible in fall if a 5-inch stubble is left for winter.
Reed canarygrass

Reed canarygrass is a tall, coarse, rhizomatous perennial grass. Its most distinctive characteristic is that it will survive on poorly drained soils or under flooded conditions better than any other cool-season grass. It is also quite drought-tolerant because it has a deep and extensive root system. Reed canarygrass is nutritious in its vegetative state but becomes coarse and unpalatable as it matures. Old cultivars contain several alkaloids that can depress animal performance. However, many new cultivars have lower levels of these compounds. Many producers find reed canarygrass difficult to establish because the seeds often germinate slowly and irregularly. However, once established, it will out-compete other grasses in a mixed pasture. It can be quite useful for pasture-based dairies if grazing begins early in the season and it is kept in its vegetative form.

PRODUCTION AND MANAGEMENT TIPS FOR REED CANARYGRASS

Origin: Worldwide
Adaptation to Missouri: Statewide
Overwintering ability: Good
Growth habit: Sod-forming
Tolerance to drought: Good
Tolerance to poor drainage: Excellent
Defining characteristics: Large, membranous ligule; short, scaly rhizomes.
Ease of establishment: Moderately difficult
Seeding rates: 5 to 10 lb/acre
Seeding dates: March to April; Aug. 15 to Sept. 15
Preferred seeding depth: 1/4 to 1/2 inch
Months from seeding to first grazing: 2 to 4
Preferred soil pH: 5.5 to 7.5
Fertilization: 40 to 60 lb N/acre after the first grazing or harvest in spring, followed by another 40 lb N/acre after the second grazing if growing conditions permit. Phosphorus and potassium to soil test.
Timing of production: 50 percent of growth before June 15.
When to begin grazing: When grass is 6 to 8 inches tall.
When to cut for hay: Just prior to heading.
Lowest cutting or grazing height: 3 to 4 inches
Fall management: Light grazing possible in September and October. Leave a 6-inch stubble for winter.
**Small grains**

The small grains, primarily wheat and rye, are used extensively in Kansas, Nebraska, Oklahoma and Texas for winter pasture for stocker calves, but they can fit into pasture-based dairy systems in Missouri as well. If planted around Sept. 1, wheat or rye will produce enough forage for an initial grazing by late November under normal conditions. Wheat and rye continue to grow through the winter, although they grow slowly during cold spells. Rye generally produces 30 to 60 percent more forage than wheat. In a vegetative state, small grain pasture is often more than 20-percent crude protein and 23- to 28-percent ADF. Wheat and rye remain in a vegetative state until mid- to late March; as a result, forage quality is fairly constant from November through late February. Rye matures three to four weeks earlier than wheat and thus is hard to manage for dairy-quality feed after early March. In addition, small grain pasture is susceptible to trampling damage under muddy conditions.

**PRODUCTION AND MANAGEMENT TIPS FOR SMALL GRAINS**

**Species:** Wheat and rye  
**Origin:** Near East and Europe  
**Adaptation to Missouri:** Statewide  
**Overwintering ability:** Good for wheat. Excellent for rye.  
**Growth habit:** Nearly sod-forming grass  
**Tolerance to drought:** Good  
**Tolerance to poor drainage:** Good  
**Ease of establishment:** Easy  
**Seeding rates:** 100 to 130 lb/acre pure live seed (PLS)  
**Seeding dates:** Sept. 1 to Oct. 15  
**Preferred seeding depth:** 3/4 to 1 inch  
**Months from seeding to first grazing:** 2  
**Preferred soil pH:** 5.5 or higher  
**Fertilization:** 75 lb N/acre at establishment. An additional 40 to 60 lb N/acre can be applied in late February if needed. Phosphorus and potassium to soil test.  
**Timing of production:** 80 percent of growth from Feb. 1 to May 1.  
**When to begin grazing:** When the grass reaches 8 inches in height.  
**When to cut for hay:** Boot stage, typically in late April or early May.  
**Lowest cutting or grazing height:** 4 inches  
**Fall management:** Light grazing possible in late fall if a 4-inch stubble is maintained throughout winter.

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Chapter 5 / Forage Crops for Pasture-based Dairies
Smooth bromegrass

Smooth bromegrass is a cool-season grass often used for hay, pasture, silage, green chop and erosion control. Its responsiveness to nitrogen fertilizer, ability to grow well with legumes, good drought-tolerance and excellent overwintering capacity make it important throughout the northern United States. Although Missouri is on the southern edge of its range, smooth bromegrass still provides a valuable resource for many dairy farmers. Smooth bromegrass can easily suffer from overgrazing and does not regrow as well as other cool-season grasses. It is important to avoid clipping or grazing smooth bromegrass shorter than four inches. Fields clipped or grazed shorter than this do not regrow well or persist very long.

PRODUCTION AND MANAGEMENT TIPS FOR SMOOTH BROMEGRASS

**Origin:** Eastern Europe  
**Adaptation to Missouri:** Especially northern Missouri  
**Overwintering ability:** Excellent  
**Growth habit:** Sod-forming grass  
**Tolerance to drought:** Good  
**Tolerance to poor drainage:** Fair  
**Defining characteristics:** "M"-shaped watermark midway up leaf blade.  
**Ease of establishment:** Moderate to difficult  
**Seeding rates:** 10 to 15 lb/acre pure stand; 10 lb/acre mixed grass/legume.  
**Seeding dates:** Late February to April; September  
**Preferred seeding depth:** 1/4 to 1/2 inch  
**Months from seeding to first grazing:** 4  
**Preferred soil pH:** 5.5 or higher  
**Fertilization:** 30 to 40 lb N/acre following the first grazing or harvest in spring. In addition, apply 40 to 60 lb N/acre in mid-August for fall pasture. Phosphorus, potassium and lime as needed.  
**Timing of production:** 80 percent of growth before June 15.  
**When to begin grazing:** When the grass reaches 8 inches in height.  
**When to cut for hay:** Early heading stage, typically about mid-May.  
**Lowest cutting or grazing height:** 4 inches  
**Fall management:** Light grazing or haying possible through October if a 6-inch stubble is left for winter.
Tall fescue

Tall fescue is one of the most popular grasses in the United States. It is grown on more than 34 million acres nationwide. Because of its hardiness and adaptability, it is used for several purposes, including silage, hay and pasture as well as wildlife habitat and erosion control. Tall fescue is most nutritious in early spring and again in autumn. In addition, tall fescue has a waxy leaf surface that helps it retain its forage quality through winter better than any other perennial grass. As a result, many producers stockpile tall fescue for deferred grazing in winter. Unfortunately, most tall fescue is infected with an endophyte, a fungus that produces compounds that are toxic to cattle. If cattle eat tall fescue that carries the endophyte, they exhibit reduced weight gains and/or milk yields as well as a number of more serious illnesses such as fescue foot. Although endophyte-free tall fescue does not have this problem, it does not persist as well as tall fescue that contains the endophyte. The lower milk yields associated with the endophyte cause many dairy farmers to avoid tall fescue.

Origin: Europe
Adaptation to Missouri: Statewide
Overwintering ability: Good
Growth habit: Sod-forming grass
Tolerance to drought: Good if endophyte-infected; fair if endophyte-free
Tolerance to poor drainage: Good
Defining characteristics: Ribbed leaves, ciliated auricles and collars.
Ease of establishment: Moderate
Seeding rates: Broadcast 15 to 20 lb/acre; drilled 10 to 15 lb/acre.
Seeding dates: March 15 to April 30; Aug. 15 to Sept. 15
Preferred seeding depth: 1/4 inch
Months from seeding to first grazing: 3 to 6
Preferred soil pH: 5.5 to 7.0
Fertilization: 40 to 60 lb N/acre mid-August for fall or stockpile pasture. In spring, 40 to 60 lb N/acre after the first grazing or harvest. If pasture is lacking, follow with another 40 lb N/acre after the second grazing. Phosphorus and potassium to soil test.
Timing of production: Produces 70 percent of its growth between April 1 and June 15.
When to begin grazing: When the grass reaches 6 to 8 inches in height.
When to cut for hay: Late vegetative to early boot stage.
Lowest cutting or grazing height: 3 to 4 inches
Timothy

Timothy is a relatively late-maturing, short-lived perennial grass that is best adapted to cool, moist regions. Timothy has a fibrous and relatively shallow root system. Because it does not develop a deep root system, it does not persist well under drought conditions. It is intolerant of hot weather but is among the most winter hardy of the cool-season grasses. Timothy's forage quality is often better than many other cool-season grasses in the spring because it matures 3 to 4 weeks later than orchard-grass or tall fescue. Timothy is relatively easy and inexpensive to establish, but it does not compete well with other grasses. Dairy cattle like timothy, but it can't survive close or frequent grazing. If you use timothy, you must practice rotational grazing.

**PRODUCTION AND MANAGEMENT TIPS FOR TIMOTHY**

**Origin:** Northern Europe  
**Adaptation to Missouri:** Best adapted to the northern half of the state.  
**Overwintering ability:** Excellent  
**Growth habit:** Bunchgrass  
**Tolerance to drought:** Poor  
**Tolerance to poor drainage:** Good  
**Defining characteristics:** Blunt, notched ligule; cylindrical, highly compressed seedhead.  
**Ease of establishment:** Moderate to easy  
**Seeding rates:** Broadcast 8 lb/acre; drilled 3 to 6 lb/acre.  
**Seeding dates:** February to mid-April; Sept. 1 to Oct. 1  
**Preferred seeding depth:** 1/4 to 1/2 inch  
**Months from seeding to first grazing:** 2 to 4  
**Preferred soil pH:** 5.5 to 7.5  
**Fertilization:** 40 to 60 lb N/acre in late February or early March. Phosphorus, potassium and lime as needed.  
**Timing of production:** 75 percent of growth before June 15.  
**When to begin grazing:** When grass is 6 to 8 inches tall.  
**When to cut for hay:** Just prior to heading.  
**Lowest cutting or grazing height:** 3 to 4 inches  
**Fall management:** Light grazing possible in September and October. Leave a 6-inch stubble for winter.

Yield distribution of timothy in Missouri.
**Bermudagrass**

This perennial warm-season grass is used for forage and erosion control in the warmer portions of the U.S., including the southern third of Missouri. In southern Missouri, forage annual yields in the 10,000 lb/acre range are possible with good management. Under typical management, bermudagrass is of moderate quality for both hay and pasture uses. However, forage quality and yield can be excellent if bermudagrass is well-fertilized with nitrogen and frequently grazed or harvested. Bermudagrass has some limitations. Because it must be established from vegetative sprigs, it is sometimes difficult to establish. Producers must take care to control weeds during establishment. Once established, bermudagrass is aggressive and can crowd out other species.

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### Production and Management Tips for Bermudagrass

- **Origin:** Southeast Africa  
- **Adaptation to Missouri:** Southern third of state  
- **Overwintering ability:** Fair to good in southern Missouri.  
- **Growth habit:** Sod-forming perennial grass that spreads by rhizomes and stolons.  
- **Tolerance to drought:** Fair  
- **Tolerance to poor drainage:** Fair  
- **Defining characteristics:** Narrow leaf blades, short stature and stolons.  
- **Ease of establishment:** Moderate  
- **Sprigging rate:** 20 to 30 bushels/acre  
- **Sprigging dates:** April 1 to June 1  
- **Preferred sprigging depth:** 1 to 2 inches  
- **Months from seeding to first grazing:** 10 to 12  
- **Preferred soil pH:** 5.5 and up  
- **Fertilization:** 50 to 100 lb N/acre mid-May after grass 'greens up.' Apply 75 to 100 lb N/acre every 30 days thereafter. Phosphorus and potassium to soil test.  
- **Burning management:** If needed, in early spring three weeks prior to last killing frost.  
- **Timing of production:** 85 percent of growth between May 15 and Sept. 15. More even yield distribution than most other warm-season grasses.  
- **When to begin grazing:** When grass is 6 inches tall.  
- **When to cut for hay:** June 1 and every 28 days thereafter.  
- **Lowest cutting or grazing height:** 3 inches  
- **Fall management:** Do not hay or graze after Sept. 1.
Big bluestem

Big bluestem used to be the dominant grass in the native prairies of Missouri. Today, this perennial warm-season bunchgrass is used for forage and wildlife habitat. It produces good quality hay and will persist indefinitely if properly managed. It is both winter- and drought-hardy and does better in poorly drained soils than some other warm-season grasses. It is also compatible with many other forage species. However, it is slow to establish, and thus weeds can make establishment a problem. Big bluestem grows statewide, and it is currently found on about 1 million acres in Missouri. It is well-suited to dairy farming if not allowed to become mature before grazing and if a 6-inch or greater stubble height is maintained to encourage regrowth.

**PRODUCTION AND MANAGEMENT TIPS FOR BIG BLUESTEM**

- **Origin:** North America
- **Adaptation to Missouri:** Statewide
- **Overwintering ability:** Excellent
- **Growth habit:** Bunchgrass
- **Tolerance to drought:** Good
- **Tolerance to poor drainage:** Good
- **Defining characteristics:** All leaf parts are woolly or covered with small hairs.
- **Ease of establishment:** Moderately difficult
- **Seeding rates:** 7 lb/acre of pure live seed (PLS)
- **Seeding dates:** April 15 to May 31
- **Preferred seeding depth:** 1/4 to 1/2 inch
- **Months from seeding to first grazing:** 12 to 24
- **Preferred soil pH:** 5.5 to 8.0
- **Fertilization:** 40 to 60 lb N/acre when grass is 3 to 5 inches tall. Phosphorus and potassium to soil test.
- **Burning management:** Annually when new growth is 1 to 2 inches tall.
- **Timing of production:** Produces 70 percent of its growth between June 15 and Aug. 31.
- **When to begin grazing:** When grass is 10 to 12 inches tall.
- **When to cut for hay:** Boot stage
- **Lowest cutting or grazing height:** 6 inches
- **Fall management:** Do not hay or graze after Sept. 1.
Old World bluestems

The Old World bluestems are a group of warm-season grasses imported from Russia. They are not related to native bluestems such as big and little bluestems. Caucasian bluestem is the most widely grown Old World bluestem and finds its widest use in southern Missouri. Caucasian bluestem tolerates heavy grazing; in fact, for forage quality to be acceptable for dairy cows, cacious bluestem must not be allowed to grow taller than 6 inches. It is also winter-hardy and easier to establish than many other warm-season grasses. It tolerates shallow and infertile soils better than many other species. However, cacious bluestem is best grown by itself because of its aggressiveness. It does not grow well on poorly drained soils. Finally, its nutritional value plummets if it is not well-fertilized with nitrogen or if it is permitted to form seedheads.

PRODUCTION AND MANAGEMENT TIPS FOR OLD WORLD BLUESTEMS

- **Origin:** Russia
- **Adaptation to Missouri:** Southern half of Missouri
- **Overwintering ability:** Good – better in southern Missouri
- **Growth habit:** Sod-forming grass
- **Tolerance to drought:** Good
- **Tolerance to poor drainage:** Poor
- **Defining characteristics:** Fine, leafy stems; shorter than most native warm-season grasses; no stolons.
- **Ease of establishment:** Moderate
- **Seeding rates:** 2 lb/acre of pure live seed (PLS)
- **Seeding dates:** April 15 to May 15
- **Preferred seeding depth:** 1/4 to 1/2 inch
- **Months from seeding to first grazing:** 4 to 6. Often able to graze late in the establishment year.
- **Preferred soil pH:** 5.5 to 7.0
- **Fertilization:** 50 lb N/acre in spring when grass is 3 to 5 inches (mid-May). Apply another 50 lb N/acre every 30 to 40 days thereafter. Phosphorus and potassium to soil test.
- **Burning management:** Annually, in early spring before any new growth is present (early April).
- **Timing of production:** Late May through mid-September.
- **When to begin grazing:** When grass is 4 to 6 inches tall.
- **When to cut for hay:** Late boot stage
- **Lowest cutting or grazing height:** 2 inches
- **Fall management:** Do not hay or graze after Sept. 3.
Crabgrass

Crabgrass is warm-season annual that is easy to establish. Stands of crabgrass can last almost indefinitely if managed to encourage volunteer reseeding. Although often considered a weed, crabgrass is a high-quality forage that can produce 6,000 to 10,000 lb/acre of dry matter annually. The majority of the dry matter is produced from June to August. Crabgrass is adapted statewide. Crabgrass tolerates poorly drained soils well but is not cold hardy. It responds well to split applications of nitrogen at establishment and then again after the first grazing.

**PRODUCTION AND MANAGEMENT TIPS FOR CRABGRASS**

- **Origin:** Southern Africa
- **Adaptation to Missouri:** Statewide
- **Growth habit:** Sod-forming grass
- **Tolerance to drought:** Poor
- **Tolerance to poor drainage:** Good
- **Defining characteristics:** Very leafy with long runners; grows 2 to 4 feet tall.
- **Ease of establishment:** Easy
- **Seeding rates:** 3 to 4 lb/acre of pure live seed (PLS)
- **Seeding dates:** May 1 to May 31; can be overseeded into winter annual grasses from late winter to early spring.
- **Preferred seeding depth:** 1/4 to 1/2 inch
- **Months from seeding to first grazing:** 1 to 2 (30 to 45 days)
- **Preferred soil pH:** 5.5 or higher
- **Fertilization:** 40 lb N/acre at establishment. Apply 60 lb N/acre after first cutting or grazing. Phosphorus and potassium to soil test.
- **Timing of production:** 80 percent between mid-June and August.
- **When to begin grazing:** Before it reaches 6 inches in height.
- **When to cut for hay:** Boot stage, approximately 6 to 10 inches.
- **Lowest cutting or grazing height:** 3 inches
- **Fall management:** Remove grazing livestock from pasture 2 to 3 weeks before first frost to ensure adequate seed production.
Eastern gamagrass

Eastern gamagrass, the king of bunchgrasses, is used for pasture, hay and silage. It grows well in wetter areas but prefers deep, well-drained soils. Eastern gamagrass lends itself well to pasture-based operations because it has a more even distribution of yield over the grazing season than do many other warm-season grasses. It also has better forage quality than many other warm-season grasses. Despite these advantages, eastern gamagrass has a few problems. Seed production is difficult, and gamagrass is slow to establish. Furthermore, it is easily overgrazed. Eastern gamagrass grows well throughout Missouri but is most popular in the central and western regions of the state. Despite its limitations, eastern gamagrass can be an important part of a forage system on a pasture-based dairy.

**PRODUCTION AND MANAGEMENT TIPS FOR EASTERN GAMAGRASS**

- **Origin:** Eastern North America
- **Adaptation to Missouri:** Statewide
- **Overwintering ability:** Excellent
- **Growth habit:** Bunchgrass
- **Tolerance to drought:** Fair to good
- **Tolerance to poor drainage:** Good
- **Defining characteristics:** Wide leaves (1 to 1 1/2 inches wide); seedheads have female parts low and male parts high on plant.
- **Ease of establishment:** Difficult
- **Seeding rates:** 10 lb/acre of pure live seed (PLS)
- **Seeding dates:** April 15 to May 31 for stratified seed. Nov. 1 to Feb. 28 for untreated seed.
- **Preferred seeding depth:** 1 to 1 1/2 inches
- **Months from seeding to first grazing:** 24
- **Preferred soil pH:** 5.5 to 7.5
- **Fertilization:** 50 lb N/acre in spring when grass is 3 to 5 inches tall. Apply 50 lb N/acre every six weeks thereafter. Phosphorus and potassium to soil test.
- **Burning management:** Annually, in early spring before new growth is 1-inch long.
- **Timing of production:** 85 percent of growth between May 15 and Aug. 31.
- **When to begin grazing:** When grass is 14 inches tall.
- **When to cut for hay:** Very early boot stage.
- **Lowest cutting or grazing height:** 8 inches
- **Fall management:** Do not hay or graze after Sept. 15.
Indiangrass

Indiangrass is a native, perennial warm-season grass with a number of uses, from forage crop to conservation. Indiangrass can grow throughout the state, but it is best adapted to areas north of Interstate 70. It matures two or three weeks later than big bluestem, and because it does not begin reproductive growth until later in the season, it can be of high quality both as pasture and hay. However, Indiangrass has trouble establishing itself without proper weed control and does not grow well in poorly drained areas. Its weaknesses are that it does not produce abundant forage until late in the season and has poor regrowth potential.

PRODUCTION AND MANAGEMENT TIPS FOR INDIANGRASS

**Origin:** North America

**Adaptation to Missouri:** Statewide

**Overwintering ability:** Excellent

**Growth habit:** Bunchgrass

**Tolerance to drought:** Good

**Tolerance to poor drainage:** Fair

**Defining characteristics:** Notched ligules and leaf blades narrow at the base.

**Ease of establishment:** Moderately difficult

**Seeding rates:** 7 lb/acre of pure live seed (PLS)

**Seeding dates:** April 15 to May 31

**Preferred seeding depth:** 1/4 to 1/2 inch

**Months from seeding to first grazing:** 12 to 24

**Preferred soil pH:** 5.5 to 7.5

**Fertilization:** 40 to 60 lb N/acre in spring when grass is 3 to 5 inches tall. Phosphorus and potassium to soil test.

**Burning management:** Annually when new growth is 1 to 2 inches tall.

**Timing of production:** Produces 70 percent of its growth between July 1 and Aug. 31, 2 to 3 weeks later than big bluestem.

**When to begin grazing:** When grass is 10 to 12 inches tall.

**When to cut for hay:** Early boot stage

**Lowest cutting or grazing height:** 6 inches

**Fall management:** Do not hay or graze after Sept. 1.
Sorghum-sudangrass

Sorghum-sudangrass is a warm-season annual hybrid developed by crossing tall, stemmy sorghum with leafy sudangrass. It is adapted statewide for summer grazing and is well-suited for growing in drought conditions. Sorghum-sudangrass can produce 8,000 to 16,000 lb/acre of forage when harvested to a 6- to 10-inch stubble after accumulated growth reaches a height of 24 to 36 inches. It also responds well to split applications of nitrogen at establishment and then again after the first grazing. However, sorghum-sudangrass can put livestock at risk to toxic levels of nitrate and prussic acid, both of which are aggravated by drought. It is intolerant of low soil pH and prefers levels of 5.5 or higher.

**PRODUCTION AND MANAGEMENT TIPS FOR SORGHUM-SUDANGRASS**

- **Origin:** Northeast Africa
- **Adaptation to Missouri:** Statewide
- **Growth habit:** Tall, upright
- **Tolerance to drought:** Good
- **Tolerance to poor drainage:** Good
- **Defining characteristics:** Erect, leafy, thick stem, 4 to 8 feet tall.
- **Ease of establishment:** Easy
- **Seeding rates:** 20 to 25 lb/acre drilled; 30 to 35 lb/acre broadcast.
- **Seeding dates:** May 1 to June 30
- **Preferred seeding depth:** 1/2 to 1 inch
- **Months from seeding to first grazing:** 2 (45 to 60 days)
- **Preferred soil pH:** 5.5 or higher
- **Fertilization:** 60 lb N/acre at establishment. Apply 40 to 60 lb N/acre after each cutting or grazing thereafter. Phosphorus and potassium to soil test.
- **Timing of production:** 90 percent of production occurs in June, July and August.
- **When to begin grazing:** When grass reaches 24 inches in height. (Note: To avoid prussic acid, do not graze when grass is shorter than 18 inches. It is also best to delay grazing for 14 days after frost or drought stress.)
- **When to cut for hay:** When it reaches 30 to 36 inches in height.
- **Lowest cutting or grazing height:** 8 inches
Switchgrass

Switchgrass is a native, perennial warm-season grass grown on an estimated 1 million acres in Missouri. Although its greatest use is for pasture, it is also widely used for hay production and soil conservation. Switchgrass tolerates poorly drained soils fairly well and is adapted to a wide range of growing conditions. It is easier to establish than many other warm-season grasses. However, switchgrass will out-compete other species in a mixed pasture if it is not carefully managed. In addition, switchgrass must be grazed early in the season or the grass easily becomes overmature and of poor quality. Switchgrass is only useful for pasture-based dairies if grazing begins early in the season and it is kept in a vegetative stage of growth.

PRODUCTION AND MANAGEMENT TIPS FOR SWITCHGRASS

Origin: North America
Adaptation to Missouri: Statewide
Overwintering ability: Excellent for adapted types
Growth habit: Bunchgrass
Tolerance to drought: Good
Tolerance to poor drainage: Good
Defining characteristics: A tuft of hairs (pubescence) located at the juncture of the leaf blade and sheath.
Ease of establishment: Moderately difficult
Seeding rates: 6 lb/acre of pure live seed (PLS)
Seeding dates: April 15 to May 31
Preferred seeding depth: 1/4 to 1/2 inch
Months from seeding to first grazing: 12 to 16
Preferred soil pH: 5.5 to 7.5
Fertilization: 40 to 60 lb N/acre when grass is 3 to 5 inches tall. Phosphorus and potassium to soil test.
Burning management: Annually when new growth is 1 to 2 inches tall.
Timing of production: Produces 40 percent of its growth in June, 2 to 3 weeks earlier than big bluestem.
When to begin grazing: When grass is 10 to 12 inches tall.
When to cut for hay: Late vegetative to early boot stage.
Lowest cutting or grazing height: 6 inches
Fall management: Do not hay or graze after Sept. 1.
Alfalfa

Alfalfa is a perennial legume that is one of the most important forage crops in the United States. Generally used for hay or silage, it is increasingly used to provide high-quality pasture in rotational grazing systems. Its deep root system allows it to withstand drought better than most other legumes. Alfalfa grows well with other grasses in a mixture. However, alfalfa grown alone can cause bloat in grazing animals, and alfalfa itself is prone to a number of insect and disease problems. Alfalfa produces and persists poorly on shallow and/or poorly drained soils and should not be planted on such sites. Despite this, alfalfa is important statewide, and it is grown on more than 700,000 acres. It is excellent for milk production.

### Production and Management Tips for Alfalfa

- **Origin:** Asia Minor and the Middle East
- **Adaptation to Missouri:** Statewide
- **Overwintering ability:** Good
- **Growth habit:** Upright
- **Tolerance to drought:** Good
- **Tolerance to poor drainage:** Poor
- **Defining characteristics:** Trifoliate leaves with serrations on the upper half of individual leaflets.
- **Ease of establishment:** Easy
- **Seeding rates:** 15 to 20 lb/acre
- **Seeding dates:** April; Aug. 15 to Sept. 15
- **Preferred seeding depth:** 1/4 to 1/2 inch
- **Months from seeding to first grazing:** 2 to 4
- **Preferred soil pH:** 6.5
- **Fertilization:** No N needed if nodulated.
  Maintain 40 lb P/acre and 300 lb K/acre.
  Magnesium, sulfur, and boron to soil test recommendations.
- **Timing of production:** 50 percent of annual production between April 1 and June 30.
- **When to begin grazing:** In early- to mid-bud stage.
  Needs a 30-day rest period between grazings.
- **When to cut for hay:** Late bud to early bloom
- **Lowest cutting or grazing height:** 1 inch
- **Fall management:** Do not cut or graze after Sept. 15.

![Yield distribution of alfalfa in Missouri.](image)
Annual lespedeza

Annual lespedeza is primarily a pasture legume today although it is sometimes cut for hay. It provides high-quality forage in mid-summer when other cool-season grasses and legumes are struggling. It also grows better than other legumes on infertile or shallow soils. Like birdsfoot trefoil, it does not cause bloat. However, it is not problem-free. Its annual yield is lower than that of other legumes, and it does not have as broad a window of forage production. Korean types have proven susceptible to a number of foliar diseases. There are reports that lespedeza seeds can cause cows to grow dry. Annual lespedeza can be valuable to pasture-based dairies in July and August if seed production is minimized.
**Birdsfoot trefoil**

Birdsfoot trefoil is a short-lived perennial legume capable of producing high-quality forage on soils where other legumes do not survive. Although it generally yields less than red clover and alfalfa when cut for hay, it often gives better performance than these legumes when grown in a grass/legume pasture. Unlike other perennial legumes, birdsfoot trefoil does not cause bloat in cattle. However, it does not tolerate continuous grazing or frequent haying. It is also prone to a number of diseases and pests that make management for reseeding essential. Although birdsfoot trefoil may grow statewide, it is best adapted to northern Missouri. Its high-quality forage makes it useful for milk production.

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**PRODUCTION AND MANAGEMENT TIPS FOR BIRDSFOOT TREFOIL**

**Origin:** Mediterranean basin

**Adaptation to Missouri:** Statewide but persists better in northern Missouri

**Overwintering ability:** Good

**Growth habit:** Decumbent

**Tolerance to drought:** Fair

**Tolerance to poor drainage:** Good

**Defining characteristics:** Pentafoliate leaves; bright yellow flowers

**Ease of establishment:** Moderate

**Seeding rates:** 4 to 8 lb/acre pure live seed (PLS)

**Seeding dates:** February to April; Aug. 15 to Sept. 15

**Preferred seeding depth:** 1/4 inch

**Months from seeding to first grazing:** 2 to 4

**Preferred soil pH:** 5.0 to 6.0

**Fertilization:** No N needed if nodulated. Maintain 30 lb P/acre and 250 lb K/acre.

**Timing of production:** 70 percent of annual production between April 1 and June 30.

**When to begin grazing:** Often based on the height of the grass in the mixture. Few if any pure stands exist.

**When to cut for hay:** Not normally cut for hay unless it is mixed with a companion grass. Harvest based on the maturity of the grass.

**Lowest cutting or grazing height:** 4 inches

**Fall management:** Avoid severe grazing from Sept. 15 until the first hard killing frost.
Red clover

Red clover is a short-lived, perennial legume grown on 7 to 10 million acres in Missouri. Although its yield and quality is not quite as good as that of alfalfa under ideal conditions, it is much better adapted to the poorly drained, shallow and/or infertile soils frequently found on pastur-lands. It is easier to establish than other legumes and works well in a mixture with cool-season grasses. It has problems dealing with prolonged drought and root diseases. However, it can be reseeded rather easily and inexpensively. In fact, many producers broadcast 3 to 6 lb/acre of seed annually to maintain stands. Its high quality makes it useful in dairy farming.

PRODUCTION AND MANAGEMENT TIPS FOR RED CLOVER

**Origin:** Asia Minor and southeastern Europe  
**Adaptation to Missouri:** Statewide  
**Overwintering ability:** Good  
**Growth habit:** Upright  
**Tolerance to drought:** Fair to poor  
**Tolerance to poor drainage:** Fair  
**Defining characteristics:** Prominent watermark on leaflets and pubescent leaves and stems.  
**Ease of establishment:** Easy

**Seeding rates:** 8 to 12 lb/acre pure live seed (PLS) for pure stand. 3 to 8 lb/acre PLS if seeded in a mixture. 3 to 6 lb/acre PLS on an annual basis to maintain a mixed stand.  
**Seeding dates:** January to April; Aug. 15 to Sept. 15  
**Preferred seeding depth:** 1/4 to 1/2 inch  
**Months from seeding to first grazing:** 2 to 4  
**Preferred soil pH:** 6.0  
**Fertilization:** No N needed if nodulated. Maintain 30 lb P/acre and 250 lb K/acre.  
**Timing of production:** 65 percent of annual production between April 1 and June 30.  
**When to begin grazing:** Often based on the height of the grass in the mixture. In pure stands, grazing should begin when red clover is in the early- to mid-bud stage.

**Yield distribution of red clover in Missouri.**

**When to cut for hay:** Early to mid-bloom  
**Lowest cutting or grazing height:** 3 or 4 inches  
**Fall management:** Avoid grazing below a 4-inch stubble height from Sept. 15 until the first hard killing frost.
White clover

White clover is a legume adapted to cool, moist climates. In Missouri, it is presently grown on about 8 million acres of pastureland in combination with perennial cool-season grasses. Like other legumes, the forage it provides is both palatable and nutritious. All cattle relish white clover but have a tendency to overgraze it in mixed pastures. A rotational grazing system helps manage this problem. White clover has good tolerance to poorly drained soils, and it is not drought-tolerant. In addition, white clover causes cattle to bloat if used as the only forage in the diet. Because of its high forage quality, white clover has wide application in dairy farming.

PRODUCTION AND MANAGEMENT TIPS FOR WHITE CLOVER

**Origin:** Mediterranean
**Adaptation to Missouri:** Statewide
**Overwintering ability:** Good
**Growth habit:** Short and upright with vigorous stolons.

**Tolerance to drought:**
Poor

**Tolerance to poor drainage:** Good

**Defining characteristics:** Prominent watermark on leaflets but without pubescence.

**Ease of establishment:** Easy

**Seeding rates:** 1 to 2 lb/acre pure live seed (PLS)

**Seeding dates:** January to April; Aug. 15 to Sept. 15

**Preferred seeding depth:** 1/4 to 1/2 inch

**Months from seeding to first grazing:** 2 to 4

**Preferred soil pH:** 6.0

**Fertilization:** No N needed if nodulated.
Maintain 30 lb P/acre and 250 lb K/acre.

**Timing of production:** 70 percent of annual production between April 1 and June 30.

**When to begin grazing:** Often based on the height of the grass in the mixture. Few if any pure stands exist.

**When to cut for hay:** Not normally cut for hay unless it is mixed with a companion grass. Harvest based on the maturity of the grass.

**Lowest cutting or grazing height:** 3 inches

**Fall management:** Avoid severe grazing from Sept. 15 until the first hard killing frost.
Brassica species

Brassica species such as turnip, rape, Swede and kale are not widely grown in Missouri but can furnish good quality forage in late fall and early winter. If planted in late summer, these drought-tolerant plants can provide up to three tons of forage by Dec. 1. However, because they cannot withstand repeated severe freeze/thaw events, they cannot be expected to provide feed much beyond Jan. 1 most years. Although forage quality of both the tops and roots is high, bloat and other animal problems can occur if Brassicas are the only feed in the diet. Brassicas do not tolerate poorly drained soils and are notorious for contracting root and crown rot diseases, especially if grown on the same field for 2 consecutive years. Crop rotation is about the only way to successfully control these diseases. The turnip aphid, flea beetle and other insects can create problems from planting through the end of September if not controlled.

PRODUCTION AND MANAGEMENT TIPS FOR BRASSICA SPECIES

- **Origin**: Mediterranean
- **Adaptation to Missouri**: Statewide
- **Overwintering ability**: Fair to poor
- **Growth habit**: Upright
- **Tolerance to drought**: Good
- **Tolerance to poor drainage**: Poor
- **Ease of establishment**: Moderate
- **Seeding rates**: 2 to 4 lb/acre pure live seed (PLS)
- **Seeding dates**: Aug. 15 through Sept. 15 for autumn pasture.
- **Preferred seeding depth**: 1/4 inch
- **Months from seeding to first grazing**: 2 to 3
- **Preferred soil pH**: 5.0 to 6.0
- **Fertilization**: Apply 75 lb N/acre at establishment.
- **Timing of production**: 70 percent of annual production between Oct. 1 and Dec. 1.
- **When to begin grazing**: Begin grazing to utilize the forage before early January.
- **Lowest cutting or grazing height**: 0 inches – little regrowth possible.