The goal of the dairy pasture program is to provide high-quality forages to grazing livestock. Planting and managing the species described in Chapter 5, "Forage Crops," can provide high-quality forage throughout much of the year.

In this chapter, we will discuss how to establish and maintain a pasture of high quality for lactating dairy cows. Although we will discuss the maintenance of the pasture throughout the calendar year, we recognize that no pasture can provide 365 days of grazing suitable for lactating dairy cows. Rather, we will suggest ways to ensure a supply of forage for grazing until the supply is diminished by drought or covered by ice.

**Plant species to supply year-round pasture**

**Step 1: Begin with a *base forage***

In Missouri, developing a pasture that will provide forage throughout the year requires planting several plant species because no single species will grow throughout the year. To develop the type of pasture that will provide a continuous supply of forage, the dairy producer must decide which species will provide a base forage for most of the year, then fill the gaps with other forages. For most graziers, a perennial cool-season grass is the place to begin. This is because the cool-season grass will provide forage through Missouri’s long spring and fall seasons. Cool-season grasses break dormancy in early March and continue growing through mid-June if there is no drought (Figure 6.1). From mid-June through August, they are semi-dormant. They begin growing again in the fall, which in Missouri ranges from September through October. In some years, cool-season grasses can grow into November.

Grasses typically grown in Missouri grazing systems include smooth bromegrass, orchardgrass and endophyte-free tall fescue. Two other grasses worth considering that supply forage for fall and spring are perennial ryegrass and prairie bromegrass (cv. matua). Both forages have shown excellent forage quality, yet they may be considered short-lived perennials under typical Missouri conditions. Their high quality may justify the stand loss that occurs in harsh climatic years. However, there have been no controlled experiments to provide data to justify the economics of these species. All information on the use of perennial ryegrass and prairie bromegrass is based on the observations and reports of producers.

When selecting a species for the base forage, high forage quality is mandatory. For most operations, the high quality requirement immediately rules out endophyte-infected tall fescue. Studies in the country of Chile and at the University of Kentucky have shown that the endophyte in perennial ryegrass and tall fescue will decrease milk yield between 20 and 30 percent (Butendieck et al., 1994; Strahan, 1987).

In general, forage quality is a function of management, not forage species. Exceptions to this rule would be the high-quality annuals. Annual ryegrass and winter cereal grasses, for example, contain much less fiber than common perennial forages.

The overwhelming influence of management over species can be seen in Table 6.1. The table summarizes milk production data from dairy cattle grazing three different cool-season grasses at different plant heights. The data show no difference in milk production from cattle consuming three cool-season grasses. Rather, the data show a 15-lb
difference in milk production due to management, in this case the height of grass when it was consumed (Table 6.1).

The scientific literature is full of reports comparing grasses in side-by-side trials. However, most of these trials report plant analysis data, not milk production data. In plant analysis, perennial ryegrass has been shown to be equal to or higher in quality than other cool-season grasses (Scheaffer et al., 1998). These findings confirm producer observations of higher forage quality in perennial ryegrass. However, studies do not always show differences in quality among cool-season grasses. Some studies that report fiber concentrations and digestibility are better in orchardgrass while other studies report better analysis in tall fescue and smooth bromegrass.

Table 6.1. Milk production as affected by grass species and initial plant height. Summary of five different studies.

<table>
<thead>
<tr>
<th>Grass</th>
<th>Milk production, lb/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 to 10 inches</td>
</tr>
<tr>
<td>Endophyte-free tall fescue</td>
<td>58.0</td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>58.2</td>
</tr>
<tr>
<td>Perennial ryegrass</td>
<td>59.2</td>
</tr>
</tbody>
</table>

Establishment of cool-season grasses

Cool-season grasses can be established in either spring or fall. In Missouri, early spring establishment requires field preparation in early March and planting in mid- to late March. Fall establishment requires field preparation in mid- to late August, followed by planting in late August or early September (Figure 6.2).

For most cool-season grasses, fall establishment is ideal. It allows seedlings to develop under little weed pressure, and the oncoming winter usually does not kill seedlings. Orchardgrass may be established in the fall as well, but spring establishment may involve less risk. This is because orchardgrass seedlings are susceptible to low temperatures early in the season and severe winters. In a prepared seedbed, grasses are best established by drilling the seed at a depth of 1/4 to 1/2 inch. Under no-till establishment, grasses are best drilled at the same depth but at a higher seeding rate.

For ideal establishment of grass pastures, legumes should not be seeded at the same time as the grasses. Legumes such as red clover, white clover and alfalfa have strong seedling vigor. They establish easily and often crowd out the newly planted grass seedlings. Because it has poor seedling vigor, birdsfoot trefoil can be seeded at the same time as a cool-season grass without the threat of crowding. If you desire a mixed pasture, it is wise to seed birdsfoot trefoil at the time of grass seeding because it will be difficult to interseed later.

Step 2: Fill the production gaps with legumes or other grasses

After a base forage has been established, the pasture program is still far from ready to provide grazing throughout the year. It still has gaps in production. If the base forage is a cool-season grass, the gap in production occurs during July and August. To fill this gap, consider the addition of summer (warm-season) forages. Warm-season forages include both grasses and legumes. Although summer forages can grow well in high temperatures, none will grow well in a drought.

Of the legumes, alfalfa and annual lespedeza will best fill in the July and August gap common in southern Missouri. In mid- and northern Missouri, birdsfoot trefoil will do the same. Alfalfa and birdsfoot trefoil begin to grow soon after the cool-season grasses break dormancy. During the spring, these two legumes create a mixture in the pasture with cool-season grasses. Annual lespedeza is a true warm-season legume, and while it germinates in late March or April, it provides little yield until July. A pasture that contains a cool-season grass and annual lespedeza is more of a double-crop than a mixture.

A number of other legumes will fill the early part of Missouri's summer gap. As noted in the previous chapter, legumes such as red clover and white clover green up in April then grow into early July. They mix well with cool-season grasses, but they
do not grow as well in August as alfalfa or annual lespedeza. In a pasture program, these legumes are used as part of a mixture with cool-season grasses and will not provide forage in late summer.

Establishment of legumes

In Missouri, it is easy to establish most legumes into a grass sod. Successful legume interseeding depends on managing the grass canopy. Certain management practices in the fall and spring will expedite legume establishment. If the grass is stockpiled in the fall and grazed through the winter, the stand will be thin during the following spring. This thin stand provides an "open canopy," which allows light to reach the legume seedlings. The grass should not be fertilized with high rates of N in the spring because it will encourage the grass to become too aggressive, thereby crowding out the newly germinated legume seedlings.

Optimal seeding methods vary with the species of legume. Annual lespedeza, red clover and white clover can be frost-seeded. In Missouri, frost-seeding is highly effective. The seed is broadcast onto the soil in February when the freezing and thawing of late winter provides good soil-to-seed contact by stretching the soil and pulling the seed slightly under the surface. Alfalfa also may be broadcast into a grass sod, but this is not a reliable way to establish alfalfa because its seedlings are sensitive to frost in spring. Alfalfa is best seeded using no-till establishment.

Establishing birdsfoot trefoil into a grass sod is difficult. It can be done but only with good management and patience. Because birdsfoot trefoil has poor seedling vigor, the fall stockpiling and spring fertility practices mentioned above are highly advised. Birdsfoot trefoil can be planted using no-till into a thin spring canopy, usually in late March. Even with these management practices and excellent seeding conditions, the first-year mixture may contain only 5-percent birdsfoot trefoil. However, it can thicken up over a 3-year period if allowed to reseed during June or July and if N fertilizer rates are minimized.

Warm-season grasses

In addition to legumes, warm-season grasses can fill Missouri's summer forage gap. Missouri has an environment suitable for many native warm-season grasses, including sideoats grama, Indiangrass, little bluestem, big bluestem, switchgrass and eastern gamagrass. Three of these, big bluestem, switchgrass and eastern gamagrass, are perennials that can provide a reliable source of forage in summer.

In Missouri, switchgrass and eastern gamagrass produce high yields, but their production peaks overlap with those of the cool-season grasses mentioned earlier. They mature in late May and early June. However, with good grazing management, switchgrass and eastern gamagrass can be maintained in a leafy growth stage. Managed correctly, forage quality of both of these grasses can be very high. Research at the Southwest Research Center of the University of Missouri in Mt. Vernon, Missouri, has shown eastern gamagrass to be similar in quality to alfalfa. This has been confirmed in switchgrass as well (Reid et al., 1988).

But even with their potentially high forage quality, these grasses are often dismissed in a pasture-based dairy. One reason is that switchgrass quickly loses its quality with poor management (Reid et al., 1988). Another reason is that most both of these warm-season grasses are only productive during 3 hot summer months, which render the land unproductive through most of the season until a practical double-cropping is developed.

In contrast to switchgrass and eastern gamagrass, big bluestem matures about 3 weeks later than switchgrass and eastern gamagrass and produces less dry matter. Studies in Missouri have shown that under proper management, both big bluestem and eastern gamagrass can provide 3 to 5 tons forage/acre from June through August.

There are two major warm-season grasses that are not native to Missouri. Bermudagrass and caucasian bluestem are perennials that grow well through August and, with good management, can support animal gains of 1.5 lb per day. Although these are data from beef steers, steer gains such as these reflect energy values that correlate with milk production. Bermudagrass rarely survives in pastures except in the southern Missouri counties, but small pockets of bermdagrass may survive throughout mid-Missouri, especially in clipped research plots or after mild winters.

Caucasian bluestem has several advantages over bermudagrass. It can grow farther north and provide pasture over a longer period of time. In addition, caucasian bluestem is established by seed rather than sprigs like bermudagrass, and the seed is readily available. Because it is an aggressive crop, caucasian bluestem has the potential to invade native grass fields. However, it is this aggressive nature that allows it to persist under the harsh Ozark conditions.

Research at the Southwest Center shows that
often is difficult because many herbicides are no longer labeled for use on warm-season grasses. Because these grasses have poor seedling vigor, weeds must be clipped during the first year of establishment. Also due to their poor seedling vigor, it is best to allow warm-season grasses to become fully established before interseeding aggressive legumes.

Warm-season grasses are more difficult to establish than their cool-season counterparts. All are best seeded into a prepared seedbed. Of those mentioned above, switchgrass and caucasian bluestem are the easiest to establish while bermudagrass and eastern gamagrass are the hardest. Bermudagrass is difficult because most desired cultivars require sprigging. Eastern gamagrass is difficult because it requires cold storage to achieve acceptable germination rates. Stands will not be fully productive until the following year.

**Establishment of warm-season grasses**

Although it is possible to grow warm-season grasses with cool-season grasses in the same paddock, most research showing the benefit of warm-season grasses has been conducted with the cool-season and warm-season grass in separate paddocks. The addition of the extra paddocks gives rise to “complementary grazing,” where separate paddocks of bermudagrass, caucasian bluestem or eastern gamagrass are established and managed for the express purpose of providing summer pasture in June, July and August.

Native warm-season grasses normally are established in late May. The major challenges to successful establishment are weed pressure and dry periods common to early summer. Weed control

caucasian bluestem supported steer gains of 1.3 lb per day through the hottest part of the summer. When grown with birdsfoot trefoil, the stand produced steer gains of 1.8 lb per day. Again, these high gains experienced in the middle of summer reflect energy values that correlate with milk production. These high steer gains depend on grazing management that favors vegetative growth. Caucasian bluestem must be grazed between 3 and 6 inches or it will become stemmy and rank and have poor quality.

**Step 3: Extend the grazing season beyond the growing season**

The first two steps required choosing a forage base then filling in the seasonal production gap. In the example given earlier in this chapter, the forage base was a cool-season grass, so the filler forages were summer legumes and grasses. Remember that these first two steps could be accomplished with other species. As an alternate example, if the base forage is a warm-season perennial grass, such as caucasian bluestem, the filler forages would need to supply pasture during the spring and late fall.

It is possible to extend the grazing season well beyond the normal growing season (Figure 6.3). In Missouri, the normal growing season begins in late March and ends in late October. The advantage of this extension is lower feeding costs; it is about 50 percent more cost effective to produce liveweight gain on pasture than on hay.

The most common way to extend the fall grazing period is by stockpiling (Figure 6.4). Stockpiling is a
November through May. In pasture-based dairies, winter annuals often are preferred over stockpiled perennials because energy values are higher. Species such as annual ryegrass and annual small grains provide the forage quality required for the milking herd.

Managing the year-round pasture

To manage all these species, the grazer needs to follow management-intensive grazing (MiG) practices. Figures 6.5, 6.6 and 6.7 illustrate the concept of management-intensive grazing. They show paddocks constructed with permanent, high-tensile wire. The same principles of MiG on pasture can be seen with temporary fences; for example, a single hot wire and step-in posts. In addition, the hot wire and step-in posts can provide a back fence to permit strip grazing in each paddock (Figure 6.7), thereby converting the fixed paddock system into one with an unlimited number of paddocks.

Why all the paddocks?

Management-intensive grazing requires a large number of paddocks and the relatively rapid movement of livestock around the paddocks (rotation). There are several advantages to this setup, and most of the advantages are agronomic in nature. Each paddock receives a heavy stocking rate, yet the grazing period is short and the recovery period is long (Figure 6.8). A heavy stocking rate for a short grazing period forces the animals to graze the paddocks more evenly and distribute manure more evenly over the paddock. The long rest period allows the desirable plants to persist and provides time for plants to complete their carbohydrate cycles. The rest period also allows plants such as annual lespedeza, birdsfoot trefoil and red clover time to reseed. Finally, the rest period allows plants to provide regrowth for the next cycle of grazing.

Another way to extend the grazing season is to grow winter annual grasses. Annuals such as small grains or annual ryegrass can be planted in early September and provide forage for grazing from mid-
Grazing height and plant canopy

Although there are several ways to manage grass/legume mixtures, the most practical method involves simply managing the height (Figure 6.9). In Missouri, a diverse pasture will include at least one cool-season perennial grass and several legumes. It is necessary to manage the pasture in such a way that properly and frequently removes the plant canopy. This will “level the playing field” several times throughout the season. If the canopy is not removed, plants such as white clover and annual lespedeza will not produce to their yield potential. If the canopy is removed often, yet in so doing the pasture is grazed too short, the plant will not “bounce back” quickly in its allotted rest period. In addition, grazing the grass too short will likely force animals to consume low-quality forage, which will result in low weight gain and low milk production.

In general, pastures with at least one cool-season perennial grass and several legumes are grazed quickly in the spring. It is impossible to graze them low enough. This is because the pastures are growing rapidly and the cattle must move through the entire paddock system quickly to control plant maturity. As the spring continues, however, it is possible to move onto a paddock when the grass height reaches 8 to 10 inches and move off when the stubble reaches 4 inches. For native warm-season grasses, a stubble height of 6 inches is better.

Putting it all together:
An example pasture

The first section of this chapter presents a 3-step process for developing a dairy pasture — begin with a base forage, fill in the production gaps and extend the grazing season. The second section discusses the rationale for managing such a pasture.
This third and final section offers an example grazing system for pasture-based dairies.

In the example illustrated by Figure 6.10, only those forage species capable of producing the high-quality forage required by lactating dairy cows have been used. Because forage quality has an immediate and direct impact on milk production, it often takes a higher priority than plant persistence.

Note the selection of plant species in the example. Although individual dairies may choose different species, it is wise to select plant species on the following basis:

- First, select plant species by quality.
- Next, select on the basis of growing season; the inclusion of several warm- and cool-season species will ensure that forage is provided during most of the growing season.
- Finally, in the case of mixed grass/legume pastures, select plant species for their ability to grow with each other.

Spring grazing

As a general rule, one acre of pasture will provide adequate forage for one lactating cow during the grazing season. Therefore, the pastures in the example should provide enough forage for up to 120 lactating cows assuming the pastures are well-managed. The annual ryegrass and wheat pastures would be grazed beginning in February. Though the entire field is sown in winter and summer annuals, late-winter and early-spring grazing would involve monocultures only. Cows would “strip graze” each 20-acre field because the allocation of pasture is controlled by temporary fences. During April and May, cows could graze additional fields, such as the perennial ryegrass/white clover mixture.

In normal years, April and May represent the period when pasture management is critical. All 120 acres in the example contain forages that are growing and maturing. If livestock cannot be rotated quickly enough, ungrazed plants will mature, thereby decreasing forage quality and milk production. To avoid a decrease in quality, plant maturity must be held in check by increasing grazing pressure with nonlactating livestock or by clipping fields.

While it is generally true that quality has a higher priority than persistence, it also is generally true that pasture management is more important than the forage species selected. It does no good to select a species reputed to have inherent high quality and then fail to keep it vegetative.

Summer grazing

In the example given, clipping pastures would control the quality in most of the forage. In certain pastures, it would serve another purpose — it would remove the winter canopy. More than half of the summer grazing depends on two annuals: sorghum-sudangrass and crabgrass. Because both of these forages occur in fields with winter annuals, they can only grow when annual ryegrass and wheat are kept short. These 20-acre fields should be managed as double-cropped fields, not as true mixed pastures.

Summer grazing also would be available with the 30 acres of alfalfa/orchardgrass. In drought years, these would likely be the most dependable pastures. Summer grazing of this field would need to be managed as a pure stand of alfalfa. Though it is a cool-season legume, alfalfa continues to grow through June, July and August while orchardgrass is semi-dormant.

Fall and winter grazing

Fall grazing could continue initially on the alfalfa/orchardgrass mixture. However, alfalfa pastures should be rested in October to allow carbohydrates to be replenished. Further fall grazing could resume on mixed pastures that contain perennial ryegrass and endophyte-free tall fescue. With the addition of 60 lb N/acre, endophyte-free tall fescue could be stockpiled and grazed through the remainder of the fall and into early winter.

Additional management information

While this chapter outlines a general management strategy for a diverse forage system, it does not present the detailed management recommendations found in technical bulletins and guides. Each of the forage species listed in this chapter, as well as those described in the previous chapter, has unique management requirements. Some of the species must be managed to prevent livestock disorders such as bloat, nitrate poisoning and prussic acid poisoning.

Management recommendations for specific species can be obtained from the appropriate MU publication, which is available from your local University Outreach and Extension center.
References

