

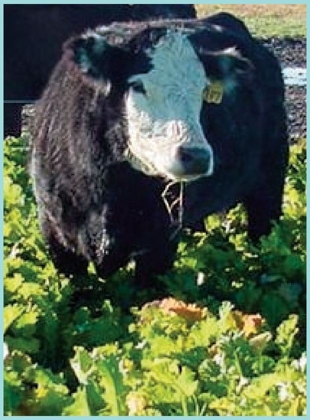

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Extending grazing and reducing stored feed needs

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Why extend the grazing season?

For most livestock producers, extending the grazing season for their animals, or otherwise filling gaps in pasture forage availability to reduce stored feed needs, should be a high priority objective. There are several reasons why this is beneficial:

- **Better for the environment.** Feeding hay or other stored materials in a barn or other enclosed area concentrates animals, and the manure that accumulates requires expense to remove. Feeding livestock in pastures often results in hoof damage to the land.
- **Weather is less of a concern.** Weather is a major concern with hay production, but animals can graze almost without regard to weather.
- **Higher-quality forage leads to better animal performance.** The forage quality of young, vegetative pasture growth and even leafy autumn residue is usually considerably higher than that of hay, which is produced by cutting older, more fibrous forage. Consequently, performance is typically better when animals graze properly managed pasture.
- **Requires less labor.** Less labor is required to have animals graze rather than to provide them with stored feed. In particular, in contrast to feeding stored feed in an enclosed facility, the labor associated with manure removal is avoided.
- **Lowers expenses.** Stored feed is almost always two to three times more expensive per animal or per day than pasture. In livestock budgets, stored feed typically accounts for 25% or more of the cost of production, and producer records often reveal it to be higher. The quantity of stored feed required is one of the best indicators of profitability for a livestock operation. In general, the less hay needed, the more cost-efficient the operation.

Clearly, extending the grazing season and reducing the need for stored feed is highly desirable. Though the best techniques to accomplish this vary with geographic region, type of farming operation, and other factors, this publication outlines strategies that can be used in some or many areas to extend grazing and reduce stored feed needs, thus increasing profit.

Exploit forage growth distribution differences

Grow warm-season and cool-season perennial grasses

Most grazing programs are based around perennial forage species, mainly grasses. In the northern United States, most perennial forages are cool-season species that make most of their growth in spring and autumn. In the South, warm-season perennials that make most of their growth during warm weather are most common. Even among species within these categories, the specific dates during which pasture forage will be available for grazing, as well as the total grazing days per year, can vary considerably.

When making planting decisions regarding forage crops, it is always important to take soils, sites, and climatic conditions into consideration and to only plant species that are known to be adapted. For example, warm-season perennial options are limited in the most northerly states, and cool-season perennial

options are limited in the Deep South. However, in many areas of the nation there is an opportunity to have at least some pasture acreage of warm-season perennials and cool-season perennials.

For example, in the area between the upper Midwest/Northeast and the Deep South, tall fescue, orchardgrass, and white clover are some of the more widely grown cool-season perennial forages. However, several warm-season perennials can be grown as well, including some varieties of bermudagrass, various native grasses, and (especially in the western portion of this area) weeping lovegrass.

Usually it is best to plant warm-season and cool-season perennials in different fields, but in some areas they may volunteer as mixed stands, or can sometimes be successfully planted and maintained together. However, mixed stands of cool-season and warm-season species require more careful management; otherwise, the stand of the less-favored species may decline over time. Where mixtures can be grown, the result is a longer grazing season, a more constant supply of forage through the season, and usually greater total dry matter production than either would produce alone.

In some instances or locations, growth distribution can differ significantly between species within the warm-season and cool-season perennial categories. For example, within warm-season perennial grasses, switchgrass, dallisgrass, and bahiagrass begin growth earlier in spring than bermudagrass. Within cool-season perennial grasses, tall fescue makes more autumn growth than orchardgrass in the southern portion of its area of adaptation within the USA, though not in the Upper Midwest. Therefore, as the number of different forage grasses grown on a farm increases, the length of the grazing season also often increases.

Use legume companion species

Some producers regularly face a forage deficit in summer, most commonly because they live in areas in which cool-season perennial grasses dominate pastures. Growing a cool-season perennial legume as a companion species to these grasses can help even out forage production. Red clover is a good example, as it often makes an impressive amount of growth during warm weather. Alfalfa, with its deep taproot, has an even longer growing season, and in many areas is a dependable producer of high-quality forage even during dry weather. Before seeding legumes, the pasture needs to be fertilized and limed according to soil test recommendations, and grasses must be grazed closely or otherwise suppressed just before planting.

Growing perennial legumes with perennial grasses offers numerous benefits including often extending the grazing period.

Plant annuals to complement perennials

The cost per unit of dry matter produced is usually higher with annual forages than with perennial forages. However, annuals may produce higher quality forage and often complement perennials by producing forage when the perennials are dormant or growing slowly.

Warm-season annual grasses such as sudangrass, sorghum-sudangrass hybrids, and pearl millet can complement cool-season perennial forages and offer the advantage of producing a lot of forage quickly, but grazing management of these species can be challenging. These upright-growing forages should be planted separate from cool-season perennials to prevent excessive shading. They perform best when planted on a prepared seedbed, although establishment costs are higher and the potential for soil erosion is also greater when using this approach.

Crabgrass is another warm-season annual that is vigorous and widely adapted, but it is sometimes overlooked as a forage crop. Yield of crabgrass is usually less than that of the summer annual grasses mentioned in the previous paragraph, but forage quality (and therefore animal performance) is quite good by comparison. Where some tillage can be provided sometime between autumn and spring, it is usually not difficult to get crabgrass to reseed and to provide relatively inexpensive volunteer stands year after year.

Striate lespedeza and Korean lespedeza are warm-season annual legumes that work well in some situations in the Upper South. Both species typically produce relatively low yields, but are adapted on dry, acid, upland sites where clovers do not persist well. Furthermore, they produce good-quality forage during summer when the quality and quantity of forage provided by cool-season perennials such as tall fescue is low. Thus, annual lespedeza can greatly enhance a tall fescue pasture, especially if the fescue is highly infected with toxic endophyte.

Numerous winter annual forage crops can be used to complement the grazing seasons of warm-season perennial forages and, depending on which one (or what mixture) is planted, the period during which they make forage growth may be quite different. Annual ryegrass, which makes most of its growth in early- to mid-spring, is a particularly productive winter annual in areas where it is adapted. By contrast, small grains such as rye, wheat, and oats are more productive in autumn. In the extreme northern areas of the country, spring-planted winter cereals such as spring barley, oats, or triticale may be used to provide forage growth in late spring, summer, and into the autumn.

Annual legumes, which are widely used in the Deep South, vary from making most of their growth in early spring (e.g., crimson clover) to being most productive in late spring and even early summer (e.g., arrowleaf clover and hairy vetch).

Winter annuals can be grown on a prepared seedbed, seeded into a warm-season perennial pasture, or into crabgrass stubble. In any of these situations, total yield and calendar days of grazing will be increased as compared to having only warm-season pasture. Planting winter annuals on a prepared seedbed, or no-till planting them into crabgrass stubble can usually be accomplished earlier than overseeding them on bermudagrass or bahiagrass, allowing earlier grazing.

Timely planting

Weather often dictates planting dates, but it pays to be ready to plant as early as possible within the recommended planting period for a particular crop. This applies more to annuals than to perennials, but the earlier you can safely plant, the earlier you can begin grazing. It is important to avoid grazing too early, however, or stand damage may occur.

Variety selection

Growth distribution differences exist among many varieties within species. For example, some varieties of annual ryegrass complete growth in mid-spring, while others can make a substantial amount of growth in late spring. Some tall fescue varieties (summer dormant types) produce more winter growth than others. Some alfalfa varieties are highly winter dormant and quickly cease growth under cool temperatures, while less-dormant varieties may make a considerable amount of growth under identical conditions.

A review of variety test data, especially if multiple years of testing have been summarized, allows identification of such growth differences. Forage distribution should not be the only variety selection criterion, but it deserves consideration, especially if one is deciding between two or more varieties that are similar with regard to other characteristics such as dry matter yield, forage quality, and disease resistance.

Stockpile forage

Stockpiling (also referred to as deferred grazing) can be defined as the managed accumulation of vegetative growth to be used at a later time. In the context of this publication, stockpiling refers to accumulating standing forage for grazing by livestock. Most stockpiling is done to extend grazing into autumn and winter, but in some situations it can also be useful in keeping animals grazing when dry periods during the growing season slow forage growth.

The growing seasons of various annual legumes vary, even for varieties within species.

Stockpiling tall fescue

Nearly any type of forage can be stockpiled, but tall fescue is the species most widely used for this purpose. Tall fescue typically makes a good amount of growth in autumn, it has a waxy layer on its leaves that makes them resistant to frost damage and weathering, and grazing to a low winter residual height has little effect on its spring regrowth or stand density. In addition, tall fescue forage accumulates a high concentration of soluble carbohydrates in the fall. The result is that stockpiled tall fescue not only has good forage quality, it maintains this quality extremely well through the winter. In fact, the total digestible nutrient (TDN) and crude protein (CP) content of stockpiled tall fescue is typically significantly higher than the average hay fed to beef cattle (figure 1).

Stockpiling may also help reduce the toxicity of endophyte-infected tall fescue. A 2001 study showed that levels of the toxin ergovaline found in endophyte-infected fescue dropped during the winter grazing period (figure 2). In light of the slow decline in protein content and digestibility of stockpiled fescue forage, this makes a strong case for delaying the use of stockpiled toxic endophyte fescue as long as possible into the winter months. This can be done by grazing winter annuals or stockpiled summer forage first.

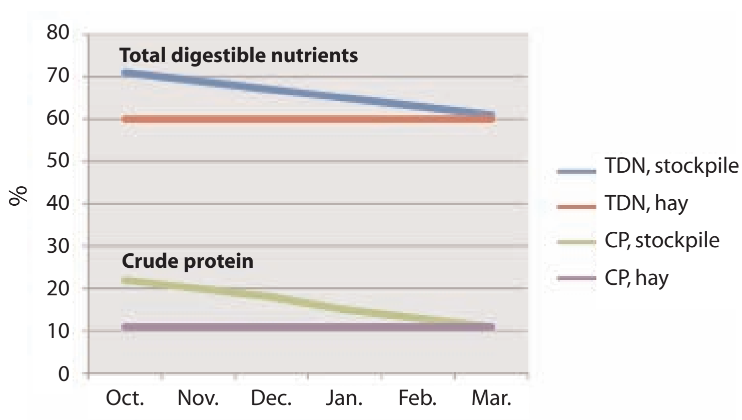
Stockpiling other forage crops

Other cool-season perennial grasses such as orchardgrass and smooth bromegrass can be stockpiled for late fall grazing, but are less desirable than fescue. The quality of stockpiled forage of these grasses declines more rapidly, plus these species have less persistence under heavy grazing during the winter, and stands may thin in subsequent growing seasons. Stockpiled forage of these species should be grazed within a few weeks after a hard freeze.

Legumes, such as red clover, and cool-season annual grasses, such as annual ryegrass and small grains (including wheat, rye, and triticale), may also be stockpiled, but the stockpiled forage deteriorates rather quickly. These forages usually work best when used for autumn and late winter/spring grazing. When used in this manner, they provide high-quality grazing before and after the use of stockpiled fescue, and bridge the gap between stockpiled fescue and spring growth of cool-season perennials. Near the Gulf Coast, cool-season annuals may provide at least some forage growth for grazing essentially throughout the winter.

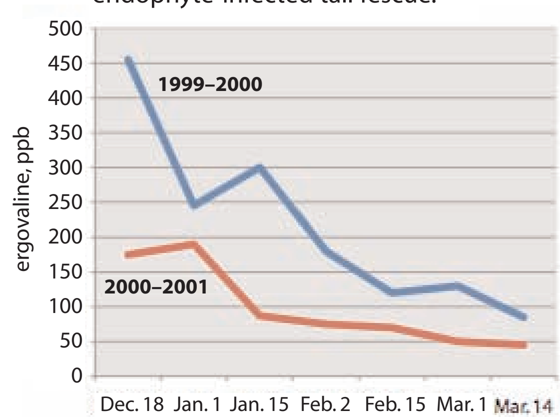
Warm-season perennial grasses such as bermudagrass, bahiagrass, old world bluestems, big bluestem, indiangrass, and eastern gamagrass, as well as warm-season annual grasses such as crabgrass and sweet sorghum have

Figure 1. Comparison of stockpiled tall fescue quality to average hay quality.



Source: *Mark Kennedy, Missouri, 1997–2003, and John Jennings, Arkansas, 1998–2002.*

Figure 2. Concentration levels of the toxin ergovaline in stockpiled, endophyte-infected tall fescue.



Source: *Rob Kallenbach, University of Missouri, 1999–2001.*

also been successfully used for stockpiling forage. It was once thought that protein and energy levels of stockpiled warm-season perennial grasses drop too low to be of much value as livestock feed, but in studies in Oklahoma with bermudagrass, protein levels stayed above 10% and energy did not drop significantly, especially if harvested by the end of December.

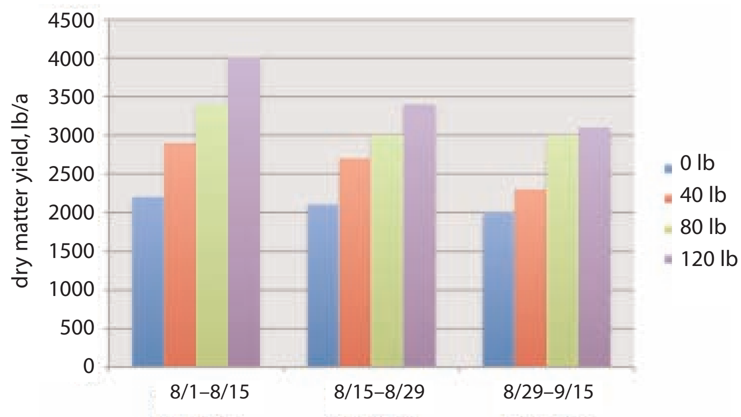
On-farm data collected in Missouri has shown that crude protein levels of stockpiled old world bluestems and native warm-season grasses dropped to 7 to 9%, but TDN (total digestible nutrient) levels generally stayed between 58 and 60%. Livestock acceptance of stockpiled switchgrass has been poor in some climates, so stockpiling monoculture stands of switchgrass should generally be avoided. Grazing eastern gamagrass during winter has resulted in some crown damage and subsequent stand thinning.

With these types of grasses, a protein supplement would be needed for most classes of livestock. However, an approach that has worked successfully in Oklahoma and Missouri is to limit graze cool-season annuals or stockpiled tall fescue for the purpose of using the grass as a protein supplement on dormant warm-season grasses. Work at the Noble Foundation in Ardmore, Oklahoma has shown that as little as 30 minutes of grazing of a cool-season annual pasture per day can meet livestock protein needs.

Corn is generally considered a summer row crop or silage crop, but it can also be grazed during late summer or autumn or be allowed to mature and then be grazed as standing corn. Corn seems to have much potential for stockpiling in view of its high energy value and its high yield potential. However, to prevent excessive waste, daily strip grazing is advisable.

Accumulation of high-quality forage should begin about 60 to 90 days before the end of the growing season.

Figure 3. Tall fescue stockpile yields at various nitrogen rates and application dates.[a]



[a]*Geographical location will affect the suitability of various dates of application.*

Source: *Jim Gerrish, University of Missouri, 1997.*

TECHNIQUE FOR STOCKPILING TALL FESCUE

The following steps have proven successful for stockpiling tall fescue forage:

1. At 60 to 90 days before the end of the fall growing season, graze or clip pastures leaving 3 to 5 inches of forage growth.

2. Immediately after grazing or clipping, apply 40 to 80 pounds of nitrogen per acre. Both the rate and timing of nitrogen fertilizer have an important impact on yield (see figure 3). Applying fertilizer earlier than 90 days before the end of the growing season will not significantly increase the yield, but quality will be significantly lower. Delaying initiation of stockpiling will result in higher quality forage, but lower yields.

3. Defer grazing stockpiled tall fescue forage until late fall or winter. Be sure to properly use forage growth in other pastures before beginning to use stockpiled forage. However, late-season growth of warm-season species may be of low quality and thus may require supplementation.

4. If possible, stockpile 1 acre per cow. Under normal conditions this will give a 75- to 90-day feed supply if grazed properly. (A 1,000-pound cow eating 2.6% of her body weight per day in dry matter consumes 26 pounds of forage per day. An acre of fescue stockpiled for 90 days typically produces 3,000 pounds of forage. Assuming 70% efficiency during strip grazing, this translates to 2,100 pounds of usable forage, or about 80 days worth of food.)

5. Although low quality, highly perishable material such as crop residues or stockpiled warm-season forage should be used first, once the use of stockpiled fescue has begun, start with the highest quality stockpiled fescue forage, because weathering causes more value loss in high-quality material than in low-quality material.

Regardless of the species stockpiled, accumulation of high-quality forage should begin about 60 to 90 days before the end of the growing season. Allowing pasture to grow for longer periods will result in low-quality forage (due to excess dead residue), which in turn will translate to poor animal performance. The same holds true for forage that has been allowed to accumulate in waterways or along field borders. Unreasonable expectations regarding the forage quality of such material is a common reason for producer disappointment with stockpiling.

Use stockpiled forage efficiently

Once forage has been stockpiled, using it efficiently is important in developing a low-cost winter feeding system. The most economical way is to strip graze the pastures. By allocating forage in strips calculated to be used within 3 days, animals consume 70% or more of the forage; by comparison, when given access to a 2-week feed supply, animals will consume 40% or less of the forage. That difference allows a significantly longer grazing period of quality forage for livestock. Many producers like to allocate a new strip every other day, which works well. If stockpiled grass is available, hay will only need to be fed if there is a deep cover of snow (6 inches or more). However, as little as 1/4-inch of ice alone or as a crust on snow may prevent grazing of stockpiled forage.

Take advantage of unique grazing opportunities

Graze crop residues

In mixed crop and livestock operations, residue in corn and grain sorghum fields can be used to provide a substantial number of days of grazing. When grassed waterways, terraces, and field borders are present and are properly managed and used, this option becomes even more attractive. Iowa State University Beef Cattle Center data indicates that for each acre of corn stalks grazed, approximately 1/2 ton of hay will be saved.

Crop residues are normally the least expensive feed source, because most expenses are charged against the row crop enterprise. The cost of grazing corn crop residue is about 5 cents per day according to Iowa State University beef cow business records. In a 4-year summary of experiments, cows grazing corn crop residue at 2.5 acres/cow per season for 112 to 174 days required about 1 ton less hay per cow to maintain adequate body condition than cows maintained in a dry lot. In a 5-year study conducted by Dr. Jim Russell at Iowa State University, 113 grazing days were obtained when cornfields were grazed after corn harvest with a stocking rate of 1.9 acres per cow.

An entirely different situation may exist in some areas where wheat or other cool-season annual crops are grown in autumn and/or spring and harvested in late spring or early summer. In such cases, after harvest there may be a combination of straw or other plant material as well as volunteer weeds and grasses that can provide summer grazing.

Crop residues usually represent about half of the pre-harvest plant dry matter. For example, a field producing 120 bushels of corn grain (about 7,200 pounds) will contain 3 to 4 tons of roughage dry matter per acre. Depending on stocking rate and grazing method, cows grazing cornstalks or grain sorghum stubble will consume 25 to 30% of the available residue in 30 to 100 days, still leaving enough material to prevent soil erosion.

In the Midwest, corn crop residue will feed animals for an average of 65 to 111 days. The optimal grazing allowance on corn crop residue fields will depend on the weight gains necessary to obtain a desired body condition. With low supplementation, cows can maintain body weight with as little as 1/2 acre of corn crop residues per cow per month, but may need as much as 2 acres per cow per month if weight gain is desired.

Table 1. Relative amounts and values of corn residue plant parts.

Item	Plant parts: Husk	Leaf	Stem[a]	Cob
Residue (% of total dry matter)	12	27	49	12
Crude protein (% by plant part)	3.6	7.8	4.5	2.2
In vitro dry matter disappearance (%)[b]	67	47	45	35
Palatability	high	high	low	low

[a] *Includes leaf sheath.*

[b] *A measure of dry matter digestibility determined by a laboratory analysis.*

Source: *Wilson, C.B., G.E. Erickson, T.J. Klopfenstein, R..J. Rasby, D.C. Adams, and I.G. Rush. 2004.* A Review of Corn Stalks Grazing on Animal Performance and Crop Yield. *University of Nebraska 2004 Beef Research Report.*

Livestock select the portions of crop residues with the highest digestibility and protein concentration first (table 1), so supplement needs beyond trace mineral salt and vitamin A are likely to be minimal for the first month of grazing. Providing simultaneous access to stockpiled grass or late summer growth of legume forages may supply protein and energy, and thereby reduce needs for supplementation. As winter progresses and crop residue quality decreases because of grazing selection and weathering, supplementation of protein and phosphorus may become necessary.

As with stockpiled forage, strip grazing crop residues allows more efficient use, resulting in more grazing days, and helps ensure a high-quality diet over a longer period of time by reducing selective grazing. A caution associated with grazing corn crop residue: Livestock may overload on excessive amounts of grain left in the field, putting them at risk of founder (or acidosis), a serious digestive problem. Strip grazing reduces the likelihood of this disorder.

Graze dormant alfalfa

In the northern portion of the United States it is recommended to allow alfalfa growth to accumulate for about 6 weeks before the first killing frost is anticipated. This allows alfalfa plants to replenish root carbohydrate reserves before winter. However, once plants are dormant, the accumulated growth can be grazed by livestock. This should be done promptly, before the frozen leaves drop off. An added benefit of grazing the frosted forage is that it tends to reduce alfalfa weevil populations the following spring in southern areas. In northern areas, leave roughly 3 to 4 inches of stubble to catch and hold snow to reduce winter damage and minimize temperature fluctuations that may result in plant heaving.

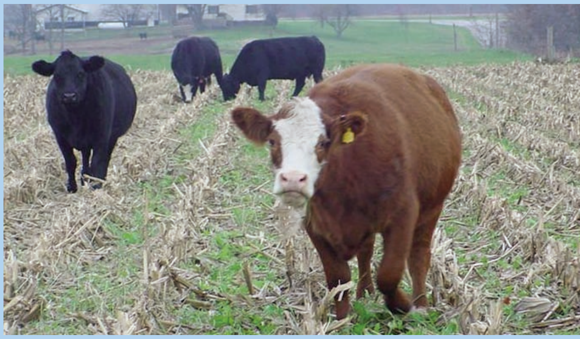
Graze hayfields

The need for stored feed is most commonly associated with cold temperatures that limit forage growth during winter, but other climatic conditions such as drought or an unexpected need to pasture more animals than planned may also make supplemental feeding necessary. In such a situation, it can be advantageous to graze a hayfield provided species-appropriate residual stubble heights and a suitable rest period are provided. (although for a few forage species late summer grazing or grazing closer than a certain minimum stubble height may hurt winter survival and/or spring growth).

It usually isn't possible to accurately predict how much hay will be needed. Thus, it may turn out that a producer will have enough hay whether or not a hayfield is grazed. Regardless, grazing a hayfield may "buy time" that makes it possible to carefully evaluate the situation and implement other strategies to reduce stored feed needs such as culling of animals, planting of winter annuals, or locating a relatively inexpensive source of hay or an alternate supplemental feed (grain or a by-product of crop processing, for example). Meanwhile, the expense of harvesting the forage as hay has been avoided, and the cost of purchasing hay or other stored feed at a later time may be little more (or even less) than making hay from the forage growth that would otherwise have accumulated.

GRAZING CROP RESIDUES: ADDITIONAL POINTS

- Before grazing crop residue fields it is important to check the labels of any pesticides used on the crop to see if they are cleared for grazing crop residues. Label restrictions should be strictly observed.
- It is advisable to make certain no poisonous plants are present in fencerows or other areas adjacent to fields in which crop residues are to be grazed. Forage produced in fencerows and waterways within row crop fields is of most value if mowed, fertilized, and managed as stockpiled forage, as discussed earlier.
- Research conducted at several Midwestern universities shows no difference in the performance of cattle that grazed Bt corn crop residue and those that grazed non-Bt corn crop residues.
- Research has been conducted in several Midwestern states to determine if winter grazing of row crops had any impact on crop yields the following year. Corn and soybean have shown similar yields for grazed and ungrazed fields, particularly if grazed when soils are frozen.



Crop residues can be an inexpensive source of nutrition.

- Soybean stubble is low in quality and cannot provide adequate nutrition for beef cows or stockers. It should not be used as a feed source unless supplemented substantially.

Use other plant growth

Grazing animals, especially ruminants, have the unique ability to digest plant material and convert it into meat, milk, and fiber. Innovative livestock producers around the world who see forage as a resource are always on the lookout for low-cost or free sources of nutrition for their animals. In some nations it is common practice to graze animals in public areas such as road rights-of-way. In addition, in some countries shrubs, in addition to grasses and forbs, are cultivated specifically for the purpose of providing nutrition for cattle, sheep, and especially goats. Here in the United States it is not unusual for producers in some areas to graze volunteer growth in old crop fields, swampy areas, or woodlots. It is important to meet animal nutritional needs, and to avoid exposing grazing animals to poisonous plants or other dangerous situations, but staying alert to unique grazing opportunities makes sense and can help reduce costs.

Forage or livestock management approaches

Grazing management

Good grazing management yields numerous benefits, including several that deserve mention here. First, when pastures are grazed appropriately for the forage species they contain, the plants will be healthier and more productive over a longer period of time, thus reducing the need for other strategies. Grazing plants too closely will slow regrowth, resulting in lower yields, and will also weaken plants due to depletion of food reserves. Forage crops such as upright-growing bunchgrasses that store much of their food reserves in stem bases are particularly sensitive to this type of damage. Healthy plants with good root systems are impacted less by drought and other stresses than are plants that have been weakened by overgrazing.

Good grazing management also reduces forage waste. If pastures are undergrazed at certain times (which often occurs with poorly managed continuously stocked areas), losses due to trampling and fouling of forage can be substantial. A number of grazing practices can reduce forage losses by 20 to 30%, which can in turn lengthen the grazing period. These techniques include limit grazing (giving animals access to a pasture for only a few hours at a time), strip grazing (allocating only a strip of pasture forage to animals at any given time), forward grazing (giving animals having higher nutritional requirements first access to a pasture), and rotational stocking (rotating animals among pastures or paddocks).

With rotational stocking, it may be possible to begin grazing earlier in the growing season while staying within the realm of good grazing management. This is because removing animals from an early-grazed pasture allows the grass to rest before being grazed again. Since the first pastures grazed are likely to be slower to recover, this approach may also help avoid some of the excess growth problems that often occur during the spring flush. Shortening rotation intervals tends to result in forage growth being better distributed over the growing season as long as pastures are not grazed more closely than recommended for the species they contain.

Grazing management can also help ensure animal nutritional needs are met. For example, creep grazing allows young animals to obtain a more nutritious diet than their mothers; forward grazing allows groups of animals grazed in sequence to consume forage of differing quality levels; and limit grazing a high-quality pasture (perhaps 2 or 3 hours every other day) can provide excellent dietary supplementation.

Finally, as grazing management is intensified, there is usually more even distribution of dung, urine, and therefore of recycled nutrients. This tends to ultimately reduce fertilizer needs, increase the efficiency of fertilizer applications, and keep pastures growing for longer periods of time. However, under wet soil conditions a concentration of animals may create extremely muddy conditions and result in much pasture stand damage. A "sacrifice" paddock that can be reseeded later may therefore be justifiable.

Workers in Georgia compared continuous and rotational stocking. Rotational stocking resulted in dramatic increases in stocking rate and calf gain per acre (table 2). It also resulted in a 32% reduction in amount of hay required per cow by extending the grazing season.

In Missouri, researchers compared strip-grazing intervals of cattle grazing stockpiled tall fescue. When forage was allocated in a 3-day supply compared to a 14-day supply, cow-days per acre were increased by 32 days, with a 56% increase in carrying capacity. The extra days on pasture translates to a corresponding reduction in the amount of hay required, reducing the cost of wintering animals (table 3).

Irrigation

Pastures often become unproductive or go dormant in mid- to late summer due to lack of water. Irrigation may relieve the situation, but before proceeding with this alternative, landowners should thoroughly consider all the issues that contribute to irrigation system cost:

- Is there an inexpensive source of water available? Water sources vary greatly in cost, so this should be carefully checked. During hot weather, some plants require approximately 0.25 to 0.30 inches per day. Check with a knowledgeable irrigation specialist for water requirements in your area. One inch on one acre is 27,158 gallons, so the water supply must be able to supply a minimum of 7,000 to 8,000 gallons per acre per day(after evaporation and other losses) to be effective for irrigating any field or pasture.
- Pumping from streams frequently requires a permit from the U.S. Army Corps of Engineers and/or the state agency or regional water district responsible for natural resources. If irrigation is desired by a certain time, there should be an assessment as to how long it will likely take to acquire permits and install equipment. Permit time can be up to 12 months, depending on the on-site physical situation.

Table 2. Comparison of animal gain and winter hay requirements using continuous and rotational grazing systems.

	Grazing systems[a]		
	Continuous	Rotational	Change, %
Stocking rate, cow-calf units/acre	0.50	0.69	+38
Calf weaning weight, lb	500	496	0
Total calf gain/acre, lb	248	340	+37
Cow pregnancy rate, %	96	95	0
Hay fed/cow, lb	2,570	1,750	–32

[a]*Beef cattle grazed stockpiled tall fescue ('AU Triumph').*

Source: *Dr. Carl Hoveland, University of Georgia.*

Table 3. Daily and seasonal forage costs for alternative wintering strategies at typical yields, costs, and period of use based on a 100-cow autumn-calving herd. Winter feeding period from December 1 to April 10.

Item	Hay	Cornstalks	Stockpiled tall fescue	Ryegrass + cereal rye
$/cow/day[a]	100%	4%	23%	46%
Days of use	130 (hay)	60 (stalks) 70 (hay)	90 (graze) 40 (hay)	90 (graze) 40 (hay)
Wintering cost[a]	100%	71%	41%	63%

[a] *Expressed as a percentage of hay.*

Source: *Jim Gerrish, University of Missouri.*

- Will irrigation of pastures be cost effective? The quantity and value of forage produced on average must be enough to justify installing the system plus the expense of operating it. Typically, irrigation must be used hundreds of hours each year for many years to be economical.
- Irrigation equipment application efficiency should be considered. Newer pivot irrigation equipment may have 85% or higher efficiency (% of water pumped that is made available to plant), but older systems, particularly traveling guns, may only be 60% efficient. Lower efficiency means more water and more pumping energy is needed to get water application rates and yield responses comparable to higher efficiency systems.
- Labor to operate irrigation equipment should be considered. Pivot irrigation systems are the least labor intensive at about 0.0125 hour per acre. Traveling gun or tow irrigation systems may need ten times that (about 0.15 hour per acre).
- With irrigation automatically comes the need for balanced and often increased fertilization. Irrigating malnourished pastures is a waste.
- In some areas, soil types, or situations, soil compaction caused by the hooves of grazing animals (which is greatly intensified when soil is wet) or eventual soil salinization may be a concern.

If these issues can be resolved, pasture irrigation may be a consideration, but it should be a long-term commitment, not a "knee-jerk" reaction to one or two years of drought.

Forages respond to irrigation at any vegetative stage. The yield increase is linear to the total water applied up to the amount needed by the plant for daily growth. The critical question is whether the extra pasture forage that may be produced on average will be worth the cost. An effective pasture irrigation system is generally not much less expensive per acre than an effective row crop irrigation system.

Fertilization and liming

A simple and cost-effective strategy for extending the grazing period is to maintain a proper fertilization program. Well-fertilized, vigorous plants begin growth earlier and resist stresses such as drought better than weaker, nutrient-deficient plants. Soil testing and applying lime and fertilizer to pastures according to recommendations is important.

Fertilizer can be used as a management tool to optimize production when good growing conditions exist, and to increase forage production just before times of slow plant growth. Thus, application of fertilizer can shift the timing of availability of pasture forage, although this is contingent upon adequate moisture being available for plant growth.

Nitrogen (N) is the most common limiting nutrient. Each growth cycle of a pasture generally takes up most of the soil N available, leaving little for the next growth cycle. This means that periodic applications must occur during the season. Typically, two or three applications of 40 to 60 pounds of N per acre are recommended during the growing season, with the first application being made at greenup of the species most desired in the pasture. By splitting applications, some of the high points in the growth curve are a bit flatter and forage quality during the growing season tends to be more uniform.

Failure to have adequate N available for plant growth in early spring at the beginning of the growing season of perennial grasses is a common reason for delayed spring forage growth. (Note: Application of N to a grass/legume mixture may shorten stand life of the legume.) In situations where volunteer species that may be considered desirable are present (for example, annual ryegrass and/or wild barley in a bermudagrass pasture in early spring), it may be justifiable to fertilize several weeks earlier than normal. Conversely, on farms where there is typically a huge excess of spring growth, it may make sense to postpone the first application until later in the season.

In drier areas, providing good fertilization in spring when rainfall is likely may provide stockpiled grass for use during low rainfall periods in summer. Rotational stocking of pastures results in more even distribution of recycled nutrients (in the form of manure) as well as a higher percent utilization of accumulated pasture forage. Manure, whether directly deposited by livestock or applied, represents a slow-release source of nutrients that favors pasture growth over time. However, excessive phosphorus, regardless of the source, is environmentally undesirable.

Missing later fertilizer applications may limit growth for late summer grazing or stockpiling. Initiating fertilizer applications at different times to different paddocks or pastures may result in forage production peaks at different times.

Keeping the soil pH at a level that is suitable for growth of the forages being grown (or to be grown) is also essential for good production and a long grazing season. The soil pH requirements for growing many legumes is higher than that of forage grasses, and thus it is especially important to lime the soil in accordance with soil test recommendations in order to obtain good legume establishment, production, and persistence.

Get the most benefit from your pastures by having animals with higher nutritive requirements graze the best-quality forage.

Other useful concepts

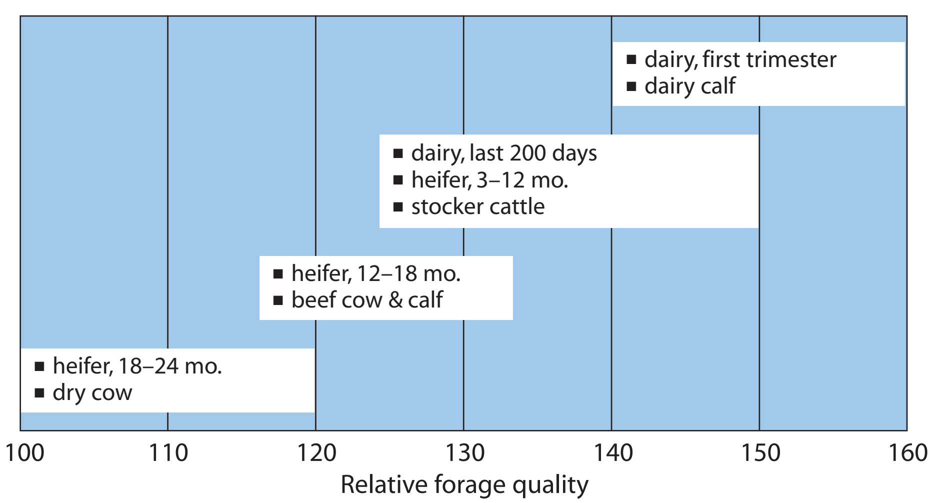
Match forage quality and nutrient intake to animal needs

Another strategy can be to carefully match animal needs to forage quality. Different animal types and classes have different forage quality needs (figure 4). You can get the most benefit from your pastures by having animals with higher nutritive requirements graze the best-quality forage and using lower-quality forage in the rations of animals with lower nutritive requirements.

The nutritional needs of breeding female livestock vary greatly during the year, with the greatest nutritional demand occurring during early lactation. This leads to varying requirements for forage quality and quantity at various times. For example, in a beef cow/calf operation using a late winter or spring calving schedule, calves have high needs for energy and protein to make good gain late in summer, while dry, pregnant cows can be on a maintenance diet. Thus, calves should receive good quality pasture while cows can be supplemented with lower quality hay or pasture.

Having a controlled breeding season and calving at a time that allows animal nutritional needs to match the quality and quantity of available pasture forage are keys to both good animal performance and reduced supplemental feeding. Depending on calving dates, the ease of providing appropriate quality pasture forage may vary greatly. In an area where winter annuals can be easily grown, autumn calving (which lowers cow nutrient requirements in early spring) may work well. Late winter or spring calving may be more suitable for producers who rely primarily on cool-season perennials. (Note: Rebreeding during warm weather, especially if animals are grazing toxic endophyte tall fescue, may not work well.)

Figure 4. Forage quality needs of cattle.



Forage testing—or, in a range or pasture, fecal analysis—is a tool livestock producers can use to make better use of their pasture, hay, and silage. Knowing the quality of the forage available and matching that to animal needs allows producers to ensure acceptable animal performance while minimizing supplements. When pasture is running short, grain (or grain processing by-products) rather than hay may be the most cost-effective supplement.

Beginning to provide supplementation as pasture growth slows will ensure high energy and good animal response while substituting for some forage. It may make it possible to stretch the pasture through the period of low production by lowering forage intake. This, in turn, may keep a pasture from being overgrazed and subsequently being slow to recover.

Change the stocking rate

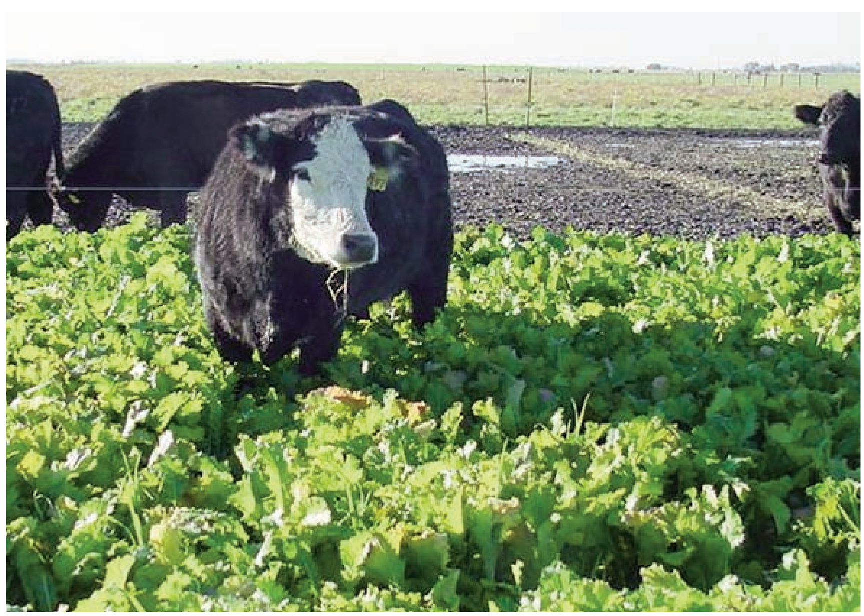
It may be beneficial to lower the stocking rate to match pasture growth and production. The major reason that most beef producers calve in late winter or spring is to have plentiful, high-quality pasture available for the growing calves and milking beef cows during April, May, and June. When forage production begins to decline, some method of reducing animal numbers will leave forage available for the remaining animals during the rest of the summer and fall. Options include:

- Move cows to an area that provides lower-quality forage. This effectively reduces the number of animals on a given pasture.
- Wean calves early and sell some in midsummer. As calves (or stocker cattle) grow, their forage requirement increases at a time when pasture production is typically declining. For a cow-calf producer with a late winter- or early spring-calving herd, selling the largest calves in early August could free up sufficient pasture to feed the remaining herd for the rest of the season. Lighter animals sold in early August usually sell for more per pound than heavier animals sold in September when a glut of animals reach the market.
- Retain ownership of calves, but move a portion to feedlots in early August. If managed properly, the remaining herd on pasture may be able to remain longer and be sold at higher prices later in the year.
- In a breeding herd, cull open mature animals before the winter feeding season. Reducing animal numbers in late summer and autumn may also allow stockpiling tall fescue or other forage species. Some producers might opt to keep a small enough number of breeding animals to allow getting through the winter without needing much stored feed, and then purchase calves or other livestock to graze during the spring flush.

Keep in mind that overstocking usually leads to overgrazing, lower forage yields, and reduced animal performance, as well as to higher amounts of stored feed needed. On farms where stored feed needs are consistently high, it may be that some reduction in overall stocking rates should be considered.

Use winter annuals in crop rotations or to supplement perennial forages

In much of the United States, winter annuals can be useful in helping provide an extended grazing season. On farms where row crops are grown, winter annuals can allow use of cropland all 12 months of the year while providing a cover for the soil during winter. In combination with crop residues and fall growth of annual crops, this can allow livestock grazing to be extended well into the winter months.



Winter annual crops can also be valuable when planted in areas where lower quality perennial forages dominate or to provide grazing at times when it would otherwise not be available. However, because winter annual forages are more costly to grow than most perennials, they may be most economical to use primarily for growing and saleable animals unless mature animals are to be second grazers.

Brassicas

Brassicas (including turnips, rape, kale, and swedes) are highly productive, digestible forbs that contain relatively high levels of crude protein. Animals will readily consume the tops and will also grub the root bulbs out of the ground. These crops are best suited for crop rotation pastures or for being no-tilled into light sod. Dry matter yield is variable and highly dependent upon soil type, fertility, time of seeding, and precipitation. However, continuously growing them on the same land may lead to a high incidence of crown or root rot within a few years.

- **Turnips** grow fast and can be grazed as early as 70 days after planting. They reach near-maximum production level in 80 to 90 days. The proportion of top growth to roots for turnips can vary from 90% tops and 10% roots to 15% tops and 85% roots. Turnips can be seeded any time from when soil temperature reaches 50°F until 70 days before a killing frost.

  Note: Sheep producers need to be aware that copper toxicity can be a problem with turnips.

- **Rape** is more easily managed for multiple (more than two) grazings than are the other brassica species. Rape can generally be grazed at 4-week intervals. Leave approximately 6 to 10 inches of stubble after the first grazing to promote rapid regrowth; on the final grazing, plants should be grazed close to ground level. Rape can cause sunburn (scald) on light-skinned animals, especially if it is grazed while the plants are immature.

- **Kale** has more variation among varieties than most other brassica species. Some varieties may provide grazing after about 90 days, followed by a regrowth opportunity; others may require as much as 180 days to mature. Dry matter yield of kale can be impressive.

- **Swedes** (also known as rutabagas), like turnips, produce large edible roots. Swedes yield more than turnips, but require 150 to 180 days to reach maximum production. Swedes is one of the best crops for fattening lambs and flushing ewes. Yield is maximized with a 180-day growth period for many varieties, but most hybrids produce the greatest yields when allowed to grow 60 days before first grazing and 30 days before the second grazing.

Brassicas should not comprise more than about two-thirds of cattle diets because of their low dry matter content. Therefore, it is important to provide adjacent pasture, corn stalks, or a palatable, dry hay fed free choice to cattle when grazing these crops. It is also desirable to introduce them to brassicas slowly by limit grazing for a couple of hours per day until their digestive systems are accustomed to them.

Brassicas require good soil drainage, and soil pH should be in the range of 5.5 to 6.8. Brassicas can be seeded into wheat stubble or no-tilled into a sod, provided it has been killed with glyphosate. Clean-till seeding works well, but may have increased insect pressure. If seeding after crop farming, herbicide carryover residues can be an enormous problem. As a rule, carryover label recommendations for sugar beets are usually applicable to most brassica species. Some producers in the Upper Midwest have had success in aerially seeding turnips into standing corn in mid-August. The corn must be physiologically mature for this to be successful.

Fertilizer should be applied at the time of seeding to give brassicas a competitive edge on weeds. Normally 75 to 80 pounds of nitrogen per acre and any phosphorus and potassium needed should be applied similar to what would be applied for a small grain. Good soil moisture following seeding is key to successful establishment.

As with stockpiled forage, brassicas should be strip grazed. If regrowth is desired, at least 2 inches of leaf should be left intact. Generally animals will consume the leafy portion of the plant before progressing to the root portion. To encourage consumption of roots, it may be necessary to disk after the tops have been grazed.

Small grains

Cereal crops such as wheat, rye, oats, barley, or triticale can provide autumn or early winter grazing opportunities. However, certain management practices need to be modified from what is normally done for grain production. When small grains are used for grazing, they should be planted 3 to 4 weeks earlier than for grain production. Also, between 60 and 100 pounds of nitrogen per acre is normally applied at planting time (check local recommendations).

Recommended seeding rates vary depending on establishment method and seeding combinations.

Rye is more productive than wheat or triticale for both fall and spring production. However, forage quality is better with triticale than with rye. Oats seeded in the fall can be excellent quality and very productive, but will be killed by cold weather during winter (except in the Deep South). Depending on geographical location, with adequate fall moisture, rye, triticale, and wheat should be available for grazing from October through much of December and then again in early spring.

The intended use of small grain determines what the stocking rate and grazing dates should be. If a silage or grain harvest is planned, grazing should only be moderate, as heavy grazing can reduce grain yields. Moderate grazing in the autumn will not result in significant silage or grain losses provided moisture and soil fertility are adequate. In fact, fall pasturing can be beneficial where the small grain was seeded early and has made excessive growth and soil conditions are dry. Spring grazing may be started when growth resumes. If a grain or silage crop is to be harvested, grazing should be discontinued when the plants start to grow erect, just before jointing (growth stage); otherwise grain yield will be reduced.

Seeding date has a major impact on how early small grains can be grazed. If the goal is to graze in late fall, seeding should be completed by late August in the Midwest and by late September in the Deep South. With adequate moisture, growth will continue until air temperatures drop to around 40°F. Remove livestock when 3 inches of growth remain to maintain sufficient leaf area for continued growth and recovery.

Annual ryegrass

Annual (or Italian) ryegrass can be used as a companion species with, or as an alternative to, the small grain cereal crops to provide grazing in late autumn, early winter, and spring. Compared to small grains, ryegrass is easier to manage, has a higher feed quality, and fewer management problems in spring, and can make rapid regrowth after initial grazing.

Annual ryegrass can be easily established into standing corn or soybeans or in these or other summer row crop fields after harvest. It can also be no-tilled into old alfalfa fields. There are differences in winterhardiness among annual ryegrass varieties, so if spring grazing is desired, it is important to plant varieties that are known to be adapted. Seeding rates vary according to planting method and combination of species. (Check local recommendations for specific seeding information.) Wait to graze winter annual grasses until at least 8 inches of growth have accumulated.

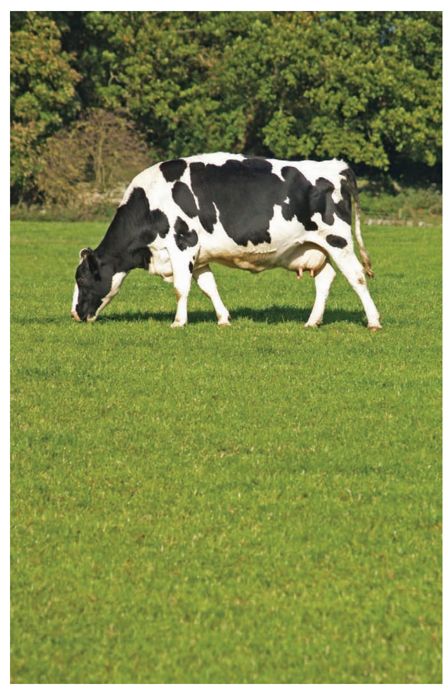
Winter annual legumes

In climates and management situations in which plants are likely to persist, it is generally advantageous to grow perennial rather than annual legumes. However, in the Deep South, where perennial legumes such as white clover usually act like annuals, any of several winter annual legumes are a usually a better choice, depending on soils, rainfall, and producer objectives. Various species may be grown alone, with another annual legume, or in combination with winter annual grasses.

Winter annual legumes make almost all of their growth in late winter and spring, but the distribution of growth of various species within this time period varies greatly. Some row crop producers plant winter annuals as cover crops to provide nitrogen for a summer row crop, improve soil tilth, and protect the soil during winter. Of course this forage can also be grazed in late winter or spring. Hairy vetch is hardy enough to be grown as far north as the Lower Midwest, but it produces most of its growth during a few weeks in mid-spring.

Overseed winter annuals on summer grass sods

Winter annuals, including annual ryegrass, small grains, and various annual legumes such as clovers and vetches can be seeded as a single species or in various mixtures into warm-season perennial grass sods such as bermudagrass, bahiagrass, or dallisgrass to extend the grazing season by 30 to 60 or more days. Winter annuals should normally be overseeded about 2 or 3 weeks before



Extend the grazing season by 30 to 60 days or more by overseeding winter annuals on summer grass sods.

the expected date of a killing frost. Unless some tillage is provided to ensure good seed-soil contact, the existing grass should be clipped or grazed to 1 to 2 inches tall. Producers who have pastures of both tall fescue and summer perennial grasses may be able to graze their summer grass closely to facilitate overseeding of winter annuals at the same time they are stockpiling tall fescue. Overseeded pastures should be kept grazed closely in spring to prevent shading of summer species.

Provide supplemental feed during warm weather

Despite the best management plans, shortages of forage commonly occur during July and August in the cool-season grass region due to drought or overstocking. When this happens, supplemental feeding of hay or grain by-products in July and August might be used to avoid overgrazing. Also, a pasture or paddock of summer annual grass might be planted in anticipation of reduced pasture availability.

In areas where cool-season perennial forages dominate pastures, if pastures are short or pasture forage is of poor quality in July and August, feeding animals in a dry lot might be an option. This may be more cost effective than overgrazing or trying to supplement animals on overgrazed pastures. There is less hay loss when feeding hay in summer months as compared to winter. Also, this approach allows pastures to begin recovering from overgrazing or drought and provides an opportunity to stockpile for late fall and winter grazing. Using the same logic, some producers might also consider feeding hay in late summer or autumn to allow stockpiling of tall fescue forage.

Once livestock are removed from pastures, it may be worthwhile to apply 30 to 60 pounds per acre of nitrogen to stimulate plant recovery. During hot weather, use of ammonium nitrate may be advisable as surface-applied urea can lose significant amounts of nitrogen through volatilization. If using urea, the application should be made just before a rain to minimize the exposure time of the fertilizer material on a dry soil surface.

Minimize hay losses

This publication emphasizes the value of grazing, but most livestock producers will need to provide hay or some other stored feed at certain times during the year. Losses during the harvesting, storing, and feeding of hay vary considerably. Ranges in losses are included in table 4. Given the worst-case scenario, animals may consume only about 29% of the forage present in a hay field at harvest. Further, the more hay wasted, the more that must be produced or purchased to feed animals at times when adequate pasture forage is not available.

The value of hay storage and feeding losses alone in the United States are estimated to exceed 3 billion dollars annually. On some farms, hay storage and feeding losses account for over 10% of the cost of livestock production. This is particularly objectionable because these losses occur after all the time, energy, and effort required to produce and harvest the hay have been incurred. Also, these losses can be greatly reduced or eliminated without a great deal of expense or effort.

Table 4. Percent loss of hay from curing through feeding.

	——Lax management——		—— Good management——	
	Incremental[a]	Additive[b]	Incremental[a]	Additive[b]
Field curing	25	25	12	12
Harvesting	15	36	8	19
Storage	35	58	5	23
Feeding	30	71	8	29
Total loss	—	**71**	—	**29**

[a] *Losses of dry matter present at the beginning of a step.*

[b] *Losses accumulate with each step.*

Source: *Dr. Mike Collins, University of Kentucky.*

Possible pasture combinations by region

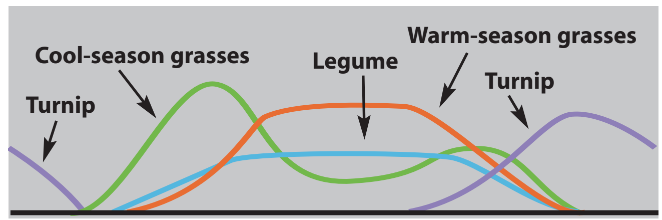
Numerous strategies discussed within this publication can be used to help extend grazing and reduce the number of days stored feed must be provided to livestock. Obviously, some are appropriate only in certain geographical areas or on certain farms within an area, and some are likely to be of much more value in a specific situation than others. No particular set of strategies is appropriate for every producer, even within a given geographical area.

In most areas, exploiting forage growth distribution differences offers much opportunity for extending grazing. Figure 5 illustrates some forage species or categories of species that often work well for producers in selected areas of the nation. The graphs show a few general combinations likely to be used in the Upper Midwest and Northeast, in the Tall Fescue Belt, in the Deep South, and in the Humid Southwest.

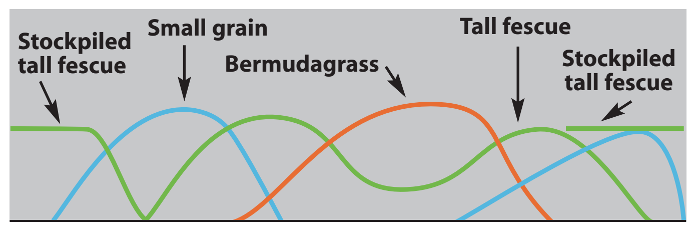
Once pasture forage growth distribution has been maximized, other strategies to lower stored feed requirements can be employed. These may include changing the breeding season, selling animals at certain times of the year, use of creative grazing management, or implementing practices to minimize hay waste. Almost anything a livestock producer can do to shave days off the length of time stored feed would otherwise need to be fed will favor increased profitability.

Figure 5. Growth patterns of forage species by region.

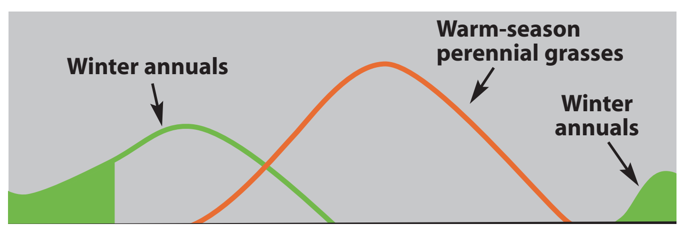
Corn Belt, Upper Midwest, and Northeast



Tall Fescue Belt

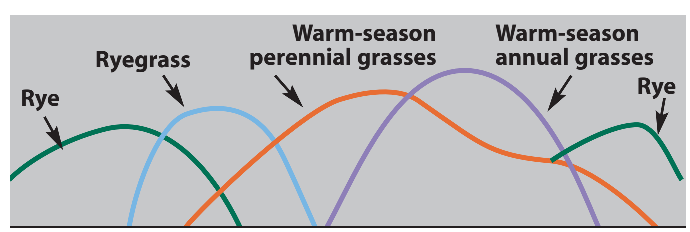


Deep South



Autumn and winter growth (shaded areas) varies due to several factors including date of planting, species planted, and geographical location.

Humid Southwest



Ten keys to a profitable forage program

1. **Remember that you are a forage farmer.** Forage typically accounts for over half the cost of production of forage-consuming animals and provides most of their nutrition. Thus, it has a major influence on both expenses and income. Efficient forage production and utilization are essential to a profitable operation.

2. **Know forage options, animal nutritional needs, and establishment requirements.** Forages vary as to adaptation, growth distribution, forage quality, yield, and potential uses. Various types and classes of animals have different nutritional needs. Good planting decisions depend on knowing forage options for your land resources and the nutritional needs of your animals.

3. **Soil test, then lime and fertilize as needed.** This practice, more than any other, affects the level and economic efficiency of forage production. Fertilizing and liming as needed help ensure good yields, improve forage quality, lengthen stand life, and reduce weed problems.

4. **Use legumes whenever feasible.** Legumes offer important advantages including improved forage quality and biological nitrogen fixation, whether grown alone or with grasses. Once legumes have been established, proper management optimizes benefits.

5. **Emphasize forage quality.** High animal gains, milk production, and reproductive efficiency require adequate nutrition. Producing high-quality forage necessitates knowing the factors that affect forage quality and using appropriate management. Matching forage quality to animal nutritional needs greatly increases efficiency.

6. **Prevent or minimize pests and plant-related disorders.** Variety selection, cultural practices, scouting, pesticides, and other management techniques can minimize pest problems. Knowledge of potential animal disorders caused by plants can help avoid them.

7. **Strive to improve pasture utilization.** The quantity and quality of pasture growth vary over time. Periodic adjustments in stocking rate or use of cross fencing to vary the type or amount of available forage can greatly affect animal performance and pasture species composition. Matching stocking rates with forage production is also extremely important.

8. **Minimize stored feed requirements.** Stored feed is one of the most expensive aspects of animal production, so lowering requirements reduces costs. Extending the grazing season with use of both cool-season and warm-season forages, stockpiling forage, and grazing crop residues are examples of ways stored feed needs can be reduced.

9. **Reduce storage and feeding losses.** Wasting hay, silage, or other stored feed is costly. Minimizing waste with good management, forage testing, and ration formulation enhances feeding efficiency, animal performance, and profits.

10. **It's up to you.** Rarely, if ever, do we get something for nothing. In human endeavors, results are usually highly correlated with investments in terms of thought, time, effort, and a certain amount of money. In particular, the best and most profitable forage programs have had the most thought put into them.

Source: Ball, D.M., C.S. Hoveland, and G.D. Lacefield, 1996. Adapted with permission from the International Plant Nutrition Institute, Norcross, GA.

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